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ELIMINATING LONG-DISTANCE CONSONANTAL SPREADING*

Past theoretical analyses have claimed that some languages employ a special type of phonological spreading of a consonant over a vowel, long-distance consonantal spreading. I argue that this type of spreading can and must be eliminated from the theory, by reducing it to segmental copying as in reduplication. This elimination is first motivated from a number of perspectives, including considerations of locality and theoretical redundancy. The reduction to reduplication is then developed in detail for Temiar, one of the main indigenous languages of Malaysia, notorious for the complexity of its copying patterns. Crucial to this reduction is the notion of gradient violation of constraints in Optimality Theory (Prince and Smolensky 1993), and the notion of correspondence, with its particular application to reduplication (McCarthy and Prince 1995a). The proposal extends to other languages (e.g., Arabic, Chaha, Modern Hebrew, and Yoruba), where the putative spreading had been thought necessary. The elimination of long-distance consonantal spreading is argued to further obviate two other special mechanisms, also thought to apply on a language-particular basis: (a) the representation that segregates vowels and consonants on different planes, known as V/C planar segregation, and (b) the distinct mode of word formation consisting of mapping segments to templates.

0. Introduction

Past theoretical analyses have claimed that in some languages a configuration such as C_1VC_1, 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 hypothetical type of spreading has been called '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.

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(1) V/C planar segregation

Consonant Plane	C-Root	
Skeleton	X X X	(output: $[C_1VC_1]$)
Vowel plane	V-Root	

(example: Arabic radadtu 'I returned')

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. My goal in this paper is to address this redundancy in a phonological theory which admits two distinct operations of segmental copying, and advocate its elimination by reducing LDC-spreading to the same formal mechanism which underlies reduplication. Crucial to this reduction will be the notion of gradient constraint violability in the Optimality Theory (OT) framework of Prince and Smolensky (1993).

The paper is organized as follows. Section 1 introduces the Optimality-Theoretic notion of correspondence, which has been successfully employed to characterize the cross-linguistic facts of reduplication, and which will play a central role in the analyses throughout this paper. Section 2 argues that the elimination of LDC-spreading is a necessity motivated on both empirical and conceptual grounds. The theory admitting LDC-spreading 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. This and other problems are resolved under the proposed unification since it is clear that segmental copying, as in reduplication, targets only whole segments, not individual features. Moreover, reconstructing the original argument for having both LDC-spreading and reduplication, I show that it is based on the premise that reduplication and the grammar in general are based on inviolable conditions; thus the violable constraints of OT crucially enable the implementation of the unification proposal.

Section 3 develops the proposal of the paper by considering the noted redundancy between the two copying mechanisms in Temiar, one of the main indigenous languages of Malaysia (Benjamin 1976). Temiar was chosen for two reasons. First, the language is notorious for the complexity of its copying patterns, and despite valiant attempts (McCarthy 1982, Broselow and McCarthy 1983, Sloan 1988), it had so far resisted a satisfactory account. Second, Temiar had been argued to require the full deployment of both copying mechanisms, LDC-spreading and reduplication. This paradigm language for the theory admitting both copying mechanisms is then a problem that the present proposal must unavoidably address.

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.

The next two sections examine other cases where LDC-spreading has been argued to be crucially involved. Apparent cases of LDC-spreading from Semitic languages are discussed in section 4. Instances of LDC-spreading that have also been argued to be responsible for certain across-the-board effects in languages like Chaha and Yoruba are discussed in section 5. These sections further secure the proposal of the paper by showing how the reduction of LDC-spreading to copying via correspondence extends to these languages as well.

Turning to the theoretical implications of the proposal, in section 6, I argue that as a consequence of the elimination of LDC-spreading, its geometric prerequisite of V/C planar segregation receives no independent support, and that it should also be eliminated, with welcome results. Section 7 concludes with a summary of the main argument and results of the paper.[1]

1. 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. In this paper, I assume that faithfulness is formalized as in McCarthy and Prince (1995a)

[1] 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 and Mester (1993) on the status of true geminates in OT.

by introducing the notion of 'correspondence'. Correspondence is a relation between two forms, defined as in (2) below.[2]

(2) *Correspondence:* Given two segmental strings S_1 and S_2, *correspondence* is a relation $\Re$ 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 $\alpha\Re\beta$.

A correspondence relation imposes a number of constraints requiring identity between the two related segmental strings. Two basic correspondence constraints are given in (3) and (4) for the Base(B)/Reduplicant(R) correspondence relation (McCarthy and Prince 1995a).[3]

(3) $\textsc{Max}^{BR}$
Every segment of B has a correspondent in R.

(4) $\textsc{Dep}^{BR}$
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 satisfies $\textsc{Max}^{BR}$ and $\textsc{Dep}^{BR}$. Deviations from perfection are found when, because of higher-ranked constraints, the reduplicant copies less than the whole base, violating $\textsc{Max}^{BR}$, or when the reduplicant contains segments which are not part of the base, violating $\textsc{Dep}^{BR}$. Both cases of violation correspond to well-attested phenomena, partial reduplication and prespecified reduplication respectively. In Temiar, for example, 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 $\textsc{Max}^{BR}$ because /v, c^2/ are not copied.[4] Moreover, the output contains /a/, which is not part of the base, a violation of $\textsc{Dep}^{BR}$.

Other constraints evaluate the quality of the identity between correspondent segments over featural and prosodic dimensions, as in (5) and (6) respectively (from McCarthy and Prince 1995a and McCarthy and Prince 1993a respectively; see also Steriade 1988).

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[2] On the motivation for revising the original OT PARSE/FILL formalization of faithfulness in Prince and Smolensky (1993) and McCarthy and Prince (1993a), see McCarthy and Prince (1995a), McCarthy (1995), and Orgun (1995).

[3] It is to be kept in mind that an independent set of the same constraints holds for the Input/Output correspondence relation, namely, $\textsc{Max}^{IO}$ and $\textsc{Dep}^{IO}$. For extensions of correspondence theory to faithfulness relations between output forms see Benua (1995), Kenstowicz (1996), and McCarthy (1995) (cf. also Burzio 1994, Orgun 1996).

[4] The superscripts in the CV pattern indicate the relative order of consonants and '.' stands for a syllable boundary.

(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 coda position due to a constraint specific to codas, CODA-COND (Prince and Smolensky 1993, Itô and Mester 1993, Itô 1989, Steriade 1982). When a copy of the base-final consonant is affixed, as in *yaap* 'to cry', *yɛm.yaap*, the consonant is thus nasalized: IDENT^{BR} (nasal) is violated because of the higher ranked CODA-COND.[5]

SROLE in (6) is unviolated in Temiar 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 $c^1a.c^1vc^2$. But when the copied consonant is placed in coda position, as in $c^1\varepsilon c^3.c^2vc^3$, 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 a coda in the reduplicant but an onset in the base (Hayes and Abad 1989).

In developing the main proposal of this paper 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. Before doing so, I first motivate the elimination of LDC-spreading from a number of perspectives.

2. On the Need to Eliminate LDC-Spreading

2.1. *The Exceptional Status of LDC-Spreading*

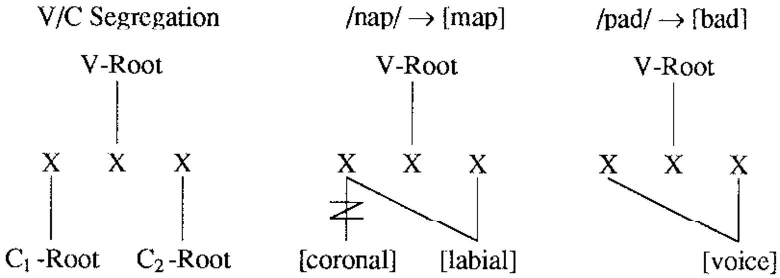
Virtually all discussions of the locality of autosegmental spreading in the feature-geometric research program ignore LDC-spreading or treat it as exceptional (see for example Clements 1985, Clements and Hume 1995, NíChiosáin and Padgett 1993). The reason for this is that these discussions

[5] The final consonant of the base *yaap* 'to cry', also a coda, remains faithful to its input orality. This is captured by the ranking IDENT^{IO}(nasal) $\gg$ CODA-COND $\gg$ IDENT^{BR}(nasal), an instance of what McCarthy and Prince (1994, 1995a) call 'the emergence of the unmarked': the phonology of unmarked codas expressed by CODA-COND emerges in reduplicant codas, but not in base codas, due to the differential ranking of the two IDENT constraints.

focus on languages with concatenative morphophonologies, where vowels and consonants are generally assumed to lie on the same plane (see Steriade 1987a for arguments), and thus the geometric premise of LDC-spreading, V/C planar segregation, is not necessarily assumed. This section shows that even in languages with nonconcatenative morphophonologies, where V/C planar segregation is assumed, the existence of LDC-spreading is problematic.

Consider that under V/C planar segregation, the two consonants in a C_1VC_2 sequence are adjacent, as shown in (7a).

(7)a. b. c.



This representation, (7a), blurs the distinction between biconsonantal clusters and pairs of consonants separated by a vowel, since, in both cases, the consonants are adjacent. Consequently, V/C planar segregation predicts assimilations between the two consonants in a CVC sequence which are of the same type as those found between the two consonants of a CC cluster. For instance, it is known that place assimilation and voice assimilation are very frequent in CC clusters. According to the prediction of V/C segregation, then, the comparable assimilations in CVC sequences, examples of which are shown in (7b) and (7c), should also be attested. However, such phenomena are not attested at all, in languages with either concatenative or nonconcatenative morphophonologies, as in fact has been noted by Clements (1985, p. 46).[6]

A possible objection to the above argument must be considered. Some consonantal features, especially those under the Coronal place of articulation or Coronal itself, it has been argued, spread from C-to-C in a CVC sequence in consonant harmony systems (Sagey 1986, Shaw 1991). This does not affect the argument above. LDC-spreading differs from the spreading found in consonant harmony systems in two respects – one is technical, the other substantive. First, the technical difference: putative

[6] Clements, in turn, attributes the observation to Morris Halle.

LDC-spreading requires V/C planar segregation, because 'spreading' targets the whole consonant. In contrast, standard analyses of consonant harmony do not require V/C planar segregation, but instead employ tier segregation below the Root node, where the Roots of vowels and consonants are on the same plane but their features may lie on different tiers (see among others Poser 1982, Sagey 1986, Steriade 1987b, Shaw 1991, and Odden 1994). In fact, for those past analyses that attempt to explain the special status of coronals with respect to consonant harmony, the fact that V/C planar segregation is not employed is a crucial assumption (e.g., Shaw 1991). Clearly, if V/C planar segregation is admitted, unattested cases of consonant harmony such as those in (7b–c) are predicted.

Second, a closer look at consonant harmony further emphasizes the exceptional character of LDC-spreading. Recently it has been argued that consonant harmony is not an instance of long-distance spreading between the two consonants in a CVC sequence (Flemming 1995, Gafos 1997a, 1998). The cross-linguistic study in Gafos (1998) reveals a rather restricted typology of the phenomenon, where the consonantal features subject to harmony are those describing the mid-sagittal and cross-sectional shape of the tongue tip-blade, the part of the tongue employed for coronal sounds. It turns out that for certain phonetic reasons these are precisely the consonantal parameters which can propagate through a vowel without significantly affecting its acoustic quality. The restricted typology of consonant harmony may then be properly understood if the harmonizing features spread through the intermediate vowel. Otherwise there would be no principled explanation for why it is only those very specific consonantal features that harmonize. If it is true that spreading in a CVC sequence propagates through the intervening V, this can only serve to underscore the exceptionality of LDC-spreading. On the one hand, spreading a whole consonant through the vowel in CVC would impose a consonantal constriction, completely obscuring that vowel, certainly a fatal candidate. On the other hand, obstinately insisting that LDC-spreading exists implies stating a glaring exception: spreading between the two consonants in a CVC propagates through the vowel, *except when the whole consonant spreads*.

One final point remains. In the VCV configuration, a number of cases have been reported where we must admit V-to-V spreading of the whole vowel to create the symmetric configuration V_1CV_1 (e.g., Steriade 1987a, Paradis and Prunet 1989). If so, should we be more skeptical about eliminating LDC-spreading in a CVC sequence? Perhaps we should, but only if such cases truly involve V-to-V spreading in a VCV sequence, skipping over the consonant. There is independent converging evidence to doubt that assumption. McCarthy (1994a), Padgett (1995), Gafos and Lombardi

(1997), and Gafos (1998) argue that proper understanding of the V-to-V spreading phenomenon must crucially assume that spreading of a V in a VCV sequence propagates through the intervening C, as with the consonant harmony results reported in Gafos (1998), where spreading is argued to propagate through the V in a CVC sequence.[7]

With these counterarguments and points for skepticism addressed, I conclude that broad considerations of locality and results from related research areas converge to highlight the exceptionality of LDC-spreading. To sum up the main point, LDC-spreading admits undesirable expressive power, predicting unattested long-distance spreading phenomena like those of (7b–c). A different way of stating the same problem is that LDC-spreading fails to explain why 'spreading' in a V/C planar segregated CVC sequence always spreads the whole consonant and nothing less than that. If, as I argue in the rest of this paper, putative cases of LDC-spreading in fact involve the same mechanism as in reduplication, this problem disappears. As in reduplication, copying targets the whole Root of the segment and not its isolated features.

2.2. *The Apparent Need for Reduplication and LDC-Spreading*

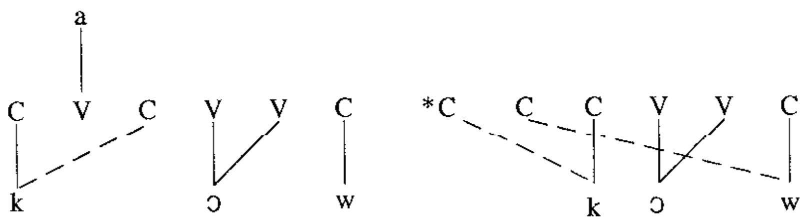
This section shows that the motivation for the putative existence of LDC-spreading can be traced to the assumption that the grammar is a set of inviolable conditions. When the grammar is seen instead as a set of violable constraints the mechanism of LDC-spreading becomes unnecessary.

The original argument for the apparent need for two copying mechanisms, LDC-spreading and reduplication, is based on some Hebrew and Arabic data discussed in McCarthy (1979, 1981). The argument will be first illustrated with Temiar data, turning to the original data next. Consider the simulfactive aspect [kakɔɔw] of the biconsonantal base /kɔɔw/ 'to call'. In the output [kakɔɔw], the segmental marker for the simulfactive aspect, the vowel /a/, is preceded by a copy of the first base consonant /k/. In

[7] McCarthy (1994a) and Gafos and Lombardi (1997) depart from past underspecification approaches to V-to-V spreading, which assumed that the reason for the transparency of the intervening consonant, typically a coronal (Paradis and Prunet 1989) or a laryngeal (Steriade 1987a), is its lack of a Place node. The reason, as discussed in Gafos and Lombardi, is that there are languages such as the Najdi dialect of Bedouin Arabic (Abboud 1979), where both the (sonorant) coronals and the gutturals (a superset of the laryngeals, Goldstein 1994, McCarthy 1994b) are transparent. In these languages, underspecification could not be the reason for the transparency of coronals *and* gutturals versus the opacity of all other consonants. Pursuing an idea originally due to McCarthy (1994a), Gafos and Lombardi argue that the reason for the transparency of coronals and gutturals is that these consonants are better hosts of the spreading vocalic place features than other consonants.

previous analyses (McCarthy 1982, Broselow and McCarthy 1983, Sloan 1988) the copy of the base-initial consonant is the result of LDC-spreading, as shown in (8a) below. After a left-to-right scan of the base melody, whose purpose is to associate step-by-step each consonant or vowel of the base to the next available templatic slot of the template CaCVC, the second C slot of the template remains unassociated. Then, the consonant /k/ spreads to fill this slot. All previous analyses of the simulfactive had assumed that spreading, as opposed to a reduplicative mechanism, was involved here because, as shown by the other simulfactive pattern for a triconsonantal base, $c^1a.c^2vc^3$ (e.g., /slɔg/ 'to lie down', [salɔg]), copying does not always take place.

(8)a. Simulative   b. Continuative



output: [kakɔɔw]   intended output: [kwkɔɔw]

On the other hand, the continuative aspect of the same verb /kɔɔw/, [kwkɔɔw] in (8b), shows that spreading cannot be involved here, because it would create line-crossing.[8] Hence, the other mechanism devoted to copying segments, reduplication, needs to be invoked. This is done by postulating a morphemic template, [root root], specific to the continuative aspect. 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 template CCCVVC by a complex set of mechanisms whose details need not concern us here.

Turning now to the original data, a similar situation to that of Temiar exists in Arabic and Hebrew (McCarthy 1979, 1981). Some quadriliteral 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 underlie this class). This pattern is not productive in Arabic, but the traditional grammar of Hebrew includes two binyanim which show the same pattern. These are the Pilpel $c^1vc^2c^1vvc^2$ (e.g., *gilgēl* 'to roll-trans.'), and the Hitpalpel $hitc^1vc^2c^1vvc^2$ (e.g., *hitgalgēl* 'to roll oneself

[8] The continuative template, CCCVVC, given here as assumed in McCarthy (1982), is syllabified as CɛC.CVVC; see the discussion of minor syllables in the next section.

along'). Along with these two patterns, there is also the pattern of the first binyan, $c^1vvc^2vc^2$ (e.g., *gālal* 'to roll-intrans.'). The analysis given in McCarthy (1979, 1981) uses LDC-spreading to derive the form of the first binyan (e.g., spreading of /l/ in *gālal*), 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 CVCCVVC and hit CVCCVVC 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 the first binyan 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 the 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 must involve LDC-spreading because, in both cases, triconsonantal roots do not show any copying at all. As we will see in detail in the Temiar analysis, however, the fact that no copying surfaces in the simulfactive of triconsonantals, $c^1a.c^2vc^3$, can simply be seen as an extreme case of violation of Max^{BR}, the constraint that requires that every segment of the base be copied in the reduplicant. In Temiar, Max^{BR} is ranked lower than the markedness constraints, Markedness, that penalize the presence of segmental structure, so copying occurs only when required by constraints ranked higher than these markedness constraints. Specifically, the prosody of the language dictates an absolute ban on onsetless syllables. That is, the constraint Ons, which requires syllables to have onsets, is undominated. The overall ranking is $\text{Ons} \gg \text{Markedness} \gg \text{Max}^{BR}$. Thus in the simulfactive of biconsonantals, $c^1a.c^1vc^2$, even though the copied consonant incurs additional violations of Markedness, its presence is required because $\text{Ons} \gg \text{Markedness}$. In the triconsonantal output $c^1a.c^2vc^3$, in contrast, no copying is necessary. The additional base consonant can assume the role of the needed onset, and since $\text{Markedness} \gg \text{Max}^{BR}$, any copying would incur additional violations of the higher ranked markedness constraints.

Copying is thus suppressed in the triconsonantal output, but that does not mean that the mechanism effecting the copying in the biconsonantals must be distinct from reduplication. LDC-spreading does not need to be invoked. Similar patterns of copying in the Semitic languages where LDC-spreading had been thought necessary submit to a similar ranking schema (with Max^{BR} low-ranked). Hence the impasse of previous approaches comes from a rigid notion of reduplication, based on inviolable conditions, and is resolved by adopting a view in which reduplication, and the grammar in general, is based on violable constraints, the essence of Optimality Theory.

In the proposed analysis of Temiar, then, the mechanism responsible for copying in the simulfactive is identified as the same mechanism used in the continuative: reduplication. The property of gradient constraint violability (of $\textsc{Max}^{BR}$ in particular) is crucial in achieving this unification. At the same time, by obviating LDC-spreading, this proposal solves the problems pointed out in the previous subsection for the theory which permits this kind of spreading.

3. Developing the Proposal: Temiar Verbal Morphology

Temiar [təmɛɛr] 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, Thomas and Headley 1970). The Mon Khmer family includes eleven groups, one of which is Aslian languages spoken in the Malaysian peninsula.[9] 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 section.[10]

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 aspectual paradigms of the language, the simulfactive and the continuative. 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

[9] See Jenner (1969) on Khmer, Svantesson (1983) on Kammu, and Henderson (1952) on Cambodian.

[10] See Diffloth (1976b, c) for brief descriptions of Semai and Jah-Hut 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 of the close similarities of this language to Temiar.

segmental copying in the morphology of the two aspects, as presented in subsection 3.2.

3.1. *Basic Prosodic and Morphological Properties*

Temiar shows the striking word prosody of Mon Khmer languages, where lexical items consist of a *major* syllable preceded optionally by a sequence of *minor* syllables (see (9)). The major syllable is stressed and contains the only phonologically specified vowel in the word. Minor syllables, in contrast, are not stressed and consist of consonants with no phonologically specified vowel. For example, in (9b), the verb ***t.***_lɛk_ 'to teach' is composed of the consonant /t/, which is the onset of the minor syllable, followed by the major syllable /lɛk/. Minor syllables are shown in bold.

(9) a.	deek	'house'	f.	**tʔ.**taaʔ	'old men'
b.	**t.**lɛk	'to teach'	g.	**s.ng.**lɔg	'knot'
c.	**b.**huj	'guilty'	h.	**k.rn.**waak	'frame'
d.	**br.**caaʔ	'to feed'	i.	**gn.gr.**lut	'spindly-ness'
e.	**cb.**niib	'going'			

Minor syllables can be closed, as in (9d), ***br.****caaʔ* 'to feed', where /b/ is the onset and /r/ is the coda. The examples in the third column show words with two minor syllables. The list could be expanded at will, and even longer sequences of minor syllables are created by various morphological processes of the language.

In his phonetic transcriptions of minor syllables, Benjamin employs two predictable vowel qualities. He transcribes open minor syllables with [ɔ] and closed minor syllables with [ɛ], as in [**kə.rɛn.**waak] 'frame'. There is evidence suggesting that this categorical '[ɔ] in open/[ɛ] in closed syllable' transcription of minor syllable phonetic realizations may be an oversimplification of the range of their possible vowel qualities. Diffloth (1976a), for example, notes that minor syllables are realized phonetically with other transitional vowel qualities. In the context of a labial consonant, the vowel of the minor syllable has a [u]-like quality, while in the context of palatal consonants it has a high front [i]-like quality. Whatever the precise quality of minor syllable vocalism, I will assume that these vowels are not specified underlyingly, but are the phonetic realizations of a syllable with no phonologically specified vowel. This seems to be the generally accepted assumption among Southeast Asianists for the Senoic group and the Mon Khmer family in general (Diffloth 1976a,b,c, Matisoff 1973).[11]

Since words in Temiar are stressed on the final syllable, the prosodic structure, which allows only one major syllable per word preceded optionally by a sequence of minors, can be seen as a special case of a widely attested tendency for languages to reduce the number of vowel contrasts in unstressed positions (the observation dates back to Trubetzkoy 1939; see Steriade 1995, Beckman 1955 for two recent theoretical proposals). For example, Italian reduces a seven-vowel inventory in stressed positions to a five-vowel inventory in unstressed positions, Russian reduces a five-vowel inventory to a three, and Catalan a seven to a three (see Hayes 1995, p. 23). Temiar can be seen as the extreme case of this tendency. Whereas in the final major syllable a full system of nine vowels is allowed, in prefinal unstressed positions no vocalic constrasts are allowed.[12]

I will not attempt in this paper to derive the word prosody of Temiar from constraint interaction, a task which requires considerable deviation from the main concerns of this paper (see Gafos 1998 for a proposal). For current purposes it will suffice to assume a constraint *PREFINAL-V in (10), which simply states the generalization evident in the examples shown in (9). I emphasize that *PREFINAL-V is used as a cover name for the set of constraints that may lie behind the Temiar (and Mon Khmer) generalization.[13]

(10) *PREFINAL-V
Prefinal (= unstressed) vowels are not allowed.

Apart from the existence of minor syllables, the structure of the Temiar syllable is simple. An onset consonant is always present and complex margins (onsets or codas) are not allowed. Unambiguously, then, in a form like ***br.caaʔ*** 'to feed' the first consonant is the onset and the second

[11] If the surface vowels of minor syllables are not specified underlyingly then their variation can be seen as a reflex of the articulatory transition between two consonantal gestures. The first is the gesture of the onset of the minor syllable and the second is the gesture of the following consonant, which can be either the coda of the minor syllable or the onset of the following syllable. In producing this consonantal sequence, the first gesture forms a constriction and then releases it before producing the constriction of the second gesture. In the transitional period between the onset of the release of the first gesture and the formation of the constriction of the second gesture, there is no complete obstruction in the vocal tract. This gives the effect of a vowel whose quality is highly dependent on the context (see Browman and Goldstein 1992 for relevant discussion).

[12] Note that this would be true even if Benjamin is correct in suggesting that there are only two entirely predictable and thus non-contrastive vowel qualities [ɔ/ɛ] in minor syllables.

[13] As can be seen in (12) below, this generalization admits exceptions under very specific conditions. See the relevant discussion in Section 3.2.

is the coda of the minor syllable. Following standard assumptions and adopting the terminology of Prince amd Smolensky (1993, sec. 6.2), syllables always have a daughter *Nuc* node, and two other optional nodes, *Ons* and *Cod*, as the leftmost and rightmost daughters or margins. The universally undominated constraint NUC in (11a) enforces the presence of the *Nuc* position. I also follow Prince and Smolensky (1993) in assuming that the *Nuc* position may be empty, as is the case with minor syllables in Temiar. Two other undominated constraints which play an important role in the analysis to follow are ONS and *COMPLEX in (11b) and (11c). Finally, *CODA (11d) is violated whenever CC clusters occur.

(11) a. NUC
Syllables must have nuclei.

b. ONS
Every syllable must have an onset.

c. *COMPLEX
No more than one segment may link to any syllable margin position.

d. *CODA
Syllables must not have a coda.

I now turn to the morphological properties of the language. In the verbal morphology of Temiar, 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 (12).

(12)	Active Voice	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, (12a). This perfective is the base for the formation of the two other aspects, the simulfactive and the continuative. The simulfactive aspect in (12b) is marked by the vowel /a/, and in the biconsonantal case, also by a copied base consonant (stress is invariably on the final syllable). The continuative aspect in (12c) involves only copying of base consonants.

The aspectual paradigm of the causative voice is shown in (13).

(13)	Causative Voice	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 causative perfective aspect is formed from the corresponding active perfective base (repeated in (13) as the Base) by addition of the affix /tr/, (13a). This affix is subject to allomorphy, as shown in the case of triconsonantal bases, where it appears as an infixed /r/.[14] 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/, (13b), and the continuative by copying of various base consonants, (13c).

An important property of 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 (14a). The continuative patterns have a copied consonant also immediately to the left of the major syllable of the base, as shown in (14b).

(14) a. Simulfactives: c^1**a**.c^1vc^2 c^1**a**.c^2vc^3 t.**ra**.c^1vc^2 c^1.**ra**.c^2vc^3
b. Continuatives: c^1**c^2**.c^1vc^2 c^1**c^3**.c^2vc^3 t.**rc^2**.c^1vc^2 c^1.**rc^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. I propose to capture it with an alignment constraint, requiring that the right edge of an affix must be aligned with the left edge of the stressed (major) syllable of the base, σ́. The constraint can be stated in the generalized alignment schema of McCarthy and Prince (1993b) as in (15), where 'Affix' ranges over the set {Simulfactive, Continuative}.

(15) ALIGN (Affix, R, σ́, L)
The right edge of Affix must be aligned with the left edge of the stressed syllable. (henceforth, α-HEAD, where HEAD is meant to indicate the syllabic head of the PrWd)

Apart from this there does not appear to be any particular prosodic requirements on how these affixes surface in the various outputs. The

[14] This allomorphy will not be dealt in this paper. See Gafos (1998) for its analysis.

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, in contrast, 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 that the only difference between them is that the simulfactive is prespecified for the vowel /a/. This difference is illustrated in (16a) and (16b) respectively, where 'α^{RED}' indicates that the morpheme is a reduplicative ($^{\text{RED}}$) affix (α), and the association line in the simulfactive depicts morphological affiliation.

(16) a. Simulfactive affix: α^{RED}
|
/a/

b. Continuative affix: α^{RED}

(no segmental content)

It will be seen that the fact that the continuative is always realized with a (copied) 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 from the interaction of independently established prosodic regularities, expressed by *COMPLEX, ONS, and *PREFINAL-V.[15]

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 words may not contain prefinal vowels (*PREFINAL-V). Finally, the basic generalization about the locus of affixation in both 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 an analysis of the simulfactive and continuative aspects, in that order. In the simulfactive forms of (17) there are two

[15] The alignment constraint on the placement of the affixes in Temiar essentially requires that the affix be in the rime position of the prefinal syllable. In descriptive terms, the aspectual morphology of Temiar can be seen as the addition of a mora to the base, an operation that has been claimed to take place in various other languages. See especially Lombardi and McCarthy (1991), but also Broselow and McCarthy (1983), Bat-El (1989, fn. 24), Samek-Lodovici (1993), and McCarthy and Prince (1995b).

voices, active and causative. Each voice exhibits two possible patterns, one biconsonantal and one triconsonantal. Copies of consonants are shown in bold.

(17) Active

		Biconsonantal	Triconsonantal
a.	Base	c^1vc^2	$c^1.c^2vc^3$
		kɔɔw 'to call'	s.lɔg 'to lie down'
b.	Simulfactive	$\mathbf{c^1}a.c^1vc^2$	$c^1a.c^2vc^3$
		ka.kɔɔw	sa.lɔg

Causative

		Biconsonantal	Triconsonantal
c.	Base	$tr.c^1vc^2$	$c^1r.c^2vc^3$
		tr.kɔɔw	sr.lɔg
d.	Simulfactive	$t.ra.c^1vc^2$	$c^1.ra.c^2vc^3$
		t.ra.kɔɔw	s.ra.lɔg

All simulfactive forms have a prefinal syllable with the vowel /a/, a clear violation of the constraint *PREFINAL-V, expressing what is otherwise a family-wide generalization of Mon Khmer languages that prefinal vowels are not allowed. This provides us with the first ranking argument of the analysis. Let us 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 (18) below.

(18) Ranking argument: MAX$^{\text{AFFIX-IO}}$ ≫ *PREFINAL-V

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

*PREFINAL V favors a candidate like (18a), where the input vowel /a/ does not surface in the output. This candidate, however, incurs a violation of MAX$^{\text{AFFIX-IO}}$, which requires that every segment of the affix in the input must have a correspondent segment in the output. Candidate (18b) is in perfect correspondence with the input but incurs a violation of *PREFINAL-V. The two constraints are thus in conflict. To choose the correct candidate, MAX$^{\text{AFFIX-IO}}$ must dominate *PREFINAL-V, MAX$^{\text{AFFIX-IO}}$ ≫ *PREFINAL-V. The prosodic regularity expressed by *PREFINAL-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. (MAX$^{\text{BASE-IO}}$ is undominated and is not shown in this or following tableaux.)

The output $c^1a.c^2vc^3$ is otherwise unremarkable. 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 (17d), is formed from the corresponding causative base $c^1r.c^2vc^3$ in (17c) by affixation of /a/ according to the demands of α-HEAD. The only difference between the causative $c^1.ra.c^2vc^3$ 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. It is easy to see that the other causative simulfactive output of biconsonantals in (17d), $t.ra.c^1vc^2$, is similar in all respects to $c^1.ra.c^2vc^3$.

Consider now the active simulfactive of biconsonantals $c^1a.c^1vc^2$ in (17b). 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 the constraint ONS is undominated. This then explains the presence of the new consonant in the output. There is therefore no need to attribute this consonant to some output template specific to the simulfactive, as had been assumed in previous analyses of these facts (McCarthy 1982, Broselow and McCarthy 1983, Sloan 1988), or to 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 full surface realization is 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, while partially specified, the simulfactive affix is also reduplicative, in the sense that there is a correspondence relation between it and the base. This correspondence relation is what dictates copying. More specifically, the constraint DEP$^{\text{BR}}$ 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$^{\text{BR}}$. The situation is depicted formally in tableau (19) below. Under DEP$^{\text{BR}}$, for each violation mark, I also show the offending segment in parentheses.

(19) Active simulfactive of biconsonantals; copying induced by DEP^{BR}

Input:	a, c^1vc^2	ONS	DEP^{BR}
a.	a.cvc	*!	*(a)
b.	Ta.c^1vc^2		*(a)*(T)!
c. ☞	c^1a.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 (19a) 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 (19b) 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 (19c) 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, however, an additional ranking must in fact be established. Creating a copy of a segment introduces another instance of the original segment, inheriting its markedness. Following Prince and 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 (20) directly expresses the fact that certain consonants are less marked than others by a ranking of the *PL/χ constraints.[16]

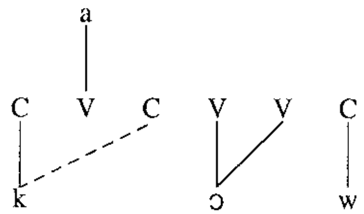
(20) Markedness Hierarchy: *PL/Labial, *PL/Dorsal $\gg$ *PL/Coronal

Hence, for copying to take place, the markedness violation of the copied segment must never be serious enough to block copying of the consonant, leading to the epenthesis of 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/χ^{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} $\gg$ *PL/χ^{MAX}, which is in turn ranked higher than *PL/χ^{MIN}, the constraint for the markedness of the least marked segment /T/.

[16] On the basis of neutralization facts, Lombardi (1995) argues for extending the hierarchy to include the gutturals (i.e., the laryngeals ʔ, h, the pharyngeals ʕ, ħ, and the uvulars ʁ, χ; see McCarthy 1994b, Goldstein 1994) as the least marked consonants: *PL/Labial, *PL/Dorsal $\gg$ *PL/Coronal $\gg$ *PL/Pharyngeal, where 'Pharyngeal' denotes the place specification of gutturals.

Consider now the fact that in the rest of the simulfactive outputs, $c^1a.c^2vc^3$, $t.ra.c^1vc^2$, and $c^1ra.c^2vc^3$, no copying takes place. In previous analyses (McCarthy 1982, Broselow and McCarthy 1983, Sloan 1988), this fact had been taken as evidence that the simulfactive involves no reduplication at all and that the copying of the consonant in $c^1a.c^1vc^2$ is the result of a completely unrelated mechanism, namely, LDC-spreading. Specifically, the analysis of the simulfactive in McCarthy (1982) stipulates a prosodic template CVCV(V)C whose first vocalic position is occupied by the simulfactive affix /a/ (see (21)). Assuming a biconsonantal base like *kɔɔw* 'to call', the base melody *kɔɔw* associates in a left-to-right (LR) sweep to the positions of this template. The resulting associations are as indicated in (21).

(21) kɔɔw → [kakɔɔw]



The empty second C of the CVCV(V)C template, which remains unassociated after this first sweep, is filled by LDC-spreading of the base-initial consonant /k/. 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 the planar segregation hypothesis requiring that different morphemes lie on different planes, introduced in McCarthy (1979) and extended later to V/C planar segregation in McCarthy (1989).

Turning to a triconsonantal base within the context of the previous analyses, no copying takes place in the simulfactive, /s.lɔg/ → [salɔg], because after the first step of the association procedure above all three consonants of the template will be filled with the consonants of the base. A crucial tenet of OT, however, is that constraints are violable. Most relevantly, the constraint $\text{M}{\small AX}^{BR}$ which requires that every segment of the base have a correspondent in the reduplicant can be violated. Assuming violability, absence of copying does not necessarily imply nonreduplicative morphology. For example, the output $c^1a.c^2vc^3$ where no segment of the base is copied can be seen as illustrating the extreme case of $\text{M}{\small AX}^{BR}$ violations. None of the four base segments is copied. Likewise, because only one consonant is copied in $c^1a.c^1vc^2$, this output incurs two violations of MAX^{BR} (/v, c^2/ are not copied). 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 harmonic the output becomes. In Temiar copying is minimized. For example, in the biconsonantal simulfactive **c^1**a.c^1vc^2, a consonant is required in the output because of the undominated ONS, but in c^1a.c^2vc^3 no consonant is required because the base already contains c^1, which can serve the role of the needed onset. Thus no copying takes place. If it did, as in the alternative output c^1.**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/χ^{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 rankings have thus been established. DEP^{BR} ≫ *PL/χ^{MAX}, forcing copying instead of epenthesis of default consonants, and *PL/χ^{MIN} ≫ MAX^{BR}, minimizing the number of copied segments. Since, by definition *PL/χ^{MAX} ≫ *PL/χ^{MIN}, the overall ranking is DEP^{BR} ≫ *PL/χ ≫ MAX^{BR}, where *PL/χ stands for any constraint of the markedness hierarchy, or, in other words, the encapsulation of the Markedness Hierarchy (Prince and Smolensky 1993, sec. 8.4), henceforth just MARKEDNESS. In short, then, DEP^{BR} ≫ MARKEDNESS ≫ MAX^{BR}.

Tableau (22) formalizes the preceding discussion in terms of the proposed constraints. Under the constraint MARKEDNESS, I only show the additional violation(s) of markedness caused by segmental copying or epenthesis. Candidates (22a–c) have already been discussed in tableau (19). Candidate (22d) copies the whole base, satisfying MAX^{BR} completely, but at the expense of violating MARKEDNESS more than (22c).[17]

(22) Active simulfactive of biconsonantals: a^{RED}, c^1vc^2 → **c^1**a.c^1vc^2

Input: a^{RED},c^1vc^2	DEP^{BR}	ONS	MARKEDNESS	MAX^{BR}
a. a. c^1vc^2	*(a)	*!		***
b. Ta, c^1vc^2	*(a)*(T)!		*(T)	***
c. ☞ **c^1**a.c^1vc^2	*(a)		*(c^1)	**
d. **c^1v.c^2**a.c^1vc^2	*(a)		*(c^1)*(v)*(c^2)	

[17] In fact, the candidate (22d) also incurs one more violation of *PREFINAL-V than the optimal candidate, and also a violation of another undominated constraint, SROLE, to be introduced soon. Hence, that candidate does not provide the argument for the proposed ranking between MARKEDNESS and MAX^{BR}. It is the following tableau that provides the argument for MARKEDNESS ≫ MAX^{BR}.

The next tableau, in (23), illustrates the case of triconsonantals, a^{RED}, $c^1.c^2vc^3 \rightarrow c^1a.c^2vc^3$, with no copying at all. ONS is not at stake here because the base already contains a consonant that can serve that role. The lower-ranked MARKEDNESS is now decisive and suppresses copying of 'unnecessary' segments, as in the suboptimal candidate below.[18]

(23) Active simulfactive of triconsonantals: a^{RED}, $c^1.c^2vc^3 \rightarrow c^1a.c^2vc^3$; MARKEDNESS in action

a^{RED},$c^1.c^2vc^3$	DEP^{BR}	ONS	MARKEDNESS	MAX^{BR}
a. $c^1.\,c^2a.c^2vc^3$	*(a)		*(c^2)!	***
b. ☞ $c^1\,a.c^2\,vc^3$	*(a)			****

This completes the main part of the analysis of the active simulfactive paradigm. To review, the simulfactive affix is reduplicative and pre-specified with vocalism /a/. The presence of a copied base consonant $\{a^{RED}, c^1vc^2\} \rightarrow \mathbf{c^1}a.c^1vc^2$ is not due to some templatic constraint on the shape of the affix or on the simulfactive output *per se*. Rather, it follows from the regular prosody of the language, namely, ONS. Absence of copying in the other simulfactive output, $\{a^{RED}, c^1.c^2vc^3\} \rightarrow c^1a.c^2vc^3$, follows from the ranking (ONS ≫) MARKEDNESS ≫ MAX^{BR}.

The analysis readily extends to the simulfactives of the causative voice. Specifically, it is easy to see that the same ranking as above accounts for the absence of copying in the two simulfactive forms of the causative voice in (17c, d): $c^1.ra.c^2vc^3$ and $t.ra.c^1vc^2$, formed from the causative bases $c^1r.c^2vc^3$ and $tr.c^1vc^2$ respectively. The alternative outputs with complex onsets in the prefinal syllable, $c^1ra.c^2vc^3$ and $tra.c^1vc^2$, are excluded because *COMPLEX is undominated.

I turn next to the question of what determines the choice of the copied consonant, specifically, the choice between the two possible candidates $\mathbf{c^1}a.c^1vc^2$ and $\mathbf{c^2}a.c^1vc^2$. Putting alternatives aside for the moment, I propose that 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.

[18] Recall that because *COMPLEX is never violated in Temiar, in the suboptimal candidate, /c^1/ is forced into a syllable by itself. Specifically, /c^1/ is the onset of that syllable, followed by an empty nucleus.

(24) Choice of copied consonant

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

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 1995a)
Correspondence preserves alignment in the following sense: the left/right peripheral element of the Reduplicant corresponds to the left/right peripheral element of the Base, if the Reduplicant is to the left/right of the Base.

ANCHORING is meant to capture the generalization that reduplicative affixes copy material from some designated edge of the base, with reduplicative prefixes usually copying material from the left edge of the base, and reduplicative suffixes usually copying material from the right edge of the base (Marantz 1982, McCarthy and Prince 1986). 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 4, 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	Biconsonantal	Triconsonantal
a.	Base	c^1vc^2	$c^1.c^2vc^3$
		kɔɔw 'to call'	s.lɔg 'to lie down'
b.	Continuative	$\mathbf{c^1c^2}.c^1vc^2$	$c^1\mathbf{c^3}.c^2vc^3$
		kw.kɔɔw	s**g**.lɔg
	Causative	Biconsonantal	Triconsonantal
c.	Base	$tr.c^1vc^2$	$c^1r.c^2vc^3$
		tr.kɔɔw	sr.lɔg
d.	Continuative	$t.r\mathbf{c^2}.c^1vc^2$	$c^1.r\mathbf{c^3}.c^2vc^3$
		t.r**w**.kɔɔw	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] (derived from /s.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 a reduplicative affix α^{RED} whose exact realization is determined by the grammar. Noting that the affix is invariantly realized with a copy of at least one base consonant, one might suggest that it should be some sort of a consonantal segment, as in fact is assumed in the analysis of Broselow and McCarthy (1983). However, this fact follows independently from the regular prosody of the language. Indeed, if the affix was realized by a copy of a vowel, a prefinal syllable with a vowel would be created, a violation of *Prefinal-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 in bold if it is a copy of some other segment. In the input shown in this tableau, α^{RED} indicates the continuative affix.

(28) Continuative of triconsonantals; *Prefinal-V in action

Input: $\alpha^{RED}.c^1c^2vc^3$	Prefinal-V	Dep^{BR}	Markedness
a. $c^1\underline{v}.c^2vc^3$	*!		*(v)
b. $c^1T.c^2vc^3$		*(T)!	*(T)
c. ☞ $c^1\underline{\mathbf{c}}^3.c^2vc^3$			*(c^3)

Candidate (28a) realizes the affix with a copy of the base vowel /v/, a violation of *Prefinal-V, while (28b) fills it with a default consonant /T/, a violation of $\textsc{Dep}^{BR}$. Finally, (28c) avoids both violations by copying a base consonant.[19]

Recall that *PREFINAL-V is dominated by $\textsc{Max}^{AFF\text{-}IO}$, and thus violated in all simulfactive outputs as established earlier in the analysis. In the case of the continuatives, on the other hand, *PREFINAL-V plays an active role in determining the optimal candidate. This difference arises from the fact that 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 *PREFINAL-V, play an active role in choosing the optimal candidate.

The second observation 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 must be realized as /. . . $\mathbf{c}.c^1vc^2$/ to satisfy the joint demands of α-HEAD and *PREFINAL-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, $\textsc{Dep}^{BR}$. As in the case of the simulfactive of biconsonantals, $\mathbf{c^1}a.c^1vc^2$, 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, as was assumed in previous analyses (McCarthy 1982, Broselow and McCarthy 1983, Sloan 1988). It is instead required by ONS, an unviolated prosodic property of the language. The emergence of the biconsonantal active continuative form $\mathbf{c^1c^2}.c^1vc^2$ is expressed formally in tableau (29). In the candidates of this tableau, the placeholder symbol '_' indicates the position of the minor syllable nucleus in order to make clear the syllabic positions of the copied consonants. For example, in (29a) $\mathbf{c^2}$ is placed in the coda position of the minor syllable as required by α-HEAD.

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[19] I assume the presence of a superordinate requirement that the affix must be realized with some segmental material; that is, a candidate like $c^1.c^2vc^3$, with no segmental expression of the affix, is excluded. The implementational choices of stating such a requirement are numerous and their details nontrivial. Nevertheless, the presence of such a requirement in the grammar is uncontroversial, and the matter must be put aside for reasons of space. For the simulfactive affix, it should be clear that because /a/ is part of the underlying specification of the affix, the optimal candidate $c^1a.c^2vc^3$ in tableau (19) does satisfy the morpheme realization requirement even though it does not copy any of the base consonants.

(29) Continuative of biconsonantals

Input: α^{RED},c^1vc^2	ONS	DEP^{BR}	MARKEDNESS
a. _c^2.c^1 vc^2	*!		*(c^2)
b. T_T.c^1vc^2		*!*	*(T)*(T)
c. T_c^2.c^1 vc^2		*!	*(T)*(c^2)
d. c^1 _T.c^1 vc^2		*!	*(T)*(c^1)
e.☞ c^1 _c^2.c^1 vc^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. 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. Finally, consider another noteworthy 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 in the onset position of its minor syllable is separated from the left edge of the major syllable by the empty *Nuc* (nucleus) node of the minor, indicated with the '_'.[20]

Recall that in the triconsonantal output, $c^1c^3.c^2vc^3$, 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, and thus no additional copying is necessary. The same applies to the other two continuative patterns of the causative voice, t.rc^2.c^1vc^2 and c^1.rc^3.c^2vc^3. Placement of the continuative affix is determined by α-HEAD and its realization as a consonant by the regular prosody of the language, namely, *PREFINAL-V.

This concludes the analysis. To sum up, the simulfactive and continuative affixes are reduplicative morphemes, obeying a common placement constraint, α-HEAD, which requires that they be prefixed to the stressed syllable of the base. The only difference between the two affixes is that

[20] Alignment, then, between the affix and the base syllable is strict in the sense that no syllabic constituent, segmentally filled or empty, may intervene between the affix and the base syllable. Seemingly quite abstract, in fact, this interpretation of (the violation of) alignment in c^1_.c^1vc^2 can in fact be expressed in phonetically precise terms: what separates the consonant in the onset of the minor syllable from the consonant in the onset of the major syllable is the release of the former. All coda consonants are crucially not released in Temiar. Thus an affixal consonant is properly aligned only at the coda position of the preceding syllable. This interpretation of alignment makes interesting connections to claims about the phonological relevance of release and closure positions in phonology (Steriade 1993, Saussure 1949), which I will not pursue here.

the simulfactive includes a prespecified vowel /a/. The surface realizations of all (eight) verbal patterns of the simulfactive and continuative paradigms are determined by the core ranking of the analysis given below.

(30) Summary ranking:
α-HEAD, ONS, *PREFINAL-V, DEP^{BR} $\gg$ MARKEDNESS $\gg$ MAX^{BR}

In particular, the surface shape of the affix-base combination emerges from the requirements of α-HEAD and the constraints of the regular prosody of the language, that is, mainly ONS and *PREFINAL V. Copying of segments is induced by the correspondence constraint DEP^{BR}. The number of copied segments is minimized because the segmental markedness constraints MARKEDNESS are ranked higher than the other basic correspondence constraint, MAX^{BR}.

The following two sections further motivate and justify the elimination of LDC-spreading by reconsidering a number of other cases where this mechanism has been argued to apply.[21]

4. APPARENT LDC-SPREADING IN SEMITIC MORPHOPHONOLOGY

We now turn our attention to Semitic languages to test the proposed elimination of LDC-spreading in the face of the same data that had originally motivated the conception of the mechanism. There are two goals. The first is to show that the theory without LDC-spreading is sufficient. In section 4.1, Semitic patterns with or without copying of consonants are examined, and an analysis is presented that does away with LDC-spreading. In section 4.2, another phenomenon that putatively requires LDC-spreading, the distribution of identical consonants in the so-called 'geminate roots' of Semitic, is examined, and is also reanalyzed without employing LDC-spreading.

The second goal of this section is to argue that the elimination of LDC-spreading has two attractive consequences: (a) it obviates an array of special mechanisms employed in past analyses of Semitic 'nonconcatenative' morphophonology, and (b) it does away with a number of problems

[21] Apart from the cases we are about to consider, another instance where LDC-spreading has been argued to be crucially employed is in the formation of Ancient Greek present stems (Steriade 1982). In independent work, Gafos (1997b) shows how the Ancient Greek data can be analyzed without LDC spreading. The argument requires elaboration on the issue of the proper statement of the constraint ANCHORING, a digression that would takes us beyond the scope of this paper.

arising in the theory that admits both copying mechanisms, LDC-spreading and reduplication.

4.1. *LDC-spreading as Reduplication in Semitic Morphophonology*

A few patterns of copying from Semitic languages are shown in (31) below. The well-known $c^1v.c^2v\mathbf{c^2}$ pattern, in (31a), is found in Modern Hebrew denominal formation (e.g., *kided* 'to codify' from *kod* 'code') and in the first binyan of the biliteral Arabic verbs (e.g., *samam* 'poisoned'). The pattern in (31b), $c^1vc^2.\mathbf{c^1}v\mathbf{c^2}$, is also found in Modern Hebrew denominals, where it is selected arbitrarily by some biconsonantal verbs as an alternative to the first pattern (e.g., *dildel* 'to impoverish' from *dal* 'poor'), in the Pilpel and Hitpalpel of Classical Hebrew (sec. 2.2), and with a limited number of verbs in Arabic (e.g., *zalzal* 'to shake'). Finally, the third pattern, $c^1vc^2.\mathbf{c^1}vc^3$ in (31c), is found in some modern Arabic dialects, particularly those of Levant, usually with an intensive or pejorative meaning (e.g., *barbad* 'shaved unevenly').

(31)

Copying patterns	Representative languages	Representative sources
a. $c^1v.c^2v\mathbf{c^2}$	Arabic, Modern Hebrew	McCarthy (1979), Bat-El (1994)
b. $c^1vc^2.\mathbf{c^1}v\mathbf{c^2}$	Arabic, Modern Hebrew	McCarthy (1979), Bat-El (1994)
c. $c^1vc^2.\mathbf{c^1}vc^3$	Levantine Arabic	Broselow and McCarthy (1983), Prince (1987)

In the last two patterns of (31b, c) copying cannot be the result of LDC-spreading because of the line-crossing prohibition, as discussed in section 2.2 (see the corresponding representative sources for reduplication analyses of these patterns). The pattern where LDC-spreading has been employed is (31a), $c^1v.c^2v\mathbf{c^2}$, and this will be the focus of the following discussion. The proposed analysis does not employ LDC-spreading, V/C planar segregation, or the special template-mapping procedures that usually go with those. Instead, it employs reduplication, the independently needed mechanism for the other two copying patterns in Semitic morphology.

For concreteness, consider the instantiation of the $c^1v.c^2v\mathbf{c^2}$ pattern in Modern Hebrew denominal verb formation, as in *kided* 'to code' from *kod* 'code', *ximem* 'to heat' from *xam* 'hot', *cided* 'to side with' from *cad* 'side', etc. The following discussion is structured around three themes. First, I address the issue of how to capture the interdigitation of the root consonantism with the denominal vocalism /ie/, making no use of the special mechanisms listed above. Then I turn to the factors determining the location and choice of the copied consonant, and, finally I discuss the number of copied consonants.

Before proceeding, I should point out that the proposal to eliminate LDC-spreading by reducing it to reduplicative copying in Semitic languages is not new. Angoujard (1988) makes the same claim for Semitic languages in general, as does Bat-El (1989, 1994) for Hebrew. As we will see, the implementations of these authors' individual proposals differ in crucial respects from the one developed herein.[22]

• **Interdigitation.** Following Bat-El (1994), I assume an undominated constraint requiring that the shape of the denominal output consist of two syllables, [σ σ]. I also assume that the output must end in a consonant, due to the general canon of Semitic stems, dubbed Final Consonantality in McCarthy and Prince (1990b), henceforth FINAL-C, also an undominated constraint. Essentially, this constraint further specifies the shape of the bisyllabic output.[23] In addition, I assume the basic syllabification constraints, ONS, *COMPLEX, and *CODA. I assume that ONS is undominated, echoing the Onset Rule of McCarthy and Prince (1990b) and Bat-El (1994). In contrast, both *COMPLEX and *CODA can be violated, as shown by forms such as *dmut* 'image', *tir.gem* 'he translated', *til.gref* 'he telegraphed', and so on. It is to be kept in mind that because the final consonant of the output is a coda, FINAL-C $\gg$ *CODA, the typical relation between a general and a specific constraint following from Pānini's Theorem (Prince and Smolensky 1993, sec. 7).

The union of the above constraints dictates that the denominal output consists of two syllables ([σ σ]) with onsets (ONS), ends in a consonant (FINAL-C), and violates *COMPLEX and *CODA minimally. Hence, given a simple biconsonantal root, as in *kd* of *kod* 'to code', and the vocalism *ie*, it is easy to see that the prosodic shape of the output must be CiCeC. A representative sample of candidates and their corresponding violations

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[22] Apparently unaware of each other's work, Angoujard and Bat-El offer the same motivation for their proposals: LDC-spreading creates a copy of a consonant, as does reduplication. It thus seems worthwhile to pursue eliminating LDC-spreading by attributing its effects to the independently necessary mechanism of reduplication (Angoujard 1988, p. 9, Bat-El 1989, p. 78). These two proposals do not make any claims beyond Semitic (see sections 3 and 5 of this paper), and do not make any connections to other areas of phonology (see sections 2 and 6 of this paper).

[23] The particular choices of the constraints that implement bisyllabicity and final-consonantism are not crucial for the goal at hand. It is to be expected that these constraints may differ in the complete analyses of the pattern $c^1v.c^2vc^2$ in Modern Hebrew and Arabic. For example, in Modern Hebrew, it is perhaps possible to argue that the template is an iambic foot, a unit of the prosody proper (but see Bat-El 1994, fn. 12). For Arabic, see McCarthy and Prince (1990b, p. 25) for some proposals on how bisyllabicity and its variable instantiations can be derived from more basic requirements.

are: *ki.de* violating undominated FINAL-C, *ik.deC*, *ki.ed* violating undominated ONS, *ki.de.CVC* violating [σ σ], *kid.CeC* with an extra violation of *CODA, etc.

The above reasoning suffices when we assume that the input consonantism *kd* is separated from any vowel(s) that may exist in the input noun *kod*. This assumption may not be guaranteed (see Bat-El 1994 for arguments from Modern Hebrew), and ideally we seek an analysis that does not depend on any such representational assumptions on the input (see McCarthy 1995 for OT theory-internal arguments). To demonstrate that in fact it is not a crucial assumption for the proposed analysis, I will assume that the entire noun segmentism is present in the input. Consider, then, the fact that the output verb *kided* does not contain the input vowel of the noun *kod* which has been replaced by the vocalism of the affix. This phenomenon has been formally expressed by a rule which literally substitutes the vocalism of the base with the vocalism of the affix, called 'Melody Overwriting' in McCarthy and Prince (1990a) and Bat-El (1989, 1994).[24] A more principled account for the case at hand is within reach. If all vowels in the input, /o/ of *kod*, and /ie/ of the affix, surfaced in the output, then there would be a violation of the undominated templatic constraint [σ σ] (e.g., as in $c^1vc^2ic^1ec^2$). The vowel of the base does not appear in the output in order to avoid this violation. The fact that no affix vowel gives its place to the base vowel in the output simply motivates the ranking $\text{MAX}^{\text{AFFIX-IO}} \gg \text{MAX-V}^{\text{BASE-IO}}$ (see, among other works, McCarthy and Prince (1994b) and Alderete et al. (1996) for other cases motivating V, C parametrization of the MAX constraint family). I assume $\text{MAX-C}^{\text{BASE-IO}}$ is undominated because all consonants of the base always surface in the output.[25]

• **Locus and choice of copied consonant.** Turning now to the issue of the placement and choice of the copied consonant, note that one difference between the Semitic pattern $c^1i.c^2e\mathbf{c^2}$ and the Temiar patterns $\mathbf{c^1}a.c^1vc^2$ and $\mathbf{c^1c^2}.c^1vc^2$ is that the Temiar copied consonants appear to the left of the base, while in the Semitic pattern they appear to the right. Temiar morphology is exclusively prefixal. For example, the simulfactive affix, a

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[24] The same rule is called 'Substitution' in Steriade (1988). See also Aronoff (1976) who employs a similar rule that "adjusts the vowels" (p. 67).

[25] As pointed out by an anonymous reviewer, it is possible to satisfy bisyllabicity and give every input vowel (/o/ of the noun *kod* 'code', and /i, e/ of the affix) an output correspondent at the same time, as in the candidate [koyde**d**], where the coda [y] corresponds to the input vowel /i/, arguably without even violating $\text{IDENT}^{\text{IO}}(\text{F})$, ∀F. This candidate indicates that $\text{*CODA} \gg \text{MAX-V}^{\text{BASE-IO}}$, a ranking fully consistent with the evidence adduced next for the high-ranked status of *CODA with respect to other relevant constraints.

reduplicant prespecified with the vowel /a/, is required to align with the *left* edge of a prosodic constituent. The Semitic pattern, I propose, instantiates the mirror image of this alignment situation, with the reduplicative morpheme aligned wih the *right* edge of the prosodic output. Specifically, as in the Temiar simulfactive, I assume that the affix which the vocalism /ie/ belongs to is a reduplicative morpheme. This morpheme must be aligned with the right edge of the prosodic output, ALIGN(Affix, R, PrWd, R), henceforth ALIGN^{AFF}-R. The precise realization of this morpheme is left to other constraints of the grammar, and in particular, as shown below, to the constraints determining the prosodic shape of the output.

It is now easy to see why a copied consonant appears at the right edge of the output. ALIGN^{AFF}-R requires that some segment of the affix, perhaps one of the vowels /ie/, appear at the rightmost edge of the output. However, no vowel can appear in final position because of FINAL-C. Hence, an affixal consonant must appear finally, and because the affix is reduplicative that consonant must be a copy of a base consonant. Consider the tableau in (32) below. Since ALIGN^{AFF}-R is undominated, candidates with violations of this constraint such as those in (32a, b, c, d) below are excluded. In all these candidates, the rightmost segment of the reduplicative morpheme, the vowel /e/, is not aligned with the right edge of the output (copied consonants are shown in bold). Constrast these failed candidates with those in (32e, f), where the rightmost segment of the reduplicant, a copied consonant, is aligned with the right edge of the output.

(32) Locus and choice of the copied consonant:
/c^1vc^2, ie^{RED}/ → $c^1i.c^2e\mathbf{c^2}$

Input: c^1vc^2, ie^{RED}	ALIGN^{AFF}-R	ANCHOR-R	SROLE
a. $\mathbf{c^1}i.c^1ec^2$	*	*	
b. $\mathbf{c^2}i.c^1ec^2$	*	*	
c. $c^1i.\mathbf{c^1}ec^2$	*	*	
d. $c^1i.\mathbf{c^2}ec^2$	*	*	*
e. $c^1i.c^2e\mathbf{c^1}$		*	*
f. ☞ $c^1i.c^2e\mathbf{c^2}$			*

What remains to be explained is the choice of the copied consonant, that is, the choice between candidates (32e) and (32f) shown above. In the tableau, I show another constraint, ANCHOR(ING)-R, which requires that the right peripheral element of the reduplicative affix correspond to the right peripheral element of the base (as stated in (25)). This constraint is violated by candidate (32e) because the copied /c^1/ is the leftmost, not the rightmost, segment of the base. Only candidate (32f) satisfies both ANCHOR-R and ALIGN^{AFF}-R, and thus emerges as the unique optimal output.[26]

• **Quantity of copying.** The next theme to examine is the number of copied consonants. Recall that MAX^{BR} demands full copying of the base, a request satisfied rather poorly in the optimal output c^1i.c^2ec^2. MAX^{BR} is in conflict with the bisyllabic limit on the size of the output [σ σ]. This conflict is resolved by the ranking [σ σ] ≫ MAX^{BR}, excluding candidates such as *ki.de.CVC*. A more interesting candidate, ***kid.ked***, with the base consonantism compressed in the first syllable, implies the additional ranking *CODA ≫ MAX^{BR}. Given that FINAL-C ≫ *CODA, as established earlier, the combined ranking of all four constraints is [σ σ], FINAL-C ≫ *CODA ≫ MAX^{BR} (tableaux to follow).

Compare this ranking to that established in Temiar reduplication: ONS ≫ MARKEDNESS ≫ MAX^{BR}. In both cases MAX^{BR} is low ranked. For Temiar, the effect of this ranking is to suppress copying unless it is required by ONS; recall the familiar contrast in the simulfactive aspect between the output of biconsonantals, $\mathbf{c^1}$a.c^1vc^2, where one consonant is copied, versus the output of triconsonantals, c^1a.c^2vc^3, where no consonant is copied.

The Semitic pattern illustrates the same contrast. In the case of a biconsonantal input, *kod* → ***kided***, FINAL-C requires the presence of a final consonant and thus induces copying, because it is ranked higher than *CODA. Lower ranked *CODA bans extra copying when FINAL-C is not at stake, as in the suboptimal candidate ***kidked***. The situation is expressed formally in tableau (33) below. As we move down the column of candidates, each candidate copies one more consonant than the previous one. In (33a), neither of the two consonants of the base is copied, and hence MAX^{BR} is violated maximally. That candidate also incurs a fatal violation of FINAL-C. Obvious 'non-copying' alternatives that satisfy FINAL-C such as [c^1i.ec^2] or [i.c^1ec^2] incur violations of undominated ONS (not shown in the tableau). Improving on the quantity of copying, the second candidate in (33b) copies one consonant. Further optimization in terms of MAX^{BR},

[26] In tableau (32), I do not employ the familiar '!' symbol to mark fatal constraint violations because either of the two rankings ALIGN^{AFF}-R ≫ SROLE or ANCHOR-R ≫ SROLE would suffice to derive the desired effect. Compare this latter ranking to that established in the analysis of Temiar where SROLE dominates ANCHORING.

as in (33c), renders the candidate suboptimal, because it incurs one more violation *CODA than (33b).[27]

(33) One consonant copied for biconsonantals:
$/c^1vc^2$, $ie^{RED}/ \rightarrow c^1i.c^2ec^2$

Input: c^1vc^2, ie^{RED}	FINAL-C	*CODA	MAX^{BR}
a. $c^1i.c^2e$	*!		**
b. ☞ $c^1i.c^2ec^2$		*	*
c. $c^1ic^2.c^1ec^2$		**!	

In contrast, when the input is triconsonantal, there is no copying at all in the optimal candidate, as shown by forms such as *yavan* 'Greece' → *yiven* 'to hellenize', *seder* 'order' → *sider* 'to arrange', *godel* 'size' → *gidel* 'to raise', etc. The following tableau in (34) shows how the ranking *CODA ≫ MAX^{BR} bans alternatives, such as *yiv.nen* 'to hellenize', corresponding to the suboptimal candidate below. The second candidate, with no copying and hence with the maximal violations of MAX^{BR}, surfaces as optimal.[28]

(34) Suppression of copying for triconsonantals:
$/c^1vc^2vc^3$, $ie^{RED}/ \rightarrow c^1i.c^2ec^3$

Input: $c^1vc^2vc^3$, ie^{RED}	FINAL-C	*CODA	MAX^{BR}	ALIGN^{AFF}-R
a. $c^1ic^2.c^3ec^3$		**!	**	
b. ☞ $c^1i.c^2ec^3$		*	***	*

One more ranking can be established from the tableau above. The optimal candidate violates ALIGN^{AFF}-R, because the rightmost segment of the affix, the vowel /e/, is not aligned with the right edge of the output. ALIGN^{AFF}-R is satisfied in the suboptimal candidate, where the rightmost segment of the affix, now the consonant $/c^3/$, is aligned with the right edge

[27] An account in similar terms can be given for the pattern $c^1vc^2.c^1vc^2$, which according to Bat-El (1994) is selected arbitrarily by some biconsonantal verbs of Modern Hebrew: *mišeš* ~ *mišmeš* 'he felt (by touching)', *likek* ~ *liklek* 'to lick', etc. Specifically, I assume that the output template for such verbs is further specified as $[\sigma_{\mu\mu}\,\sigma]$. Modern Hebrew does not permit long vowels, and thus a bimoraic syllable must have a consonantal coda. Assuming the same ranking as with the analysis in the text, $[\sigma_{\mu\mu}\,\sigma]$, FINAL-C ≫ *CODA ≫ MAX^{BR}, the predicted optimal candidate is $c^1vc^2.c^1vc^2$ (see tableau (33)).

[28] Forms like *film* 'film'/*filmem* 'to film' and *flirt* 'flirt'/*flirtet* 'to flirt' show that copying may also be induced by the need to preserve the contiguity of the consonants in noun-final CC clusters. A complete analysis of Hebrew denominalization is beyond the scope of this paper (see Bat-El 1994, Sharvit 1994 for proposals). I believe that the proposed analysis can be constructively extended to handle this additional complication.

of the output. Hence, the ranking between a constraint of the prosody proper, *CODA, and the affixation-specific constraint ALIGN^{AFF}-R is *CODA $\gg$ ALIGN^{AFF}-R.[29]

Summing up, the proposed analysis rids us of a number of special assumptions and mechanisms. Specifically, there is no need for a rule of 'Melody Overwriting', no need for the special representational assumption of V/C planar segregation, no need for the exceptional mechanism of LDC-spreading, and finally, no need for the previously distinct mode of word formation whereby segments are directionally mapped onto templates. In (35) below, I show the main rankings as established in the analysis.

(35) Basic rankings

'Melody Overwriting'	[σ σ], MAX$^{AFF\text{-}IO}$>> MAX-V $^{BASE\text{-}IO}$
Shape and quantity of copying	ONS, [σ σ], FINAL-C>>*CODA>>MAX^{BR}
Affixation-specific constraints	*CODA>>ALIGN^{AFF}-R, ANCHOR-R>>SROLE

Perhaps the most conspicuous characteristic of Semitic morphophonology, the interdigitation of the root consonantism with the vocalic affix, emerges from the interaction of basic prosodic constraints (ONS, *CODA), templatic constraints on the particular output ([σ σ], FINAL-C), and ordinary affixation constraints (ALIGN^{AFF}-R). The formal means of the grammar employed in the analysis, that is, the representations and the constraints, are no different from those used in the analyses of languages with concatenative morphophonologies.

A possible objection to the above analysis must be considered. One may argue that the analysis employs reduplication even in cases where the semantic correlates that usually go with reduplicative constructions are not found.[30] To illustrate, in Modern Hebrew, the final-syllable reduplication pattern, $c^1v.c^2vc^3.\mathbf{c^2vc^3}$, often carries a diminutive meaning, as

[29] Consider the fact that biliterals show copying but triliterals do not in the context of Angoujard's (1988) proposal which has the same goal of eliminating LDC-spreading. That proposal derives copying in the biliterals by marking the final position of the CVCVC template as being a 'reduplicative' consonant (1988, p. 10). This essentially stipulates the number of copied consonants and the shape of the reduplicative affix, both derivable properties of the output, as shown in the current proposal. Perhaps a more serious problem with that proposal is that triliteral roots do not show copying when mapped onto the same CVCVC template. This issue is not addressed in Angoujard's article.

[30] In Semitic and elsewhere reduplication may indicate, among other things, diminution, repetition, continuation, intensification, increase, plural, collective, etc.

shown by words like *k(a)tantan*[31] 'very little' from *katan* 'little', and *k(a)-lavlav* 'little dog' from *kelev* 'dog'. In contrast, the $c^1vc^2vc^2$ pattern is attested with no shared semantic function for nouns and verbs like *ʔaviv* 'spring', *clil* 'sound', *bazaz* 'he looted', *kilel*, 'he cursed'. In the theory admitting both LDC-spreading and reduplication, the first pattern has been analyzed using reduplication and the second using LDC-spreading (e.g., the analysis of the corresponding Tiberian Hebrew patterns in McCarthy 1979, 1981). If, following the current proposal, both are analyzed as reduplication, then the correlation between the diminutive semantics of the first pattern and the employment of the formal mechanism of reduplication is lost.

In evaluating this possible objection, the question to ask is whether there is truly such a correlation between the formal mechanism of reduplication and the semantics of a pattern, and then, if we are convinced that such a correlation exists, we should ask whether it is important that it be maintained by not extending the formal means of reduplication to words that do not have the expected semantics. It turns out that although there may be a correlation between the formal mechanism of reduplication and the semantics of the corresponding copying pattern, that correlation is far from perfect. For Hebrew, in particular, Bat-El (1989: p. 78) points out that the final syllable copying pattern $c^1v.c^2vc^3.\mathbf{c^2vc^3}$ is indeed commonly used for diminutives, but diminutive meanings are also found with the pattern that would employ LDC-spreading, as shown by examples like *kofif* 'little monkey', from *kof* 'monkey', and *karir* 'cool' from *kar* 'cold'. At the same time, there are words which exhibit the pattern of final syllable copying but are not diminutives: *ʔasafsuf* 'crowd' (*ʔasaf* 'to gather'), *šravrav* 'plumber'. Bat-El (1989) concludes that "it is impossible to identify these shapes [and, as a result, the formal mechanism employed in their analyses: DG] with any coherent semantic property due to the vast number of forms which do not fall into this [semantic] category" (p. 79).[32]

In fact, the failure to find a significant correlation between the formal mechanism of reduplication and the semantics of a pattern is not one of degree. Even with patterns that consistently have a meaning that usually goes with reduplication, we can show that the presence of that meaning has nothing to do with the formal means employed in the analysis of that

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[31] The first /a/ is in parentheses because it is often not pronounced due to the reduction of CVCVC- to CCVC- that takes place before a final stressed syllable in Hebrew (Prince 1987, p. 505).

[32] See Bat-El (1989) for further discussion of these forms and additional arguments from Modern Hebrew.

pattern (e.g., with reduplication *per se*). Consider, for instance, the local-movement CC{ɔ, a}CəC template of Chaha (Prunet 1996, sec. 3.2), with examples of roots mapped onto that template shown in (36) below. There are about 68 roots that select this template, and according to Prunet (1996), they all express "movement (of light, sound, or body)" (sec. 3.2). In addition, a notion of iterativity is associated with these words (which may not be directly reflected in the English glosses).[33]

(36)

Chaha 'local movement' template			*Formal mechanism employed*
a. Biliteral:	a-n-fɨqəfəq	'scrape flesh off'	Total root (/fq/) reduplication
b. Triliteral:	a-n-kirətət	'incline'	LDC-spreading of final C(/t/)
c. Quadriliteral:	a-n-zɨwat'ər	'stretch'	None of the above

A standard analysis of how roots map onto the template (e.g., Prunet 1996) can be given along the following lines: biliteral roots map onto the template by reduplicating entirely, as in (36a), triliterals spread one consonant onto two C positions, (36b), and quadriliterals map onto the template without any special modification, that is, without using LDC-spreading or reduplication, (36c). Clearly, the meaning of iterativity is a property that must be ascribed to the template itself, not to the formal mechanism employed in any analysis of how roots map onto the template.

Once we dissociate the formal mechanism of reduplication from any particular semantics, we can extend the proposed analysis of the $c^1vc^2vc^2$ pattern to underived nominal and verbal stems such as *ʔaviv* 'spring', *bazaz* 'he looted', *kilel* 'he cursed' that follow that pattern. *ʔaviv* 'spring', for instance, is constructed from the consonantal root /ʔv/ and the vocalism /ai^{RED}/, as in the analysis above.[34] The fact that the idiosyncratic vocalism in *ʔaviv* 'spring', or what is called the affix in the proposed analysis, has no recurring identifiable meaning is not a problem. Meaningless morphemes do exist.

In the English lexicon, for example, there is a well-defined subclass of latinate verbs which consist of a prefix-bound root combination, in which

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[33] Two things should be noted about these forms. First, the vowel after the second C in the template is unpredictably /a/ or /ɔ/ (a-n-zɨwa̠t'ər vs. a-n-fɨqɔ̠fɔq), and second, the triliterals exhibit an additional pattern, where two instances of the second consonant appear in the two medial positions (see Prunet 1996).

[34] By 'constructed' I mean the following. Abstracting away from terminology specific to rule-based theories of morphophonology, we can think of the grammar of stem formation as expressing a word formation process in the sense of Aronoff (1976): "I do not view these rules as applying every time the speaker of a language speaks. They are rules for making up new words which may be added to the speaker's lexicon. We can think of them as once-only rules" (p. 22).

neither the prefix nor the root can be ascribed any fixed meaning. The set of prefixes includes: *re-*, *con-*, *in-*, and *de-*. The set of roots includes: *-fer*, *-mit*, *-sume*, *-ceive*, and *-duce*. Verbs are constructed by combining a prefix from the first set with a root from the second set: *refer*, *remit*, *resume*, *confer*, *commit*, *consume*, etc. By considering combinations of a single prefix, say *re-*, with different roots, and combinations of a single root, say *-duce*, with different prefixes, Aronoff (1976, pp. 11–15) shows that both the prefix *re-* and the root *-duce* have no fixed meaning. In the Semitic lexicon, then, the affix /-ai^{RED}/ of *ʔaviv* 'spring' has the same status as the affix /re-/ of *reduce*. They are both meaningless morphemes that combine with roots to form words of a major class category. Moreover, as established in the analysis of the Semitic pattern $c^1vc^2vc^2$ above, the formal means of that combination in Semitic are not distinct from those needed in English.[35]

The discussion up to now has been concerned with the basic analysis of certain Semitic patterns where LDC-spreading was thought necessary. In other words, the argument has so far been that a reduplication-only analysis suffices. Below I turn to the second part of the argument which is to show that the reduplication-only analysis is superior to the 'LDC-spreading + reduplication' analysis.

The Chaha set of data discussed above bears on this issue. Recall that the LDC-spreading + reduplication analysis of that data includes statements along the lines of 'biliterals employ reduplication', and 'triliterals employ LDC-spreading' (e.g., Prunet 1996). In such an analysis, the choice of the formal mechanism is apparently conditioned by the number of consonants in the root. This is a dilemma for the reduplication + LDC-spreading analysis: why should the number of consonants in the root determine the formal means of mapping these consonants onto the template?

This dilemma does not exist under the proposed analysis. It is a virtue of that analysis that it makes no reference to the number of consonants

[35] One notable difference of course between the English /re-/ and the Hebrew /-ai^{RED}/ is that the latter affix is reduplicative. That simply means that there is a segmental dependency between it and the root it attaches to, (or, more formally, that there is a correspondence relation between it and the root), which, depending on the relative size of the root and the template, may sometimes induce copying in a systematic way (namely, for a CVCVC template, 0 consonants are copied for triliterals, and 1 consonant is copied for biliterals). Needless to say, it is precisely this systematicity that motivates an analysis of such underived stems.

in order to determine the form of the output. Irrespective of the number of root consonants, a unique formal mechanism is employed: reduplication induced by correspondence constraints. The number of copied consonants in the patterns $c^1vc^2.\mathbf{c^1vc^2}/c^1v.c^2\mathbf{vc^2}/c^1v.c^2vc^3$, two, one, and zero respectively, was seen to derive from the grammar, without any stipulations. Specifically, that number is determined by the interaction of independently necessary constraints on the size of the output ([σ σ]), constraints of the prosody proper (*CODA), and reduplication specific constraints (MAX^{BR}).

Stipulation would perhaps be minimized in the LDC-spreading + reduplication analysis, if one could argue that the LDC-spreading mechanism employed for triliterals, as well as the simple one-to-one association of quadriliterals to the CC{ɔ, a}CəC template, are just part of the default mapping-to-template mechanism of the grammar. More precisely, one would stipulate that biliterals reduplicate when mapped to the CC{ɔ, a}CɔC template, as in C^1C^2{ɔ, a}$\mathbf{C^1}$ə$\mathbf{C^2}$. Triliterals and quadriliterals would map onto the template by (directionally parametrized) left-to-right association, and when an empty templatic position remained after the left-to-right association sweep, as in the case of triliterals, LDC-spreading would apply to fill it in. The option taken with triliterals and quadriliterals would be the default one, and hence it would not have to be stipulated.

This approach, however, is not defensible. We can show that LDC-spreading cannot simply be the default mechanism for filling empty positions. Sierra Miwok, a Penutian language of California (Freeland 1951, Smith 1985, Goldsmith 1990), shows that epenthesis of a default consonant is another mechanism available to the grammar for the same purpose.[36]

The Sierra Miwok verbal system includes three types of stems: type I stems with the template CVCVVC (e.g., *kicaaw* 'to bleed'); type II, with a CVCCV template (e.g., *celku* 'to quit'); and type III, with a CVCCV template, where the medial consonant is a geminate (e.g., *hamme* 'to bury'). Examples are shown in (37). In addition to these *basic stem* types, there are three modified forms that can be found for each stem. Freeland calls these the *second*, *third*, and *fourth* stems. The second stem has the template CVCV$\underline{\text{CC}}$ with a final geminate, the third has the template CV $\underline{\text{CC}}$VC with a medial geminate, and the fourth has the template CVCCV where the second and third consonants are not identical.

[36] Precisely this point is also made by Broselow (1984) for the root-and-pattern system of Amharic, an Ethiopian Semitic language. See also Pulleyblank (1986) who makes the same point for tonal phenomena.

(37)	Basic Stem	Second Stem CVCVCC	Third Stem CVCCVC	Fourth Stem CVCCV	Gloss
Type I	kicaaw	kicaww	kiccaw	kicwa	'bleed'
	hutcel	hutell	huttel	hutle	'roll'
Type II	celku	celukk	celluk	celku	'quit'
	nakpa	nakapp	nappak	nakpa	'catch up with'
Type III	hamme	hameʔʔ	hammeʔ	hamʔe	'bury'
	liwwa	liwaʔʔ	liwwaʔ	liwʔa	'speak'

In Goldsmith (1990, pp. 83–95), this root-and-pattern system is analyzed as employing V/C planar segregation. The details of that analysis are not of interest here. What is relevant for current purposes is the behavior of type III stems: when these biconsonantal stems appear in the second, third, and fourth stem forms (CVCVCC, CVCCVC, and CVCCV respectively), the extra consonantal positions of the corresponding template are filled by epenthesis of a default /ʔ/ consonant (with local gemination in the underlined CC clusters). Apparently the LDC-spreading option is never taken (e.g., the second stem of *hamme* 'bury' is *hameʔʔ*, not **hamemm*).

Considering both the Chaha and Sierra Miwok data, we find that to fill empty positions in a template, in Chaha, some roots employ LDC-spreading, whereas, in Sierra Miwok, some roots employ epenthesis of a default consonant. This distinction must be captured, and it certainly can be captured in the LDC-spreading + reduplication analysis by simple stipulation, but then it follows that the fact that LDC-spreading applies in the Chaha analysis must be specified. It could not be left as the universal default.[37] Hence, the dilemma with the LDC-spreading + reduplication analysis of the Chaha data, where the choice of the formal mechanism for creating copies of consonants was conditioned by the number of consonants in the root, remains unsolved.

We are now in a position to point out another crucial difference between the present proposal and that of Bat-El (1989, 1994). The goal is the same: to eliminate LDC-spreading by reducing it to copying. For Bat-El, however, copying derives from the requirement to fill empty templatic positions, known as the principle of 'Template Satisfaction' (McCarthy and Prince 1990a). Simply resorting to Template Satisfaction as the

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[37] Recall from section 3.2 that for copying to take place, the following ranking was inferred for Temiar: DEP^{BR} ≫ MARKEDNESS (i.e., *PL/LAB, *PL/DOR ≫ *PL/COR ≫ *PL/PHAR). If MARKEDNESS ≫ DEP^{BR}, instead, then epenthesis of an unmarked consonant (as opposed to copying of root/base consonants) emerges as the mechanism of filling positions in the template. This is one approach to how one can capture the distinction between languages where copying is employed (Temiar, Hebrew, Chaha) and those where epenthesis of a default is employed (Amharic, Sierra Miwok) to fill empty positions.

motivation for copying is not enough, because the means of Template Satisfaction are not unique. Any analysis must capture the distinction between copying and epenthesis. The analysis proposed here does this by establishing the ranking $\text{DEP}^{BR} \gg$ MARKEDNESS which results in copying as opposed to epenthesis (see section 3.2).

Another interesting aspect of the Sierra Miwok data provides the closing argument. A generalization that stands out from the table of stems in (37) is that the long-distance geminate, the result of LDC-spreading, is not permitted, but crucially the local geminate is clearly admitted (e.g., *kicaww*, *nappak*, etc.). Under V/C planar segregation, both types of geminates are the result of a rule of spreading: spread the Root of a consonant to the next empty C position. If LDC-spreading exists, then, in the grammar of Sierra Miwok, one must stipulate that spreading is admitted when its output configuration would be a local geminate, but disallowed when the output would be a long-distance geminate. That such a distinction must be stated in the grammar of a language is a mystery in the theory that admits LDC-spreading.[38]

This concludes the argument. In sum, Semitic copying can be analyzed without LDC-spreading. In so doing, the analysis does away with an array of special assumptions and mechanisms that have been thought necessary, and at the same time it avoids a number of problems with the LDC-spreading + reduplication analysis.

4.2. *OCP Effects and Geminate Roots*

I now turn to another case where LDC-spreading was also thought to be crucially involved: the explanation of certain cooccurrence constraints on the consonants of Semitic roots. Taking Arabic as the example, the language has an absolute prohibition against the so-called 'geminate' roots beginning with two identical initial consonants, as in **sasam*, although it

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[38] The examples in Goldsmith (1990, p. 85) include the verbal stem *patiit* 'take', where it appears that another instance of the second stem consonant is in the final position. This is a typo. The actual form in Freeland (1951) has a dental final [ṭ]. It is crucial for the argument in the text that no such forms with what appears to be the result of LDC-spreading exist. Indeed, I have been able to find only two forms in Freeland (1951) that could be interpreted as having non-adjacent repetitions of a single stem consonant. These are the verbs *nanni-* 'to find' and *kook-* 'to eat clover'. When forms with identical non-adjacent consonants are found regularly, what appears to be another instance of the final stem consonant is in fact an independent suffix. For example, with the denominalizer suffix /-t/, along with *hiwwa-* 'swift, a swift runner', *hiwaa-t-* 'to run', and *molli-* 'shade', *molii-t-* 'to become shady or dusk', one also finds *cittu-ma-* 'having something in the eye', *cituu-t-* 'to remove something from the eye', where the stem-final consonant and the suffix consonant are identical.

appears to allow roots ending with two identical consonants, as in *samam* (Cantineau 1946, Greenberg 1950, McCarthy 1979, 1986).[39] This skewed distribution is explained in McCarthy (1979, p. 263) on the basis of two assumptions. First, underlying forms are subject to the Obligatory Contour Principle (OCP), which prohibits roots with two *adjacent* identical consonants (e.g., **ssm*, **smm*). Hence, the underlying form of *samam* must be *sm*. Second, in 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 unavailable under the present proposals for two reasons. The first is that in OT constraints applying strictly on underlying forms, such as the original conception of the OCP in the first assumption above, are not part of the grammar. The second reason is that I have argued that LDC-spreading, the mechanism employed under the second assumption above, should be eliminated from phonological theory.[40]

An alternative explanation for the skewed distribution of the geminate roots is available in the present context. This explanation crucially rests on one key aspect of McCarthy's original analysis, which was that the OCP applies only for identical segments *within a morpheme* (McCarthy 1979, p. 237), the latter condition motivated by the existence of forms like the eighth binyan *ktatab*, where the first affixal /t/ freely combines with the root *ktb*. The important shift in perspective is that the OCP is viewed as a constraint on the output instead of on the underlying form. Recall that the stem formation process that results in the copying seen in the $c^1vc^2v\mathbf{c^2}$ pattern consists of suffixation of a reduplicative affix realized with a copy of /c^2/. The crucial point is that the two instances of /c^2/ in the output will not incur an OCP violation because the first instance of /c^2/ is part of the root and the second instance of /c^2/ is part of the reduplicative affix, two different morphemes in the output. Turning to the non-permitted $c^1vc^1vc^2$ pattern, the only way that this pattern could sur-

[39] There are exceptions. Especially in the Ethiopic branch of Semitic, there are languages that exhibit the pattern, *sasam*, that the standard OCP explanation (about to be given) attempts to exclude. In Amharic, for instance, one finds roots like *sst* 'be greedy' with a left-aligned sequence of two identical consonants (see Broselow 1984 for discussion). The alternative analysis of the geminate roots to be given here should thus be taken as follows: if there is to be an explanation for the patterning of geminate roots in OCP terms, then resorting to LDC-spreading is not a necessary part of that explanation.

[40] Before proceeding, I should point out that a significant body of subsequent research (Mester 1986, McCarthy 1988, 1994b, Yip 1988, 1989, Padgett 1992, Pierrehumbert 1993) has extended the role of the OCP to cooccurrence restrictions on homorganic but nonidentical consonants, also known as the "place" OCP effects. LDC-spreading is not involved in the analysis of such effects, so in what follows I will be concerned solely with the treatment of the geminate roots.

face would be from a triconsonantal root with two identical first consonants (i.e., $c^1c^1c^2$), because there is no corresponding stem formation process that includes a reduplicative prefix to create a copy of /c^1/. The output form $c^1vc^1vc^2$, then, would incur a violation of the OCP, because the two instances of /c^1/ would have to be part of the same morpheme. Assuming that the OCP is undominated, that violation would be fatal and the null parse would be preferred (see Prince and Smolensky 1993, pp. 48ff. for a discussion of the null parse).

In the revised explanation above, I have assumed that the OCP applies to outputs, so that a surface form like *sasam* incurs a violation of the synonymous constraint despite the presence of the intervening vowel between the two consonants. The original statement of the OCP, it will be recalled, marks a violation of the principle only if the two identical consonants are adjacent, as they would be in the hypothetical input *ssm*. This locality condition in the statement of the OCP must be abandoned in the revised explanation; in *sasam* the vowel /a/ intervenes between the two identical consonants, since I have not assumed V/C planar segregation. In fact, abandoning the string-adjacency requirement is independently motivated, as shown by other work on the OCP. OCP effects have been observed in Russian (Padgett 1992) and English (Berkley 1994), languages where consonants separated by vowels are not adjacent in either OT or non-OT conceptions of representations (surface or underlying).[41]

To sum up, the proposed analysis of the patterning of the geminate roots in Semitic requires no use of V/C planar segregation or LDC-spreading. This result further secures the conclusion that LDC-spreading and V/C planar segregation can and should be eliminated as previous sections of this paper have demonstrated.

[41] Crucially, tier-segregation below the Root node also will not do for these languages (see Pierrehumbert 1993, Berkley 1994). These works suggest that some notion of distance is involved. On the other hand, Padgett (1992), Selkirk (1993), and McCarthy and Prince (1995a sec. 5.1) suggest that a more articulate version of identity is needed. These works, then, show that OCP violations are computed on two dimensions: one is the degree of similarity between two segments, and the other is some notion of distance between the two segments. Clearly further research in this area is needed, but in any case the revised explanation for geminate roots offered above, while maintaining a key aspect of McCarthy's original proposal, abandons the requirement for string-adjacency, a move that seems consistent with current wisdom on the proper treatment of the OCP.

5. Apparent LDC-spreading in Consonantal Across-the-Board Effects

Another argument for the existence of LDC-spreading is thought to derive from phenomena where a phonological process targeting only one consonant in a C_1VC_2 configuration ends up affecting both consonants in the symmetric C_1VC_1 configuration. This is so because, the argument goes, the process affects the single Root node doubly linked to the two C positions across the V in the symmetric configuration. Such effects have been called across-the-board (ATB) effects. The discussion here has two goals. First, assuming no LDC-spreading and building on McCarthy and Prince (1995a), I show that ATB effects can be straightforwardly reanalyzed as an instance of overapplication in Correspondence Theory. Then, I show that in contrast to the theory admitting LDC-spreading, the proposed theory without LDC-spreading predicts all and only the attested types of ATB effects in different languages.

A simple case of an ATB effect serves to illustrate the phenomenon and the approach I will be taking. The language is Yoruba, and the process of interest is 'Denasalization', which changes an [n] into an [l] before non-high vowels (see (38); data from Pulleyblank 1988). For instance, /ni owo/ 'have money', in (38f) below, surfaces as [lowo], after the resolution of hiatus (in connected speech only) has created the environment for the application of Denasalization.[42]

(38) a.	/ni irun/	→	nirun	'have hair'
b.	/ni eti/	→	leti	'in, at ear'
c.	/ni ẹnu/	→	lẹnu	'in, at mouth'
d.	/ni aṣọ/	→	laṣọ	'have cloth'
e.	/ni ọja/	→	lọja	'in, at market'
f.	/ni owo/	→	lowo	'have money'

The ATB effect occurs in the gerundive construction, which involves affixation of a Ci prefix, where the empty C position is to be filled with some consonant: input /Ci + ni owo/ surfaces as [lilowo] 'having money', *[nilowo], where both consonants undergo denasalization.

In the analysis of Pulleyblank (1988), the ATB effect is a consequence of the assumption that the duplication of the consonant is due to LDC-spreading. Specifically, denasalization affects the Root node of /l/, which

[42] Denasalization does not apply to /m/ (e.g., /mu ẹru/ → [mẹru]), as pointed out by Pulleyblank (1988, p. 252) and Michael Kenstowicz (p.c., May 15, 1997). See also Ladefoged (1968) for relevant discussion.

is linked to the two C positions, and hence the effects of the rule surface on these two C positions.

Following McCarthy and Prince (1995a), I propose to reanalyze the Yoruba ATB effect as a case of reduplicative overapplication. The core idea is that a correspondence relation between the target of Denasalization in the base and its image in the reduplicant requires, among other things, featural identity between the two correspondent segments. If Denasalization applies to a base segment, then its effects must be reflected on the correspondent segment in the reduplicant in order to satisfy the featural identity requirement. In other words, Denasalization 'overapplies' to the correspondent in the reduplicant. Tableau (39) shows the ranking of the relevant constraints that yield overapplication with a representative set of candidates. The constraints involved are the two basic correspondence constraints, IDENT^{IO}(F) and IDENT^{BR}(F), where F is the feature [nasal], and the constraint DENASAL, employed here as a cover name for whatever constraints enforce denasalization. Without affecting the validity of the argument, I also put aside the constraints enforcing resolution of hiatus. The intended target of denalization in the base is shown italicized.

(39) DENASAL $\gg$ IDENT^{IO}([nasal]), IDENT^{BR}([nasal])

Ci, ni, owo	DENASAL	IDENT^{BR} (nasal)	IDENT^{IO} (nasal)
a. ni *n*owo	*!		
b. ni *l*owo		*!	*
c. ☞ li *l*owo			*

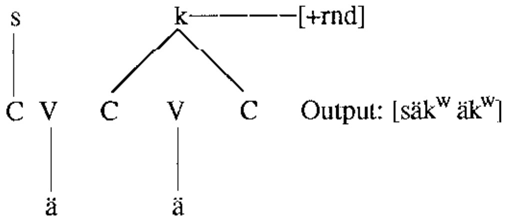
All aspiring candidates must satisfy the undominated DENASAL. Candidate (39a) fails to do this, whereas the other two candidates succeed. Satisfaction of DENASAL implies violation of IDENT^{IO} (nasal) as shown for both (39b) and (39c). The former candidate also fails to respect the featural identity requirement IDENT^{BR} (nasal) between the successfully denasalized base /l/ and its correspondent /n/ in the reduplicant. Hence, (39c) emerges as the optimal output. (See McCarthy and Prince 1995a for extensive argumentation supporting this general approach to overapplication.)

So far I have shown that it is possible to capture ATB effects without resort to LDC-spreading. I now turn to the second goal which is to show that the proposed approach in fact does better than the earlier one. I begin by reviewing another well-known ATB effect in the Ethiopian Semitic language Chaha, which, crucially for the ensuing argument, is claimed to employ both LDC-spreading and reduplication. The Chaha verb marks certain morphological categories by the assignment of the feature of labialization to the rightmost labializable consonant (velar, labial). Examples of labialization in the formation of the impersonal stem are shown in (40). The data are drawn from McCarthy (1983).[43]

(40) Bi-/Tri-literals with CVCVC template[44]

	Personal	*Impersonal*	
a.	dänäg	dänäg^{w}	'hit'
b.	näkäs	näk^{w}äs	'bit'
c.	mäsär	m^{w}äsär	'seem'
d.	säkäk	säk^{w}äk^{w}	'plant in ground'
e.	gämäm	gäm^{w}äm^{w}	'chip the rim'

Ex. (d):



The ATB cases are those in (40d,e). When biliteral roots are 'mapped' onto a CVCVC template, labialization surfaces in both instances of the copied segment. In the analysis proposed in McCarthy (1983) this is a direct consequence of double linking. As shown in the representation for 'plant in ground', the rule of labialization affects the rightmost labializable Root node which is linked to two C positions. When Tier Conflation applies to linearize the representation, the geminate splits into two identical and independent Root nodes, hence the ATB effect in the output [säk^{w}äk^{w}].

This ATB effect is also analyzable as reduplicative overapplication. Building on the analysis of the previous section, I assume that the copied consonant in the pattern $c^{1}vc^{2}vc^{2}$ is the result of reduplication. Hence, a correspondence relation exists between the copied segment and its image, requiring their identity for every feature and in particular for [round],

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[43] Scobbie (1991, sec. 6.3) argues against the long-distance geminate and V/C planar segregation in Chaha. However, no alternative solution to ATB effects has been offered there, or anywhere else, so far as I know.

[44] Jean-François Prunet and Sharon Rose (p.c., May 15, 1997 and March 12, 1996, respectively) point out to me that the data from McCarthy (1983) abstract away from other systematicities of the language that are not relevant to labialization. See Rose (1994) for some relevant discussion.

IDENT^{BR}(rnd). I also assume an alignment constraint, LABIALIZE, which, echoing the formulation of the Labialization rule in McCarthy (1983), requires the [+rnd] feature-morpheme to be aligned with the right edge of the output. The overapplication ranking and a set of candidates are shown in (41) below.[45]

(41) LABIALIZE, IDENT^{BR}(rnd) $\gg$ IDENT^{IO}(rnd)

sk, ää^{RED},[+rnd]^{Af}	IDENT^{BR}(rnd)	LABIALIZE	IDENT^{IO}(rnd)
a. säkäk^{w}	*!		
b. säkäk		*!	
c. ☞ säk^{w}äk^{w}			*

The situation is slightly different from that in Yoruba. Here the morphophonological process affects a segment in the reduplicant, not in the base. In terms of ranking, unlike the case of Yoruba where IDENT^{BR} could be ranked anywhere with respect to IDENT^{IO}, in Chaha IDENT^{BR} must outrank IDENT^{IO}. Otherwise, if IDENT^{IO} $\gg$ IDENT^{BR}, then [säkäk^{w}] would emerge as optimal, because /k/'s preserving identity with the input would be more important than being identical to its reduplicated image, which labialization targets. In the terminology of McCarthy and Prince (1995a), the latter ranking results in 'normal application', as opposed to the overapplication ranking shown in (41) above.

In Chaha, ATB effects are attested also for what are known as 'reduplicated biliterals', that is, biliterals mapped onto a template with four C positions. Examples are given in (42) below together with the representation of the output [səx^{w}äsäx^{w}]. Data is drawn from McCarthy (1983, pp. 179, 182).

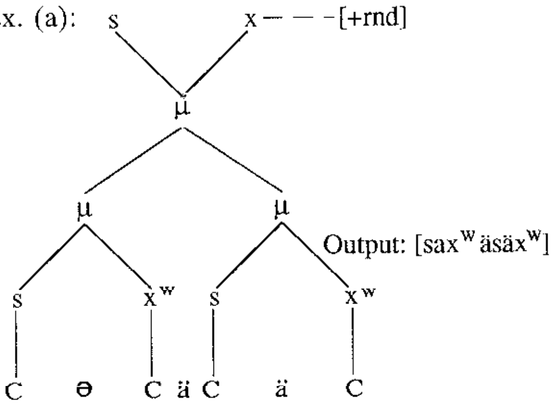
(42) Biliterals with CVCVCVC template

	Personal	*Impersonal*	
a.	səxäsäx	səx^{w}äsäx^{w}	'shell by grinding'
b.	nəqänäq	nəq^{w}änäq^{w}	'shake'
c.	dəfädäf	dəf^{w}ädäf^{w}	'press slightly'
d.	səbäsäb	səb^{w}äsäb^{w}	'gather'[46]
e.	təmatam	təm^{w}atam^{w}	'wind down'

[45] I have put aside the markedness constraints that determine the potential targets of labialization and alternative realizations of the [+rnd] feature, both independent matters that have been treated elsewhere (McCarthy 1983, Zoll 1996).

[46] Thanks to Jean-François Prunet for pointing out that 'gather' should be transcribed, more accurately, as (personal) base [səβäsäβ], and impersonal [səwäsäw]. Irrespective of how the /β/ → /w/ change is to be effected, it is clear that labialization (or, more accurately here, dorsalization) affects both instances of the labializable consonant /β/.

Ex. (a):



Labialization applies to the segments of the original root morpheme, as illustrated for 'shell by grinding' above. The effects of labialization are then inherited by the two copies of the root, which are created as a response to the demands of the morphemic template [μ μ].

Hence in the theory admitting both LDC-spreading and reduplication, the Chaha ATB effects are attested irrespective of the mechanism employed to create copies of consonants, LDC-spreading in the CVCVC template and reduplication proper in the CVCVCVC template. For the sake of the argument, consider applying the same LDC-spreading + reduplication analysis to a language that does not exhibit ATB effects (e.g., an input {säkäk, [rnd]} surfaces as [säkäkʷ]). The South Ethiopian language Ennemor (Peripheral Western Gurage) instantiates the situation we seek. This language, in fact, has two dialects with respect to the facts of labialization. The first, Ennemor^{ATB}, is like Chaha in showing ATB effects in both the (yɨ-)CVCVCV and (yɨ-)CVCVCVCV templates (Hetzron and Marcos 1966, p. 2). The second, Ennemor$^{\cancel{ATB}}$, shows no ATB effects in either the (yi)CVCVCV or the (yɨ-)CVCVCVCV template (Prunet 1991, p. 1238). Data from Ennemor$^{\cancel{ATB}}$ are shown in (43) below. Labialization, marking the Impersonal Present, targets a consonant but surfaces in different ways depending on context. When the target consonant is followed by a high vowel, labialization surfaces as a secondary articulation on the consonant, as in (43a, b). When the targeted consonant is followed by a central vowel, /ʌ, ɨ/, it rounds it (e.g., /qɨ/ → [qu], in (43c)), with optional off-gliding of the consonant (i.e., /qɨ/ → [qʷu]). Finally, as in Chaha, labialization turns /β/ into [w], in (43d). Under the Impersonal Present forms, I have underlined the stretch of sounds that are affected by the labialization.

(43) Ennemor$^{\cancel{\text{ATB}}}$

	Present	*Impersonal Present*	
a.	yɨṭʌqɨq	yɨṭʌqɨq^{w}i	'be weak'
b.	yɨfʌgɨg	yɨfʌgɨg^{w}i	'die (animal) unslaughtered'
c.	yɨqɨrʌqɨr	yɨqɨrʌquri	'move'
d.	yisiβʌsiβ	yisiβʌsiwi	'accumulate'

The forms in (43a, b) are biliterals on the (yɨ-)CVCVCV template, and the other two in (43c, d) are biliterals on the (yɨ-)CVCVCVCV template. To capture the absence of ATB effects in these two templates of Ennemor$^{\cancel{\text{ATB}}}$ the LDC-spreading + reduplication analysis requires two unrelated stipulations. The first is that labialization applies after Tier Conflation, which splits the doubly linked structure created by LDC-spreading, in effect blocking ATB effects in the (yɨ-)CVCVCV template. The second stipulation is specific to the application of labialization in the (yɨ-)CVCVCVCV template. Here labialization applies in the second root copy of the morphemic template [μ μ], not at the original root copy $\boldsymbol{\mu}$, as would be the case for Chaha and Ennemor$^{\text{ATB}}$ (see the representation in (42a)). No relation between these two stipulations exists, or indeed could be claimed to exist. It is purely accidental that in both templates there is no ATB effect. In contrast, in the reduplication-only analysis proposed here, the absence of ATB effects in both templates of Ennemor$^{\text{ATB}}$ is derived singlehandedly by one constraint ranking, the normal application ranking discussed earlier (Labialize, Ident^{IO}(rnd) $\gg$ Ident^{BR}(rnd)). No additional stipulations are necessary for the case of the (yɨ-)CVCVCVCV template.

Raising the argument beyond simplicity considerations, consider also the typological predictions of the two competing analyses. Because the LDC-spreading + reduplication analysis employs two distinct copying mechanisms, it predicts a language with ATB effects on the CVCVC template, where LDC-spreading would apply, but no ATB effects on the CVCVCVC template, where reduplication applies, or vice versa. No such languages are known, however. The reduplication-only analysis, in contrast, predicts uniformity of ATB effects across templates. This is precisely what we find: ATB effects in both CVCVC and CVCVCVC (e.g., Chaha, Ennemor$^{\text{ATB}}$), and no ATB effects in either template (e.g., Ennemor$^{\cancel{\text{ATB}}}$).

This completes the construction of both parts of the argument. In the first part, I have shown how ATB effects, previously thought to support LDC-spreading, can be analyzed as an instance of reduplicative overapplication. In the second part, I have shown that in contrast to the theory admitting two copying mechanisms, LDC-spreading and reduplication, the theory without LDC-spreading makes empirical predictions which are confirmed.[47] Once again the familiar conclusion is reached: the theory without LDC-spreading is more constrained while at the same time also more explanatory.

6. Implications of the elimination of LDC-spreading

In this section, I consider the implications of the elimination of LDC-spreading by focusing on what is perhaps the most immediate issue that arises from this elimination: if LDC-spreading has no place in the grammar, then what sources of support, if any, remain for its geometric prerequisite of V/C planar segregation.

In addressing this question, I discuss two sources of motivation that have been used in support for V/C planar segregation, the so-called 'phonological' one and the 'morphological' one, in that order. McCarthy (1989) has argued that V/C planar 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). The crucial assumption on which this argument rests is that underlying representation must contain only unpredictable information. In recent literature, there has been considerable work undermining the validity of this assumption, however, especially in OT and Burzio's constraint-based framework (Prince and Smolensky 1993, chapter 9; Burzio 1994; Inkelas 1995; Itô, Mester and Padgett 1996; McCarthy 1995; see also Steriade 1995). The basic idea emerging from this work is that properties of lexical forms are not the result of arbitrary conditions on these forms, such as

[47] Along with consonantal ATB effects discussed here there are also vocalic ATB effects between two identical vowels in a VCV sequence. Examples include Javanese laxing and rounding (Dudas 1975, Kenstowicz 1986) and Gashowu Yawelmani (now Yowlumne) lowering (Kuroda 1967, Archangeli 1985, Steriade 1986, Prince 1987). Examination of these effects is beyond the scope of this paper, as they have not been analyzed by using LDC-spreading, but instead long-distance vowel-to-vowel spreading. One approach to such effects would be to follow a similar strategy as with consonantal ATB effects, that is, argue that vocalic ATB effects follow from a correspondence relation holding between the two vowels. A second approach, in fact, exists which is unavailable fo the case of consonantal ATB effects for reasons outlined in section 2. Essentially following past analyses of such phenomena that assume multiple linking (e.g., Kenstowicz 1986), we may argue that the VCV sequence involves sharing of the vocalic features not only by the two vowels but also by the consonant, recasting those analyses under strict locality of spreading (see the different but converging arguments of McCarthy 1994a, Padgett 1995, Gafos and Lombardi 1997, Gafos 1998 for strictly local spreading in a VCV configuration).

the assumption of the underspecification argument above, but fall 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 1995, Itô, Mester and Padgett 1996) and prosodic information (Prince and Smolensky 1993, Burzio 1994, Inkelas 1995), to specification of consonant-vowel ordering in languages previously thought to be prime candidates for V/C planar segregation (McCarthy 1995). In the latter work, for example, McCarthy (1995) provides a reanalysis of Rotuman metathesis without using V/C planar segregation, in fact, arguing against it on the basis of empirical and (OT internal) theoretical inadequacies. Hence, McCarthy's (1989) original argument for V/C segregation, quite plausible within its contemporary setting, is considerably weakened by more recent work.

But even if the redundancy argument had any force, note that it does not necessarily imply geometric segregation into two different planes; it is only segregation into two linear sequences, as in the input $\{C_1C_2C_3C_4 \ldots, V_1V_2V_3V_4 \ldots\}$, that is necessarily implied. This type of segregation is fully compatible with the proposals of this paper. As shown in section 4, such inputs, if assumed, can be parsed into $[\ldots C_iV_jC_{i+1}V_{j+1} \ldots]$ sequences by prosodic forces, a typical instance of the generalized Prosody $\gg$ Morphology ranking schema of Prosodic Morphology (see McCarthy and Prince 1993a: section 7 for relevant discussion).

Indeed, it seems that 'geometric V/C planar segregation' and 'segregation into two linear sequences' have been treated as synonymous in some of the past literature. To give one example, consider Prince's (1987) discussion of Yawelmani Yokuts, a language where a lexical item like /bnit/ can appear in two templates, CCVC and CVCC (i.e., *bnit* and *bint*, *ʔamc* and *ʔmaac* 'be near'). On the basis of such facts, Prince (1987) argues that "the necessity of v,c-segregation [V/C planar segregation: DG] follows from the structure of the templates; it is not possible to prescribe a single order for the segments of the root that holds across all its allomorphs" (p. 495). Prince, then, goes on to develop a forceful argument against the approach that assumes full ordering of vowels and consonants in the underlying form. Once we understand that 'geometric V/C planar segregation' and 'segregation into two linear sequences' are not synonymous, then clearly Prince's argument or the redundancy argument above can only necessitate the latter.

Perhaps, then, backtracking to a pre-McCarthy (1989) state of affairs, an advocate of V/C planar segregation would narrow its applicability to languages with morphologically motivated segregation between vowels and consonants, as is the case in Semitic languages. This is the second or 'morphological' alleged source of support for V/C planar segregation. Once again, however, a morphological distinction between vowels and consonants does not in itself logically entail a representational distinction in terms of V/C planar segregation. The characteristic property of Semitic languages of intercalating vowels and consonants in their lexical items follows from appropriate constraint ranking as argued in section 4, requiring no geometric devices and no mapping of melody to templates, a set of mechanisms that were special to such 'V/C planar segregated' languages.

In short, both the phonologically and morphologically motivated segregation of consonants and vowels do not logically imply V/C planar segregation. V/C planar segregation would receive independent support if LDC-spreading was part of the theory, a proposition that previous sections have shown to be both unnecessary and undesirable. I thus conclude that as a consequence of the elimination of LDC-spreading, V/C planar segregation, another language-particular geometric mechanism, should also be eliminated.

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. I have proposed to replace LDC-spreading with the same formal mechanism underlying reduplication, which is independently needed in the theory. 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, and the obvious redundancy between LDC-spreading and reduplication is eliminated. The proposal is developed in detail for Temiar and it is extended to many other cases where LDC-spreading and V/C planar segregation were thought to be necessary.

Two more notable results follow. In Temiar, it was shown that the templates posited by previous analyses are derivable from the interaction of the pure prosody of the language (**P**rosody) with the equally general demands of affixation (**M**orphology). Another instance of **P-M** interaction derives the interdigitation between consonants and vowels in Semitic, without resort to V/C planar segregation and the special mode of word-formation involving association of melody to templates.

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 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 and its welcome consequences have been implemented.

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