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Long-Distance Spreading as Reduplication

Adamantios I. Gafos

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Adamantios I. Gafos
Department of Cognitive Science, The Johns Hopkins University
gafos@mail.cog.jhu.edu

1. Introduction

In this paper, I will be concerned with an analysis of certain aspects of the nonconcatenative morphological system of Temiar, a Mon Khmer language of Malaysia. The goal is to show how a canonical root-and-pattern system can be analyzed without recognizing an operation of long distance consonantal spreading (henceforth, Spreading).

The morphological system of Temiar has been characterized in the literature as extremely complex. It involves a variety of affixional and copying processes in both the verbal and nominal paradigms. The analysis presented here departs from previous ones in significant respects. I will argue that there is a principled characterization of the locus of affixation which leads to a radical simplification. In particular, three affixes in the system, the simulfactive /a/, continuative abstract consonantal /C/, and causative /r/, share the property of attaching to the prosodic head of the base. This general property with other general constraints of the language results in the apparent surface complexity of the system. The analysis is crucially given in the Optimality Theory framework of Prince & Smolensky 1993.

One major theoretical consequence of the proposed analysis is that there is no need for having both Spreading and Reduplication to account for the complex copying patterns attested in the system. By employing the notion of correspondence as developed in McCarthy and Prince (1994a,b) I show how copying is the result of the interaction of a dependence requirement which states that surface segments must have input correspondents with other constraints expressing general properties of the language.

2. Temiar

Temiar [tmEEr] is one of the main Mon Khmer languages of Malaysia. It belongs to the Senoic or Central Asian group of the Malay Peninsula, whihc includes about twenty other languages (Benjamin 1976). A word in Temiar (and Mon Khmer in general) consists of one *major* syllable preceded optionally by a sequence of *minor* syllables. A major syllable contains the root vowel and is stressed. A minor syllable consists of one (an open syllable) or two (a closed syllable) consonants and no phonologically specified vowel. The nucleus of a minor syllable will therefore be an empty structural position in the syllable.

The table below shows the two types of verbal roots, biconsonantal and triconsonantal.

1. Verbal Roots in CV form ('.' stands for syllabic boundary, v for vowel, and c^i for consonant)

Biconsonantal	c^1vc^2	kOOw	'to call'
Triconsonantal	$c^1.c^2vc^3$	s.log	'to lie down'

Biconsonantal roots consist of one major syllable. Triconsonantal roots consist of a minor syllable followed by a major syllable. The single consonant c^1 in $c^1.c^2vc^3$ is the

[1] I am grateful to Luigi Burzio, Paul Smolenksy, Linda Lombardi, Steve Anderson, and John McCarthy for discussion and advice. All mistakes are of course my responsibility.

onset of the minor syllable. The phonetic quality of the vowel by which minor syllables are realized depends on the structure of the minor syllable. If the syllable is open, the vowel is realized as a schwa, [s«.log] 'to lie down.' If the syllable is open, the vowel is realized as an [E], [sEr.log] 'to lie down-CAUSATIVE.' For convenience, I will not show the phonetic schwas of minor syllables. This should not be confusing because syllable boundaries are always shown.

Morphological categories indicate voice (active, causative) and aspect (perfective, simulfactive, continuative). The following table gives the active verbal paradigm.

2. Active Voice/Aspect inflectional paradigm

	Biconsonantal	Triconsonantal
Perfective Base	c^1vc^2	$c^1.c^2vc^3$
Simulfactive	$c^1a.c^1vc^2$	$c^1a.c^2vc^3$
Continuative	$c^1Ec^2.c^1vc^2$	$c^1Ec^3.c^2vc^3$

The perfective of the active voice is the unmarked category and corresponds to the verbal root. It is also the base for the formation of the simulfactive and continuative. The simulfactive is formed by affixation of the thematic vowel /a/ and a copy of a base consonant in the biconsonantal case. The continuative is formed by copying consonants of the base.

The causative verbal paradigm is shown next.

3. Causative Voice/Aspect inflectional paradigm

	Biconsonantal	Triconsonantal
Base	c^1vc^2	$c^1.c^2vc^3$
Perfective	$tEr.c^1vc^2$	$c^1Er.c^2vc^3$
Simulfactive	$t.ra.c^1vc^2$	$c^1.ra.c^2vc^3$
Continuative	$t.rEc^2.c^1vc^2$	$c^1.rEc^3.c^2vc^3$

The perfective of the causative is formed by affixation of /tr/ or its allomorph /r/. The simulfactive and continuative aspects are formed on the perfective bases and exhibit similar patterns to those of the active voice, i.e. affixation of /a/ for the simulfactive and copying of base consonants for the continuative.

Finally, the nominalization paradigm is considered next. As can be seen in the following table, the perfective of this paradigm is formed on the verbal base by affixation of /n/. The simulfactive and continuative aspects, again formed on the perfective bases, exhibit similar patterns to those of the two verbal paradigms in 2 and 3.

4. Nominalization paradigm

	Biconsonantal	Triconsonantal
Verbal Base	c^1vc^2	$c^1.c^2vc^3$
Perfective	$c^1.nvc^2$	$c^1En.c^2vc^3$
Simulfactive	$c^1a.nvc^2$	$c^1.na.c^2vc^3$
Continuative	$c^1Ec^2.nvc^2$	$c^1.nEc^3.c^2vc^3$

A predominant generalization in word formation of Mon-Khmer is that words cannot have more than one major syllable. The complex morphological systems of Central Aslian provide striking examples of this constraint in action. In Semai, a close relative of Temiar, the category of expressives involves complex prefixations of copies of root consonants. One example shown below is minor reduplication which prefixes a minor syllable consisting exclusively of copies of base consonants (In Semai, open and closed minor syllables are realized phonetically with a schwa).

5. Semai minor reduplication

Root	Expressive	Gloss in Diffloth (1976)
d.Noh	dh.d.Noh	'appearance of nodding constantly'
d.yool	dl.d.yool	'appearance of object which goes on floating down'

The striking characteristic is that the vowel of the base is never copied. If it was it would create a prefinal syllable with a full vowel, i.e. another major syllable. This constraint allowing only for one major syllable per word will be shown to play a crucial role in the analysis.

3. Basic Assumptions

The analysis crucially assumes the framework of Optimality Theory of Prince and Smolensky (1993, henceforth OT). Moreover, it presupposes a number of recent assumptions and developments in the framework. In particular, it presupposes the notion of *correspondence* as explicated in McCarthy and Prince (1994a,b)

6. Correspondence

Given two strings S_1 and S_2, related to one another as Base/Reduplicant, Input/Output, etc., correspondence is a function from any elements of S_2 to S_1. Any element α of S_1 and any element β of S_2 are correspondents of one another is α is the image of β under correspondence; that is, $\alpha = f(\beta)$.

Each output candidate comes with a correspondence relation between itself and the input. Analogously, each reduplicative morpheme has a correspondence relation between itself and the base. This relation is explicitly part of the representation that gets evaluated. Eval accepts Input/Output pairs with their correspondence relations. Correspondence constraints are usually paired to express the formal similarities between the Input/Output and Base/Reduplicant faithfulness relations. The following two pairs of constraints evaluate the quantitative extent of the correspondence relation.

7. The MAX Constraints (McCarthy and Prince 1994b)
   a. MAX^{IO} Every segment of the Input has a correspondent in the Output.
   b. MAX^{BR} Every segment of the Base has a correspondent in the Reduplicant.

MAX^{IO} essentially bans phonological deletion (replacing PARSE of OT) and MAX^{BR} requires that reduplication be total.

8. The DEPENDENCE Constraints (McCarthy and Prince 1994b)
   a. DEP^{IO} Every segment of the Output has a correspondent in the Input.
   b. DEP^{BR} Every segment of the Reduplicant has a correspondent in the Base.

DEP^{IO} (replacing FILL of OT) bans epenthetic segments which have no input correspondent. DEP^{BR} requires that the segmental composition of the reduplicant includes exclusively material from the base.

4. Simulfactive

Two constraints of the basic syllabic theory of OT are never violated in Temiar and must therefore be undominated in the constraint hierarchy of the language. The inventory of syllables is limited to the set CV, CVC. These two constraints are ONS and *COMPLEX.

9. ONS
   Syllables must have onsets.
10. *COMLPEX
   No more than one C may associate to any syllable position.

The following table gives the simulfactive forms of the active voice.

11. Active Voice (a copied consonant appears in boldface)

	Biconsonantal	Triconsonantal
Active Base	c^1vc^2	$c^1.c^2vc^3$
Simulfactive	$\mathbf{c^1}a.c^1vc^2$	$c^1a.c^2vc^3$

The crucial observation is that in all forms (here and also in the causative and nominal paradigms shown in 3 and 4) the affix /a/ appears attached to the final syllable of the base. Stress in Temiar is always on the final syllable, the prosodic head of the word. The affix /a/ is therefore attached to the left edge of the prosodic head. This affix placement generalization is a pervasive property of the morphological system of Temiar. It plays a crucial role in the placement of the continuative and causative affixes as well. I formulate the undominated constraint that governs the placement of the affix as follows[2].

[2]This constraint is expressible in the generalized alignment schema of McCarthy and Prince (1993) as Align (Affix, R, Head(PrWd), L). The abbreviatory name, AFX-HEAD, is used here for convenience.

12. AFX-HEAD
The affix must be aligned with the left edge of the last syllable of the base.

In the case of biconsonantal bases in 11 a copy of c^1 appears on the surface. In the triconsonantal case, however, there is no copying. This raises the following question: Does simulfactive formation involve a reduplicative morpheme? A copy of the base occurs only in the case of active biconsonantal bases, i.e. it does not occur in the active triconsonantal or causative and nominal bases either (see 3 and 4). it will be argued here that simulfactive formation does not involve any reduplicative morpheme. The simulfactive morpheme is simply /a/. The placement constraint AFX-HEAD determines the prosodic form of the output. Essentially, it forces /a/ to be the nucleus of the penultimate syllable. In terms of the theory of prosodic domain circumscription of McCarthy and Prince (1990), affixation of /a/ involves circumscribing the last syllable of the base (cvc), prefixing /a/ to this syllable, and concatenating the result, /a.cvc/, with the rest of the input. In all cases except the biconsonantal active the rest of the input includes extra consonants to be concatenated with the partial output /a.cvc/. It is only in the case of biconsonantal active bases that circumscribing the final syllable leaves no remainder. The partial output /a.cvc/ has an onsetless syllable, a fatal violation, because Temiar has an absolute ban on such defective syllables. An onset must therefore be provided.

This, so far, merely explains the presence of a new consonant in the output of the biconsonantal active simulfactive and its corresponding absence in the simulfactive of the rest of the cases. It does not explain why this consonant is a copy of a consonant of the base. The explanation for that comes from DEP^{IO} which requires surface segments to have some input correspondent. The needed onset position is realized by copying a consonant in the input, in order to satisfy the dependence constraint. Had that consonant been an epenthetic segment, no correspondence relation would have existed between it and an input segment, a violation of DEP^{IO}. When a copy of a segment of the input is part of the output it incurs whatever violation marks correspond to the markedness of that segment. For example, when c^1 appears copied in $\mathbf{c^1}a.c^1vc^2$ it causes an additional violation of $*\mathbf{c^1}$. I use the name $*C^1$ for the constraint which bans the presence of segment C^i.

13. $*C^i$
Do not allow segment C^i.

Of course, for copying to occur as an active 'filling' strategy in a language the needed ranking is $DEP^{IO} >> *C^i$. The following tableau summarizes the discussion (all notational conventions are those of OT).

14. Simulfactive of biconsonantals

Input: a + c^1vc^2	ONS	DEP^{IO}	$*C^i$
a. $a.c^1vc^2$	*!		
b. $Ca.c^1vc^2$		*!	
c. ☞ $\mathbf{c^1}a.c^1vc^2$			*

Candidate (a) has affix /a/ attached to the major syllable of the word. No onset is provided for the prefinal syllable, which causes a fatal violation of ONS. Candidate (b) provides such an onset by epenthesizing a consonant C with no underlying affiliation. This causes another fatal violation of DEP^{IO}. Finally candidate (c) avoids a violation of DEP^{IO} by copying the first consonant of the base, c^1. This incurs a violation of the lower ranked constraint $*C^i$. In this and following tableaux I show no candidates which fail to parse some input segment(s). MAX^{IO}, which requires every segment in the input to appear in the output, is undominated.

To summarize, the copied consonant, in the case of the active biconsonantal bases, is the result of two factors. These are, first, an absolute ban on onsetless syllables, and second, the need for segments in the output to depend on the material in the input. The next question to be answered is what determines the choice of the consonant to be copied. Because there are two consonants in the input of biconsonantals there are two possible candidates, $\mathbf{c^1}a.c^1vc^2$ and $\mathbf{c^2}a.c^1vc^2$. The first has a copy of c^1 and the second a copy of c^2 both in correspondence with their images in the input (i.e. both satisfy DEP^{IO}). Once two segments are in correspondence, there may be other constraints that are involved in determining the quality of their relation. One such family of constraints, IDENTITY, determines the extent to which the featural compositions of two segments are alike.

15. $IDENT^{IO}$ (F) (McCarthy and Prince 1994b)
    Correspondent segments in Input and Output have identical values for feature F.

In the two candidates, the copied segments are identical to their correspondents. Hence, for every feature F, $IDENT^{IO}$(F) is not violated. Some other constraint(s) must therefore be involved in the choice of the optimal candidate. Aside from their featural composition, segments have other linguistically relevant properties. For example, a segment can be at the left edge of a prosodic word or at the margin of a syllable. Such prosodic properties may also be relevant to the evaluation of a correspondence relation. In particular, it will be shown in this analysis that the syllabic positions of segments play a crucial role in determining the optimal candidate. The relevant constraint is SROLE.

16. SROLE (McCarthy and Prince 1993a)
    A segment and its correspondent must have identical syllabic roles.

17. Which consonant is copied? SROLE in action

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

In output (a) the copied $\mathbf{c^2}$ is parsed as an onset, while its correspondent is parsed as a coda. This causes a violation of SROLE. Candidate (b) copies $\mathbf{c^1}$ which is assigned the same syllabic role as its correspondent. Because SROLE is settling a tie between these two constraints it can be ranked anywhere with respect to the rest of the constraints (ONS, DEP^{IO}, $*C^i$).

One additional ranking is crucially involved in the formation of the simulfactive. As discussed in section 2, a very conspicuous property of Mon Khmer is the constraint which allows for only one major syllable per word, which I call *FULL-V.

18. *FULL-V
    Only one major syllable per word.

This constraint is violated in all simulfactive forms because the vowel /a/ appears as the nucleus of the penultimate syllable. The affix /a/ is part of the input of simulfactive formation. The relevant constraint forcing the violation of *FULL-V is MAX^{IO}.

19. MAX^{IO}
    Every segment in the input has a correspondent in the output (No deletion.)

20. Ranking Argument: MAX^{IO} >> *FULL-V

Input: a + c^1vc^2	MAX^{IO}	*FULL-V
a. <a>.c^1vc^2	*!	
b. ☞ $\mathbf{c^1}a.c^1vc^2$		*

To complete the analysis of the simulfactive, consider the case of active triconsonantal bases ($c^1.c^2vc^3$ -> $c^1a.c^2vc^3$). The dominant AFX-HEAD constraint again determines the placement of the affix. Dependence does not come into play because no new positions need to be created in the output. The optimal candidate is straightforwardly predicted in this and the rest of the simulfactive forms in the causative and nominal paradigm (see 3 and 4).

5. Continuative

I will start with an informal discussion of the relevant patterns, and consider formal aspects later on. The table below shows the continuative forms of the active voice.

21. Continuative Active

	Biconsonantal	Triconsonantal
Active Base	c^1vc^2	$c^1c^2vc^3$
Continuative	$\mathbf{c^1Ec^2}.c^1vc^2$	$c^1\mathbf{Ec^3}.c^2vc^3$

There are three revealing generalizations that can be made about these patterns.

22.a Only consonants are copied. The vowel is never copied.
22.b One of the copied consonants appears as a coda of the penultimate syllable.
22.c The number of copied consonants varies. In the case of c^1vc^2 roots two consonants are copied. In any other case there is only one consonant copied.

First, 22.a is the result of the constraint *FULL-V. If the vowel of the base was copied it would create a second prefinal major syllable, a violation of *FULL-V. This violation is avoided by the creation of a minor syllable because its nucleus is an empty structural position. It is important to remember that the vowel {E} of the minor syllable $\mathbf{c^1Ec^2}$ is just the phonetic realization of this empty structural position. Second, 22.b concerns the placement of the copied consonant. In all patterns there is one copied consonant which is adjacent to the onset of the major syllable. AFX-HEAD, which requires the affix to be aligned with the left edge of the major syllable is dominant again and partly determines the prosodic structure of the output. Finally, consider 22.c. In all forms there is at least one copied consonant. It is only in the case of the biconsonantal active base c^1vc^2 that two consonants are copied (see 21). This variation is easily understood, given the two previous observations and the discussion of the simulfactive of c^1vc^2 bases. If only one consonant was copied in c^1vc^2 bases it would have to be attached to the left edge of the major syllable by force of the placement constraint. It would, in other words, have to be the coda of a penultimate syllable (because *COMPLEX is undominated the affixed consonant cannot form a complex onset with the consonant of the major syllable). If no further action is taken, this penultimate syllable would be onsetless. The input form has no available onset because after the the circumscription of the major syllable all the segmental material in the base is exhausted. An onset has to be provided. This is done, as in the case of the simulfactive, by copying one of the consonants of the root. This second copied consonant is not therefore part of some output template specific to continuative formation or even part of the segmental composition of the contiuative affix. It is the prosodic requirement of having on onset, an absolute requirement of the language, that triggers the copy of the second consonant in the active biconsonantal case. The situation is completely analogous to that of the simulfactive of biconsonantals (tableau 14).

Factoring out the presence of the copied consonants triggered by general properties of the language, the invariant property of continuative formation is the copying of the final consonant of the base. The continuative affix is therefore an abstract consonant /C/. The way this consonant is realized will be determined by the grammar. In particular, it can be realized either by epenthesizing some underlying unsponsored material or by copying some consonant of the base. Similarly, the needed onset in the continuative c^1vc^2 bases could either be epenthetic or a copy of a consonant of the base. The optimal output in both cases is the one where the consonant is a copy of an input segment, a result forced by the constraint DEP^{IO}.

Consider now the formal aspects of the discussion above. In the case of the active continuative of triconsonantals the optimal output is $c^1e\mathbf{c^3}c^2vc^3$, where a copy of c^3 together with an epenthetic vowel appear in the prefinal syllable. Undominated AFX-HEAD forces the continuative affix /C/ to be attached to the left edge of the major syllable. This, in essence, makes /C/ the coda of the prefinal syllable which must of course contain a nucleus. This nucleaus can be either an epenthetic vowel or a copy of the vowel in the major syllable. Constraint *FULL-V is in conflict with DEP^{IO}. The first constraint demands that the nucleus of the prefinal syllable be empty while the second requires that nucleus to have some correspondent in the input. The following constraint tableau gives the ranking argument. For the suposes of this ranking argument, the issue of realization of the affix /C/, to be dealt with shortly, is considered independent from the interaction of *FULL-V and DEP^{IO}.

23. Active Continuative; Ranking Argument: *FULL-V >> DEP^{IO}

Input: /C/ + $c^1c^2vc^3$	AFX-HEAD	*FULL-V	DEP^{IO}
a. $c^1\mathbf{v}C.c^2vc^3$		*!	
b. ☞ $c^1EC.c^2vc^3$			*

There are two ways of giving segmental content to the affix /C/. First, it could be realized with some segmental material, C, which has no input affiliation, i.e. by epenthesis. This would cause a violation of DEP^{IO}. Second, /C/ could be a copy of some consonant in the input. In this case the copied consonant would stand in a correspondence relation with its image. The following tableau shows how SROLE crucially determines the choice of the optimal candidate.

24. Active Continuative; Which consonant is copied?

Input: /C/ + $c^1c^2vc^3$	DEP^{IO}	SROLE
a. $c^1EC.c^2vc^3$	**!	
b. $c^1E\mathbf{c^1}.c^2vc^3$	*	*
c. $c^1E\mathbf{c^2}.c^2vc^3$	*	*
d. ☞ $c^1E\mathbf{c^3}.c^2vc^3$	*	

Candidate (a) realizes the affix /C/ by some material which has no underlying source. The exact quality of the segment C is irrelevant. This candidate incurs a double violation of DEP^{IO}, one for the nucleus of the prefinal syllable and another for the realization of the affix. The next three candidates avoid one DEP^{IO} violation by copying an underlying consonant. Candidates (b/c) copy c^1/c^2 and incur one violation of SROLE because the copy of c^1/c^2 is a coda while its correspondent is an onset/coda. Candidate (c) copies c^3 which has the same syllabic role as its correspondent in the base. Any ranking of the two constraints, DEP^{IO} and SROLE, would decide correctly between the optimal candidate and its competitors.

The analysis of the active continuative of biconsonantal bases is considered only briefly. Here the output form is $\mathbf{c^1Ec^2}.c^1vc^2$ from the base c^1vc^2. Since AFX-HEAD is undominated, it will force the affix to be attached to the major syllable of the base, which in this case is the base itself. The consonantal affix will be the coda of the prefinal syllable and will be realized by copying because of DEP^{IO} . This prefinal syllable needs a nucleus which cannot be a copy of the base vowel, because of *FULL-V. It also needs an onset because of ONS. This onset is again realized as a copy of a base consonant. Finally, SROLE determines which consonants are copied.

The continuative forms discussed so far are those derived from the perfective active bases. There are four more continuative patterns, two from the causative and two from the nominal paradigm (see 3 and 4). The grammar so far fully accounts for these forms as well. Briefly, placement of the affix is determined by the undominated AFX-HEAD, and matters of realization are relegated to the interaction of *FULL-V, DEP^{IO} and SROLE.

To summarize, I have postulated the existence of two morphemes, the simulfactive /a/ and the continuative abstract consonantal /C/. Placement of the morphemes is determined by constraint AFX-HEAD. The constraint that forces copying of input segments as the means of realization is DEP^{IO} and the rest of the output is determined by the constraints ONS, SROLE, and *FULL-V.

6. Previous Analyses

McCarthy (1982) provides a comprehensive analysis of the morphological system of Temiar. This illuminating analysis is wide in scope, covering both the verbal and nominal aspects of the language. A later analysis in Broselow and McCarthy (1983), limited to the discussion of the simulfactive and continuative, is in the spirit of McCarthy (1982), so the comments in this section apply to that analysis as well. I will refer to the approach taken in these works as the ‘Template and Association Approach’ because of its two characteristic concepts, (a) templates, which state regularities in the prosodic shape or morphemic composition of a morphological category, and (b) association rules, which map underlying melodic sequences to these templates.

The analysis of the active simulfactive in the Template and Association approach stipulates a prosodic template CVCVC whose second position is occupied by the simulfactive affix /a/. Figure 1 shows the derivation of the biconsonantal root *kow* ‘to call.’

Simulfactive Active Templates

a

Prosodic Template C V C V C

Step 1: Association LR k o w

Step 2: Empty C position filled by Spreading

a

C V C V C

k o w

Figure 1: Simulfactive active templates and derivation.

The base *kow* must be mapped to the CVCVC template. First, *k* gets associated to the first C slot of the template. Then *o* has to be associated to some free V slot. Because the first V slot is already associated to /a/, *o* is linked to the second V slot of the prosodic template. Finally, *w* is associated to the last C position of the prosodic template. The resulting output is, so far, *kaCow* which contains one unassociated C slot that must be filled with some segmental material. There are two candidates, *k* and *w*. The second candidate has to be excluded because spreading *w* to fill the unassociated C slot would cause a line crossing violation. Spreading *k*, on the other hand, does not cause a line crossing violation because the affix /a/ is in another plane from that of the melody of the root. The solution rests on a crucial property of the representation called the Morphemic Tier Hypothesis (McCarthy 1979:237).

25. Morphemic Tier Hypothesis (MTH)
    Different morphemes lie on different planes.

Figure 2 below shows the mechanisms necessary for the derivation of the continuative. Part (a) shows the mechanisms needed for the derivation of the active continuative, and part (b) contains the mechanisms for the causative continuative. For the continuative active there are two templates shown in figure (2a): a prosodic template stipulating that the shape of the continuative is CCCVC, and a morphemic template [Root Root] stipulating that a copy of the root must be created as part of the derivation, i.e. stipulating that the root must be reduplicated. The output of this reduplication step must be mapped to the prosodic template. For this mapping to give the desired result the two mechanisms in 26 are also necessary.

a. Continuative Active Templates — Association Rule

CCCVC — CCCVC

[Root Root] — [[x α] [y]]

b. Continuative Causative Templates — Association Rule (Revised)

C+CCCVC — (C)CCCVC

[Root Root] — [[x α] [y]]

Figure 2: Continuative templates and association rules

26.a Continuative Association Rule (CAR): Associate the *last* element (a) in the *first* copy of the root with the *second* C-position of the prosodic template (the variables x and y in the statement of the rule stand for melodic sequences of any length).

26.b After CAR has been applied the direction of association is LR.

The application of this apparatus on biconsonantal roots is not pertinent to our purposes, so figure 3 below depicts the steps in a derivation of a triconsonantal base.

Step 1: CAR — Step 2: LR Association

CCCVC — *CCCVC (Wrong output)

slog slog — slog slog

Morphological Opacity:
Every root segment must appear at least once in the output

Step 2:

CCCVC

slog slog

Figure 3: Example of the derivations on the root slog 'to lie down'

The melody after the copy of the root will be [*slog slog*]. After the application of CAR, the first *g* will associate to the second C-slot of the template, giving C*g*CVC. The LR scan is then initiated and *s* will associate to the first C slot, giving *sg*CVC. The next two segments *lo* are now trapped between the associations of *s* and *g* and will therefore remain unassociated. The remaining melody is *slog* which has to be mapped to the remaining free template slots CVC. Continuing the LR scan, the next segment to be associated will be *s,* giving *sgs*VC, and then *l,* giving *sgs*V*l*. Finally, segment *o* remains unassociated because its association to the free V slot would result in a line crossing violation. Segment *g* also remains unassociated because there are no remaining available free C slots in the prosodic template to which it could link. The final output of this derivation, *sgs*V*l,* is wrong. Some alternative must be considered.

Backtracking to the point in the derivation after the application of CAR and the linking of *s*, the output was *sg*CVC. At this point there are three remaining consonants to be associated in the remaining melody *slog*. These must be mapped to two C positions in the remaining CVC free slots of the template. Hence, there is a choice to be made between associating *s* or *l* next. As seen before, the association of *s* leads to the wrong output. If *l* is associated instead, the output will be the desired *sglog*. The needed principle to arbitrate between these two possibilities is called Morphological Opacity.

27. Morphological Opacity (MO)
All segments of the root must appear at least once in the output.

MO excludes the association of *s* because it leaves *l* unassociated and therefore unrealized in the output. This principle is of a rather different sort from a rule in a step-wise derivation. It is a condition on the output of the whole derivation (a predecessor of MAX^{IO}).

7. Inadequacies and Comparison

There are a number of problems in the Template and Association approach described above. The first problem is the stipulatory character of templates. For example, the active simulfactive template is defined to be CVCVC for both biconsonantal and triconsonantal roots. The optimality theoretic analysis has shown, however, that the CV shape of the simulfactive is derivable from two things: (a) the placement requirement of the simulfactive affix, a general constraint of affixation in Temiar, and (b) the language-wide ban on onsetless syllables. Similarly, there is no need to postulate the active continuative template. The biconsonantal output has a CCCVC shape because the prefinal syllable created by affixing /C/ to the base, c^1vc^2, must have an onset.

Another problem exists with the arbitrary character of the special association rules needed to derive the correct forms. For example, the special rule of association in 26.a does not explain anything by making reference to particular positions in the prosodic template. In particular, why is it that the *last* element in the *first* copy of the root melody associates to the *second* position in the template? The optimality theoretic solution derives the effects of this special rule by the interaction of general constraints on affixation, prosodic form, and the notion of correspondence. An even more troubling characteristic of the templatic approach is that it has to stipulate a different template and a different association rule for the continuative of the causative voice. In the continuative causative the copied root consonant is associated with the third C-slot of the skeleton instead of the second C-slot of the continuative active. This requires a revision of the association rule, shown in part (b) of figure 2, which now states that the last segment in the first copy of the root must associate to the third position in the skeleton. This revision magnifies the stipulatory character of the templatic solution. In the optimality theoretic solution, the active, causative, and nominal continuative forms are derived by the interaction of the same general constraints, and the properties of the individual affixes do not depend on the bases of affixation.

Let me now turn to the problem that leads to the major theoretical consequence of the new analysis. The simulfactive (CVCVC) and continuative (CCCVC) templates share the need to be filled with underlying segmental material, but a substantially different mechanism is involved in the derivations of the two aspects. In the formation of the continuative, the morphemic template [Root Root] ensures that unfilled slots in the prosodic template are realized by creating a copy of the root, i.e. by reduplication. In the simulfactive, on the other hand, unfilled slots in the prosodic template are realized by Spreading, a completely different and unrelated mechanism. What are the reasons leading to the use of these two different mechanisms? In the continuative of biconsonantals, the whole root consonantism appears copied on the surface, $\mathbf{c^1ec^2}.c^1vc^2$. Crucially, this output cannot be derived by Spreading the consonants of the base because a line crossing violation will be induced. Thus another mechanism, quite different from Spreading, must be involved. This other mechanism for creating copies of base consonanants is reduplication. Because reduplication is not automatic (only Spreading is), it must be triggered by some specification in the statement of the morphological process. This is why morphemic templates are needed. The morphemic template of the continuative, [Root Root], states that the melody of the root must be mapped to two morphemic positions, essentially creating another copy of the root. In the simulfactive of biconsonsonantals, on the other hand, the additional instance of c^1 in $\mathbf{c^1}a.c^1vc^2$ is the result of Spreading made possible because the morpheme /a/ exists on a different plane from that of the root melody. There is no need for the arbitrary statement of a copying requirement (i.e. there is no need for a morphemic template).

The problem with this analysis is that two different mechanisms for creating copies of melodies are involved. In the the simulfactive, Spreading is needed to fill an empty C slot in the prosodic template CVCVC. In the continuative, the same need for filling the template CCCVC exists. Here, copying is not automatically induced but must be stipulated by the morphemic template [Root Root]. In other words, although both the simulfactive and continuative fill their templates by copying root consonants, this copying follows automatically for the former, but must be arbitrarily stipulated for the latter. In the optimality theoretic analysis proposed no operation of Spreading is necessary (and thus there is no need for the MTH either). The continuative and simulfactive are formed by the same operation of copying. Copying is induced from constraint interaction, and in particular, from the interaction of DEP^{IO} with other constraints expressing general properties of the language, such as the requirement for every syllable to have an onset.

8. Conclusions

I have shown that there is no need for having two operations, Spreading and Reduplication, to account for the same phenomenon of copying in a canonical root-and-pattern morphological system. The OT framework and the notion of correspondence lead to the intuitive solution in which consonantal Spreading is seen as formally identical to reduplication. Copying of input segments results from a correspondence requirement which states that surface segments must have input correspondents. Candidates are evaluated on the basis of constraints particular to the notion of correspondence as well as other constraints expressing general properties of the language. In addition, the analysis eliminates the stipulatory character of templates. The prosodic structure of each morphological category is derivable from general constraints on affixation. Following the elimination of templates, there is also no need for special association rules related to template mapping operations.

The most radical interpretation of this demonstration, and the one I wish to propose, would be that long distance consonantal spreading is not needed as a mechanism of the theory. This claim immediately invites a response to the traditional belief that assumes a distinction between Spreading and Reduplication. It is usually assumed that reduplication implies bimorphemic or derived status in a way that spreading does not. By considering evidence from a variety of languages, Gafos (in preparation) shows that this assumption has no status in the theory and that it is theoretically undesirable as well as empirically false.

The solution proposed here raises a number of interesting questions. On the one hand, it remains to be seen whether this approach can apply to other root-and-pattern morphological systems and what other constraints are needed to account for the patterns of reduplication found therein. In this regard, the striking similarities of Temiar with

Levantine Arabic discussed in McCarthy (1982) lend some credibility to the approach sketched in this paper. On the other hand, there is an array of issues related to the suggestion that Spreading is not available. Spreading is licenced by V/C Planar Segregation (McCarthy 1989), a geometric property of the representation. Gafos (in preparation) claims that V/C Planar Segregation is not part of the representational possibilities of language. If V/C Planar Segregation is unavailable, Spreading becomes unavailable too. This is a welcome result, not an unpleasant surprise. As this paper shows, there is no need for the theory to recognize a primitive distinction between Spreading and Reduplication. Spreading is Reduplication.

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