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*Reduplication and syllable transfer in Sanskrit and elsewhere**

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The phenomenon studied in this paper is the correspondence between the syllabic position of segments copied in reduplication and the syllabic position of their base counterparts. I will document this correlation and propose a model of reduplication that explains it.

1 Introduction

1.1 The phenomenon: modified and unmodified reduplication

There are two types of reduplication: modified and unmodified. Unmodified reduplication copies every element of the base[1] and changes none. An example of this simple and widespread procedure is provided by the following Madurese plurals, from Stevens (1968: 35):

(1)	sakolaʔan-sakolaʔan	'schools'
	panladhin-panladhin	'servants'
	panokor-panokor(-ra)	'(his) razors'

Modified reduplication, in contrast, effects certain changes in the copied base. There are three types of modified reduplication. PARTIAL REDUPLICATION copies only a portion of the base. PRESPECIFIED REDUPLICATION introduces segmental changes in the copied base. PARTIAL + PRESPECIFIED REDUPLICATION combines partial copy with segmental changes. Examples of each type, again from Madurese (Stevens 1968: 34, 52, 82) follow: the Madurese instance of partial reduplication copies only the last syllable of a polysyllabic stem; the Madurese case of prespecified reduplication changes – in somewhat unpredictable fashion – the quality of a reduplicated vowel; finally, the Madurese combination of prespecified and partial reduplication copies only the last stem syllable *and* changes its vowel to a fixed *a*:

(2) a. *partial reduplication:*

dus-garadus	'fast and sloppy'
waʔ-buwaʔ-(an)	'fruits'
bit-abit	'finally'

b. *prespecified reduplication:*

nan-nin	plant species
pun-pan	'defy'
pin-pun	'ping-pong'

c. *partial + prespecified reduplication:*

car-kacer	'mixed up'
(a)-lar-ghəlur	'men and women together'
das-garudus	'fast and sloppy'
dhat-indhit	'be of the same age'

As a preliminary to the proposals made in this study, I would like to suggest the following hypotheses concerning the relation between modified and unmodified reduplication:

H1. The transformations introduced by modified reduplication stem from operations encountered in non-reduplicative morphologies as well. Modified reduplications instantiate general operations of morphologically conditioned stem modification. Stem modification may involve STEM TRUNCATION (the elimination and/or simplification of stem syllables) or SEGMENTAL INSERTIONS AND SUBSTITUTIONS in the stem. Partial reduplication is nothing but a subtype of stem truncation. Prespecified reduplication is nothing but a subtype of segmental insertion/substitution operating on a stem morpheme.

H2. Prespecified and partial reduplication are independent types: they may but need not co-occur. Prespecified total reduplication is also an attested formal possibility.

We shall see below that H2 is in fact a corollary of H1.

1.2 Non-reduplicative stem modifications

Space does not permit a full defence of H1 here, but some illustrative examples of non-reduplicative stem modification can be provided. Cases of non-reduplicative stem truncation have been documented by Poser (1984a,b) and McCarthy & Prince (1986: 60–62). Among the cases discussed by the latter is the Madurese reduction of a stem to its last syllable, encountered in certain compounds (Stevens 1968: 102). Either the first or both members of the compound may be subject to this truncation process:

(3) a. sap-lati 'handkerchief' (usap 'wipe'; lati 'lip')
sar-suri 'afternoon market' (pasar 'market'; suri 'afternoon')
zhuʔ-ənpul 'pinky' (tuzhuʔ 'finger'; ənpul 'pinky')

b. bhu-liʔ 'younger sister of parent' (ibhu 'mother', aliʔ 'younger sibling')

As McCarthy & Prince note, there is a striking parallel between the reduplicative truncation found in *bit-abit* and the non-reduplicative type encountered in *sap-lati* (from *usap+lati*). A similar type of non-reduplicative stem truncation eliminates all but the initial syllable of the first members of Zuni compounds (McCarthy & Prince 1986: 61): thus *tukni* 'shoe' becomes *tu* in *tu-mok^{w}k^w'ane* 'stocking'; *melika* 'Anglo' becomes *me* in *me-k^w'isso* 'Anglo-negro' (=black man). Note the fact that the Zuni truncation not only eliminates non-initial syllables but also simplifies the shape of the remaining syllable by dropping its coda: *tuk.ni* → *tu*.

A rich source of evidence for non-reduplicative stem truncation is Plenat's (1984) study of French hypocoristics. One hypocoristic type reduces the original name to a disyllabic sequence. Moreover, the surviving syllables have their complex onsets simplified and, optionally, drop their codas:

(4)	Isabelle	(i.za.bel)	→	iza, zabel, zabe
	Dominique	(do.mi.nik)	→	domi, minik, mini
	Marie-Claude	(ma.ri-klod)	→	mako
	Marie-Alice	(ma.ri-a.lis)	→	mali, malis
	Laure-Lise	(lor-liz)	→	loli
	Thierry	(tye.ri)	→	teri

Observe that the elimination of syllables can be effected either left-to-right (as in *iza*, *domi*) or right-to-left (as in *zabel*, *minik*).[2] Observe also the simplification of onsets found in *teri* from *tyeri* and (*ma*)*ko* from *klod*, as well as the optional coda-drop displayed by *mako*, *zabe*, *mini*.

These stem truncation cases are formally equivalent to the stem reductions exhibited by partial reduplication. Reduplicative stem truncations consist not only of syllable elimination, as in the Madurese *bit-abit*, but also of syllable simplification, as in the Sanskrit intensive stem *kan-i-krand* (on *krand* 'cry out') or in the Sanskrit perfect *di-dvis-* (on *dvis* 'hate'). The non-reduplicative syllable simplification whereby French *klod* (in *Marie-Claude*) becomes the *ko* of *mako* is entirely parallel to the reduplicative trimming instantiated by *di-* in Sanskrit *di-dvis*.

In view of the existence of non-reduplicative instances of syllable elimination and simplification, the null hypothesis is that the truncation mechanisms encountered in partial reduplication are independent of reduplication. Partial reduplication is full reduplication accompanied by the independent operations of stem truncation. This conclusion is one part of H1.

The other side of H1 involves the relation between prespecified reduplication and the independent occurrence of segmental insertions and substitutions found in non-reduplicative morphology. I claim that the segmental changes that frequently accompany reduplication are operations independent of and unrelated to the copying process central to reduplication.

This point can be made by a brief examination of the Kaingang process of plural formation. From Wiesemann's (1972) presentation, one can

isolate three distinct formal means of signalling pluralisation in Kaingang: (a) reduplication of the last syllable; (b) insertion of *g* into the coda of the penultimate syllable; (c) raising of the penultimate vowel to [+high]. Each one of these procedures, as well as combinations involving several of them, is illustrated below:[3]

(5) a. *Final syllable reduplication*

Singular	*Plural*	
kry	kry-kry	'irritate'
jemĩ	jemĩ-mĩ	'grasp'
vasãn	vasãn-sãn	'strain, exert'
jengag	jengag-gag	'roasted meat'

b. *Insertion of* g *into the penultimate rhyme*

kavi	kagvi	'stretch'
kana	kagna	'dried out'
jeten	jegten	'strike with hammer'
juryn	jugryn	'sharpen'

c. *Penultimate V raising to* [+*high*][4]

kagje	kygje	'knot'

d. *Penultimate V raising and* g*-insertion into the penultimate rhyme*

jakajen	jakygjen	'turn, twist'
pafam	pygfam	'quiet'
pefam	pigfam	'quiet'

e. *Reduplication and* g*-insertion into the penultimate rhyme*

nã	nãg-nã	'lie'
ne	neg-ne	'bury'
tav	tag-tav	'turned'[5]

f. *Reduplication and penultimate V raising*

gon	gun-gon	'swallow'
ʔog	ʔug-ʔog	'drink'

g. *Reduplication,* g*-insertion and penultimate raising*

tav	tyg-tav	'turned'
ne	nig-ne	'bury'
ve	vig-ve	'see'
tam	tyg-tam	'cover'
pov	pug-pov	'divided'
jengag	jengyg-gag	'roasted meat'
kavej	kavig-vej	'dirty'

Note that the insertion of the segment *g* and of the feature [+high] into the stem may, but need not coincide with reduplication. Any analysis of the prespecified reduplication encountered in (5g) must take into account the fact that this case is simply a conjunction of three independent procedures (syllable copying, vowel raising and *g*-insertion). Kaingang is a rare case in which the copying step involved in reduplication can be

dissociated from the phenomenon of prespecification: the insertion of a segment or feature.

Cases of non-reduplicative stem modification consisting of feature insertion are generally known as ablaut. An extensive analysis of ablaut in the English strong verbs is provided by Halle & Mohanan (1985) in terms comparable with what I call feature insertion: for instance, the past tense of *sing* is derived by inserting the feature [+low] into the matrix of the root vowel. This yields the low vowel *a* of *sang*. Halle & Mohanan show that some of the most productive ablaut alternations of English can be reduced to rules inserting features such as [+low], [+back] or combinations of these. My point here is that these procedures can be viewed as formally identical to those deriving prespecified reduplication. Given the surface similarity between reduplicative and non-reduplicative feature insertion, the null hypothesis should be that these two cases are in fact one: this is the second facet of H1.

Let us turn now to H2. It is a fact that prespecified reduplication is more frequently encountered in conjunction with partial reduplication. We have seen however that there is some reason to decompose partial reduplication into total copy plus truncation; and that there is reason to analyse prespecified reduplication as the combination of copy and segmental insertion. If so, it would be inexplicable if the occurrence of segmental insertion (*viz.* prespecification) depended on the application of truncation (*viz.* partial reduplication). In this way, the adoption of H1 leads us directly to the claim made by H2: partial and prespecified reduplication should occur independently of each other.

In fact they do. McCarthy & Prince (1986: 84) come close to making this point in their discussion of echo-word formation. I mention here only the most familiar of the examples they discuss in this connection: that of the English *shm-* words such as *linguistics-shminguistics*, *strike-shmike*, *apple-shmapple*, *book-shmook*. The reduplication is in this case total, in the sense that no systematic truncation takes place, and prespecified, in the sense that a segment sequence is inserted into one of the twin stems created by reduplication. The disappearance of the initial onset in cases like *strike-shmike* is a direct consequence of the fact that *shm* is being inserted at the beginning of the first syllable: no English word can accommodate an initial cluster containing *shm* preceded or followed by other consonants. As in the case of Kaingang *g*-insertion, in order to accommodate the insertion of *shm* to the phonotactics of the language one must eliminate incompatible segments, such as the entire initial cluster in *strike*. Cases like these support the hypothesis that there is no necessary connection between the two major modifications that may accompany reduplication: truncation and segmental insertion. This is then the type of evidence supporting H2.

2 The proposal

2.1 Full copy

The goal of this study is to propose a model of modified reduplication. The observations made above lead to the conjecture that the phenomenon of modified reduplication is the joint occurrence of base copying and one or both of the operations of truncation and segmental insertion. Since the burden of characterising partial reduplication can be entirely carried by truncation, we are led to hypothesise that reduplication always begins by making a complete copy of the base. One element of our proposal is then the claim that copying *per se* is always complete copying: the possibility of partial or selective copying – copying a subset of the base tiers or a subset of the base units – is rejected.

Let us now give a more specific outline of the two mechanisms that may accompany reduplication: prespecification and syllabic adjustment.

2.2 Prespecification as segmental insertion

Prespecified reduplication results from the insertion of segments or features into the copied base. The locus of insertion is an existing syllable: for instance, the analysis of the *shm* words of English must mention the fact that *shm* is being *inserted into* the onset of the initial syllable, rather than being *concatenated to* the initial onset. The latter statement would generate forms like **book-shm.book* instead of the attested *book-shmook*. Unlike the segments affixed by concatenation, the segments introduced by insertion cannot generate a new syllable. They must find their place in an existing syllable.

As mentioned before, a number of cases of apparent segment substitution (such as *book-shmook* or Kaingang *tag-tav*) can be explained as stemming from the effect of language-specific phonotactic restrictions on the insertion of a segment: our general hypothesis is that whenever the inserted segment creates a phonotactically ill-formed cluster, a minimally necessary number of neighbouring segments is eliminated. The same convention is required in dealing with the insertion of features: the insertion of [+high] in the matrix of Kaingang *a* (e.g. *kagje* → *kygje*) requires the removal of the conflicting [+low] specification. In this way most cases of segment or feature substitution can be seen as context-free insertion.

The following parameters may be sufficient to characterise the possible sites of segmental insertion: (a) first or last syllable, with the option of extrametricality; (b) onset or rhyme. The site of *shm*-insertion is therefore characterised as the onset of the first syllable, without extrametricality. The site of *g*-insertion in Kaingang is the rhyme of the last syllable, with extrametricality (i.e. the rhyme of the *de facto* penult). Other possible sites can be envisioned, such as a stressed (non-peripheral) syllable, but have not been encountered so far.

2.3 Templates and syllabic adjustment

Syllabic adjustment, the second major class of stem modifications, covers both cases of truncation (elimination or simplification of syllables) and, less frequently, syllable expansion: vowel lengthening or the creation of codas through consonant gemination or resyllabification. The operations of syllabic adjustment can be understood as implementing two types of constraints: constraints on the prosodic weight of the affix and constraints on the markedness of its syllable structure. The sum of such conditions is the template itself. Thus, what one normally refers to as a CV template is viewed here not as a string of two slots, a C and a V, but as a set of two conditions: a weight condition (one light syllable) and a syllabic markedness condition (no complex onsets). This conception of prosodic templates will be essential to the analysis of reduplication proposed below.

2.3.1 *Weight parameters*. The reduplicative template may have a fixed weight. McCarthy & Prince (1986), my major source of generalisations on this score, document the following cases: a disyllabic foot (e.g. Kamaiura *ohuka-huka*); a bimoraic foot, monosyllabic or disyllabic (e.g. Manam *salaga-laga*, *malabon-bon*); a heavy syllable, which we may identify as a strictly monosyllabic foot (e.g. Mokilese *pɔd-pɔdok*, *sɔɔ-sɔɔrɔk*, *paa-pa*, *wii-wi.a*); and one light syllable (e.g. Murut *bu-bulud*, *do-dondoʔ*).[6] If we assume that a light syllable will normally not be footed – an assumption supported by McCarthy & Prince's (1986: 24–30) analysis of Ponapean reduplication – then these cases fall into two major classes: templates that must form autonomous prosodic domains (feet of various types) and templates that must be prosodically adjoined to existing domains (unfootable light syllables).

McCarthy & Prince (1986) add a third possibility: a monosyllabic template of undefined weight. Kaingang reduplication appears to illustrate this case: compare for instance *jemĩ-mĩ* with *vasãn-sãn*, forms suggesting that the last syllable is being copied regardless of whether it is light or heavy. However, it is unclear how this formal possibility could fit into an explanatory classification of prosodic templates. Moreover, it is unlikely that templates like Kaingang's must in fact be distinguished from the heavy monosyllable type. In languages like Mokilese, where vowels can be long, a light syllable like *pa* can be turned into a heavy one by lengthening: this explains how the reduplicated prefix in *paa-pa* comes to satisfy the description of a heavy monosyllable. But in Kaingang segments cannot be long: there are no formal means to turn a light syllable such as *mĩ* in *jemĩ-mĩ* into a heavy one. My suggestion is then that monosyllabic templates of apparently variable weight occur only in circumstances where, for various reasons, light syllables cannot be expanded into heavy ones. If so, then the Kaingang-type template represents the default option of the heavy monosyllable template.

Similar to Kaingang are the reduplications of Southern Paiute (Sapir

1930; Marantz 1984), Kusaeian (Lee 1975) and the Ilocano progressive (McCarthy & Prince 1986). The Ilocano paradigm, typical of this entire class, can be summarised by the following forms: *tak-tak.der*, *trab-tra.ba.ho*, *bas-ba.sa*, *da-da.it*. A heavy syllable like *tak* is copied as such. A light syllable like *ba* in *basa* is expanded by resyllabification (*ba.sa* → *bas.a*) and the resulting heavy *bas* is copied: this derives *bas-basa*. Where resyllabification is made impossible by hiatus, as in *da.it*, the default option, a light syllable, becomes inevitable: *da-da.it*. Like Kaingang, Ilocano lacks distinctive vowel length: this is why the dialect described by McCarthy & Prince fails to systematically lengthen *da* in *da-da.it*.[7]

We can conjecture then that the prosodic weight of templates is always fixed. A further observation supports this idea: if a monosyllabic template consists of an open syllable, its vowel length is always fixed. One finds either CV templates (open and light; as in the Sanskrit perfect) or CVV templates (open and heavy; as in Papago (Hale 1970) and Miskito (Salamanca to appear)). I haven't yet encountered a reduplicative template consisting of an open syllable with variable weight, yielding forms like *ba-bana*, *baa-baana*.[8]

To review then, prosodic weight requirements fall into two major classes: the requirement that the affix be a foot-sized domain and the requirement that the affixal unit not be independently footed. The second case may only correspond to a light syllable. The first case gives rise to various other options, corresponding to different foot types: the mono-syllabic and the disyllabic foot, the bimoraic and the polymoraic foot.

2.3.2 *Syllabic markedness parameters*. It has been repeatedly observed that there is a markedness hierarchy of syllabic structures, supported by the same sort of implicational observations on which the theory of segmental markedness is based.[9] Although the observable markedness relations between syllable types have not so far been explained, they can be catalogued: onsetless syllables are more marked than syllables with onsets, closed syllables are more marked than open ones, complex onsets and codas are more marked than simple ones. The segmental composition of syllables also appears to give rise to a markedness hierarchy: consonantal nuclei are more marked than vocoid nuclei (Trubetzkoy 1969: 196) and obstruent rhymes are more marked than sonorant ones (Clements 1987).

Prosodic templates frequently eliminate certain marked options from their syllabic structures. Although the language may in general allow complex onsets or consonantal nuclei, the template might specifically revoke these options.[10]

We observe the following range of syllabic simplifications in prosodic templates: onset simplification (Tagalog *ta-trabaho*, *bo-bloaut* from McCarthy & Prince 1986: 16); coda simplification (Sanskrit intensive *kan-i-krand-*, discussed below); coda drop (cf. the French hypocoristics *zabe*, *mini* from (*i*)*zabel*, (*do*)*minik*); elimination of consonantal nuclei (Sanskrit perfect *va-vṛma*, discussed below).

A further possible elimination of marked syllabic structures is the treatment of onsetless syllables in reduplication. The Sanskrit intensive template, discussed below, appears to require a non-null onset: onsetless intensive prefixes are generally impossible. Other possible applications of the idea that a template may bar onsetless syllables are discussed in Steriade (1985).

Diana Archangeli (personal communication) points out that a certain dependency exists between the prosodic weight parameters and the syllabic markedness conditions. Syllabic structures are reduced to their less marked form only if some weight condition is also imposed: there are no reduplication types which preserve every syllable of the base and then proceed to simplify complex onsets or drop codas. This observation suggests that the essential ingredient in a template is the weight parameter. A deeper exploration of the defining properties of templates will, however, not be undertaken here.

2.3.3 *Matching procedures.* I turn now to the question of template matching: how can a string of syllables be made to meet the requirements of a template?

An obvious principle underlying most instances of template matching is (6):

(6) Eliminate from the base a unit disallowed by the template.

If, for instance, the base is polysyllabic and the template monosyllabic, all but one of the syllables of the base are removed. If complex onsets are disallowed, all but one of their members are eliminated. Disallowed codas drop. Such changes are all instances of (6). One may think of the effects subsumed under (6) in terms of what Itô (1986) calls prosodic licensing: the template specifically licenses certain positions, to the exclusion of others. And unlicensed positions are eliminated.

In some cases, (6) must be supplemented by more specific provisions. Complex onsets appear to simplify systematically by eliminating *non-initial* consonants, as seen in Sanskrit *kan-i-krand-* and Tagalog *ta-trabaho*. It is perhaps possible to reduce this fact to a preference for abrupt rises in sonority at the beginning of the syllable (cf. Clements 1987) but for the moment we will postulate a specific matching procedure for this case. The format chosen for the statement of matching procedures lists three elements: a parameter of prosodic weight or syllabic markedness, a setting of that parameter, and the means by which an input string can be made to satisfy that setting. The latter is the matching procedure proper. Frequently the matching procedure is simply an instruction on the application of principle (6). This is the case below:

(7) Parameter: complex onset
Setting: unmarked (=complex onsets disallowed)
Matching procedure: (6) applies to non-initial onset consonants

When a template is matched against a base which exceeds the allowed

number of syllables, the syllables removed by (6) belong typically to the left or right periphery of the base. In general, the choice between the left and the right edge is not free: Zuni truncation always eliminates all but the leftmost syllable (recall *melika* → *me-*), while Madurese truncation eliminates all but the rightmost (*abit* → *bit*, *garadus* → *dus* in (2a)). In a few cases, the choice between left and right periphery is left indeterminate: this happens in the formation of French hypocoristics like *zabe(l)*, *iza*, both from *izabel*. Perhaps the same indeterminacy accounts for the existence of the double pattern of reduplication in Dakota: *yaza-za vs. yas-yaza* (Shaw 1976; Kiparsky 1986; Sietsema 1987). The general rule for reducing a polysyllabic base to a monosyllable can be formulated as follows:

(8) Principle (6) applies to eliminate a peripheral and continuous string of syllables.

In the normal case, this principle will be supplemented by a language-specific direction to proceed from the left edge or from the right edge of the stem. In cases like French or Dakota such a provision will be missing and variation of the type *zabe* ~ *iza* will result. As in the case of the matching procedure in (7), it is likely that the effect described in (8) is not unique to template phonology and follows from more general properties of rule application.

Template satisfaction may, in other circumstances, dictate an expansion rather than a compression of the base. Although the evidence is not very clear on this point, it appears that in such cases a variety of procedures may be employed to ensure template satisfaction. As mentioned above, if the template requires syllables with onsets, an onsetless syllable may be provided with a segmentally empty onset position, as in Kamaiura and Chukchee (Steriade 1985). Alternatively, onsetless syllables are simply avoided, as in the case of the Sanskrit reduplicated intensives described below in §4.2.

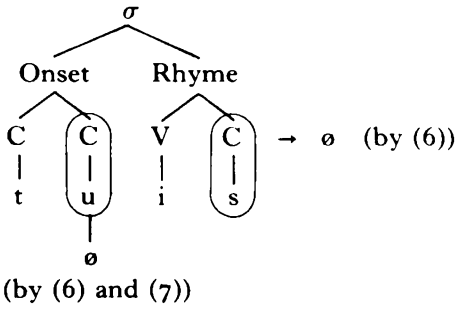
A different type of base expansion is encountered when the template requires a heavy syllable and the base lacks one, or lacks one at the relevant edge. In Mokilese (Levin 1983, 1985; McCarthy & Prince 1986), for instance, the reduplicative template is monosyllabic and heavy, and only the left edge of the base is preserved. When the leftmost stem syllable is already heavy, as in *sɔɔrɔk* 'tear', that syllable satisfies the template without further change: hence *sɔɔ-sɔɔrɔk*. When the stem is monosyllabic and light (e.g. *pa* 'weave'), it is lengthened: *paa-pa*. The same lengthening procedure is used in polysyllabic stems like *di.ar* 'find', where the first and second syllables stand in hiatus: *dii-di.ar*. Finally, when the leftmost syllable is light and followed by a consonant, as in *pɔdok* 'plant', two patterns of reduplication are attested: one is *pɔd-pɔdok*, the other is *pɔɔ-pɔdok*. The second pattern results from the same lengthening as *paa-pa* and *dii-di.ar*. The analysis of the first is somewhat less clear. I suggest, as a stop-gap measure, the possibility that *pɔd-pɔdok* results from re-syllabification in the copied base. The derivation would proceed as follows:

pɔ.dok-pɔ.dok (by reduplication proper) → *pɔd.ok-pɔ.dok* (by resyllabification in the prefix) → *pɔd-pɔ.dok* (by application of (6), which eliminates all but the initial syllable of the prefix). A different explanation of the *pɔd-pɔdok* pattern, which is widely encountered, is proposed by McCarthy & Prince (1987) and will be discussed in §5.5.

The Ilocano progressive reduplication, mentioned above (note 7), indicates that the choice between satisfaction procedures may be dialect-specific: in one dialect the prefix syllable is made heavy by resyllabification (*bas-basa*) and vowel lengthening (*da:-da.it*), in another one by resyllabification and consonant gemination (*bas-basa*, *dad-da.it*), while in a third one only resyllabification operates (*bas-basa*, *da-da.it*). The fact that one and the same structural requirement can be satisfied in a variety of ways is not surprising: the same may be true of more general conditions on the well-formedness of phonological representations, such as the Obligatory Contour Principle (cf. most recently Yip 1988 and references there).

Although much remains to be determined about the exact nature of the satisfaction procedures, two of their properties will emerge clearly from the analysis of Sanskrit reduplication. One is the fact that different parameter settings are being satisfied independently of each other: when the template requires a light syllable with a simple onset and the base provides a syllable like *tvis*, principles (6) and (7) apply independently to eliminate the coda *s* and the second member *v* of the onset, as in (9), which shows how a CCVC syllable comes to satisfy a CV template:

(9) Template:
  a. parameter: weight
     setting: unfootable domain (=one light syllable)
     matching procedure: (6)
  b. parameter: complex onsets
     setting: unmarked (complex onsets disallowed)
     matching procedure: (6) and (7)



The second property of the template satisfaction procedures assumed here is that they are either unordered with respect to each other, as in (9), or else transparently ordered, in such a way that their surface result visibly

meets all template requirements. For instance, consider the case of a base *pat*, matched against a template requiring a heavy syllable ending in a sonorant. Since the coda *t* is an obstruent, it will be eliminated by (6). The weight of the syllable will be computed not on the underlying form *pat* but on the form resulting from the removal of *t*, namely *pa*: since *pa* is light, it must be lengthened in order to meet the weight requirement of the template. The result should then be *pa:*, a syllable which transparently satisfies both template conditions: it is heavy and it ends in a sonorant.

The following is a tentative list of the parameter settings and their associated matching procedures that will be appealed to in this study:

(10) Parameter: weight
Setting: unfootable domain (light syllable)
Matching procedure: (6) and (8)

Parameter: weight
Setting: monosyllabic foot (heavy syllable)
Matching procedures: – resyllabification ($V.CV \rightarrow VC.V$) *or*
– vowel lengthening ($C_0V \rightarrow C_0V$:) *or*
– consonant lengthening
($C_0V.C_iV \rightarrow C_0VC_i.C_iV$) *and*
– (6) and (8)

Parameter: weight
Setting: disyllabic foot
Matching procedure: (6) and (8)

Parameter: complex onsets
Setting: unmarked (=complex onsets disallowed)
Matching procedure: (6) applies to non-initial onset segments

Parameter: obstruent codas
Setting: unmarked (=obstruent codas disallowed)
Matching procedure: (6)

It bears repeating that both the parameter settings listed above and the matching procedures associated with them are not specific to the reduplicative morphology and have no direct connection to it. Reduplication proper is just making a full copy of the base. Modified reduplication is full copy plus certain independent stem modifications, found in non-reduplicative morphologies as well. This hypothesis, H1 above, forms the core of our proposal.

In terms of the inventory of possible templates, the proposal presented here will have results similar, though not identical, to those following from McCarthy & Prince's (1986) ideas on the subject. Our theory adopts McCarthy & Prince's rejection of templates as unconstrained strings of slots. The chief empirical point on which the two accounts differ is that I allow a somewhat larger class of templates, because weight and syllable markedness conditions can combine freely: for instance I allow a CVX template (a heavy monosyllable, whose onset may not be complex), whereas McCarthy & Prince do not. The uses of this template will be considered in the analysis of the Sanskrit intensive.[12] A deeper difference

stems from the fact that templates are atomic entities for McCarthy & Prince: the heavy syllable, the light syllable, the core ((C)V) syllable, etc. Consequently the total list of allowable templates can be arbitrarily extended or compressed: there is no *a priori* reason why any given template, as long as it can be described in the theory of syllable structure adopted, should or should not be on the list. In contrast, templates have no independent existence in the theory advocated here: they are simply the intersection of conditions on weight and syllabic markedness. It is anticipated that these conditions themselves are not specific to the theory of templates but rather derive from the theories of prosodic domains and syllable structure. Finally, McCarthy & Prince (1986) appear to view as central in their approach to template morphology Hyman's (1985) moraic theory of syllable weight: the idea that, no matter how many segments a syllable may contain, it cannot dominate more than two weight units (or moras). The proposal made in this study, although not incompatible with certain versions of moraic phonology, does not rely on any of them.

3 Previous research on reduplication: the copy-and-association model

The preceding sections have put forth a hypothesis about the relation between modified and unmodified reduplication (H1). A model of modified reduplication was sketched, based on this hypothesis. In this section, I outline the currently prevailing views on the mechanisms involved in reduplication and summarise their shortcomings.

Until recently, the autosegmental literature has viewed reduplication as a combination of two mechanisms: copy and association. What is copied is a string of segments. The elements associated are the copied string and the terminals of a segmentally empty template. The template is a sequence of slots with specified syllabicity, Cs and Vs. The view just sketched was introduced by Marantz (1982) and developed in the work of many others, among them Yip (1982), Broselow & McCarthy (1983), Levin (1983) and Kiparsky (1986). The copy-and-association theory of reduplication expresses a fundamental intuition: reduplication is the affixation of a morpheme whose shape, like the shape of normal affixes, is independent of the base it is affixed to. Its independence may not be apparent on the surface, because the affixation of segmentally impoverished morphemes may be accompanied by massive borrowing of segments from the base. But, with minimal exaggeration, reduplication is not too different on this view from affixing a morpheme and applying some harmony rules to the result.

In the last two years it has become increasingly apparent[13] that the copy-and-association model is untenable as first introduced. Various aspects of the model have been identified as the source of difficulty: the nature of the association conventions, what elements have priority in association, what tiers get associated to each other, and finally the theory of syllable structure which underlies the model. I believe, however, that

most of the technical difficulties uncovered, as well as some latent ones, stem from the basic idea that reduplication copies just segments and that the prosodic structure of the reduplicated affix is independent of the base. A survey of these technical difficulties will show that at the root of each problem is the segment-copying procedure.

3.1 Transfer of length

A first sign of inadequacy in the copy-and-association model was Levin's (1983) discovery that vowel length is transferred from the base to the reduplicated affix. If the base contains a long vowel then a long vowel will appear in the affix, provided that the affix is not specifically restricted to a light syllable. Thus a Mokilese reduplication rule creating heavy syllables yields *pɔd-pɔdok* but *sɔɔ-sɔɔrok*. Given a standard representation of vowel length, the copied set of segments from the base *sɔɔrok* is {s, ɔ, r, o, k}: the copy-and-association system would then predict **sɔr-sɔɔrok*:

(11)
```
s   ɔ   r   o   k        s   ɔ       r   o   k
|   |   |                |  /\      |   |   |
C   V   C                C  V  V     C   V   C   (=*sɔr-sɔɔrok)
```

A comparable observation involving consonantal length was recently added by Aronoff *et al.* (1987): a long consonant in the base will surface as long in the reduplicated affix, if the template is appropriately structured. The simplest interpretation of the length transfer effects is that reduplication copies not only segments but also the tier on which length is encoded: the tier of weight units or skeleton. This interpretation is incompatible with the copy-and-association model.

3.2 Priority of association to Vs

The next symptom discovered could be dubbed 'the priority of association to V'. Marantz had noted that certain patterns of reduplication require that association of copied segments be 'segment-driven': a CVC affix added to a vowel-initial stem *ulu* yields not **lu(:)-ulu-* but *ul-ulu-*. We don't try to fill the first empty slot encountered: rather we try to associate the first floating segment. This will derive *ul-ulu*:

(12)
```
        u   l   u        u   l   u
        |   |            |   |   |
    C   V   C            V   C   V
```

But the solution turned out to be incomplete: Clements (1985), Davis (1985) and Kiparsky (1986) noted that many instances of reduplication cannot be derived unless the first step is to link a syllabic segment to the V slot of the template. An example that explains the initial appeal of this procedure will be presented in §4.2.1.3: a *CaC* reduplicating prefix added to a Sanskrit base like *krand* becomes (intermediate) *kan-krand* rather than

**kar-krand*. The initial anchoring of copied *a* to the V slot ensures the correct result in this case:

```
(13) a. k   r   a   n   d        k   r   a   n   d
        ⋮   ⋱                    |   |   |   |   |
        C   V   C                C   C   V   C   C   (=*kar-krand)
            |
            a

     b. k   r   a   n   d        k   r   a   n   d
        ⋮       |   ⋮            |   |   |   |   |
        C       V   C            C   C   V   C   C   (=kan-krand)
                |
                a
```

The addition of a vocalic priority principle to the machinery of reduplication should raise some questions: why are Vs filled first? Kiparsky (1986) has attempted to justify this principle by invoking the analogy of Vs being syllabified first. But the analogy seems remote, because association and syllabification are different operations. A more intuitive reason why *krand* does not reduplicate as **kar-krand* is that *kar* is not a (simplified) version of the original syllable: *kan-*, of the correct *kan-krand-*, is. It is the same syllable as *krand*, with a simplified onset and a simplified coda. But defining in general what is meant by 'a version of the original syllable' is strictly impossible in a copy-and-association model, since the partial CV(C) reduplication leaves the syllable structure of the base behind. If our guess is on the right track, then what Clements, Davis and Kiparsky have uncovered is not the need to give priority in association to Vs but rather the fact that partial reduplication copies not just segments but also syllable structure.

3.3 Discontinuous association

We can arrive at the same conclusion by starting from a different technical angle. McCarthy & Prince (1986: 11) note that 'free loss of melodic material under phoneme-driving leads to false predictions'. A case in point is the Ilocano reduplication *-da-da.it*. The prefix should be CVC in this case, since *takder* and *basa* reduplicate as *-tak-takder* and *-bas-basa*. Why then should *da.it* not allow its *t* to associate to the final C of this CVC prefix? Why not **dat-da.it*?

```
(14) d   a   i   t        d   a       i   t
     ⋮   ⋮       ⋮        |   |       |   |
     C   V       C        C   V   .   V   C
```

This is where the injunction against discontinuous association can help: in **dat-dait* the string *dat* does not correspond to a continuous portion of the

base.[14] But then why is Sanskrit *kan-krand-* possible, with its elimination of *r*?

This paradox does not arise if we abandon the copy-and-association model. If reduplication begins as a full copy of the base, as argued here, then both segments and their associated prosodic structure are copied. In cases of partial reduplication only a portion of the copied base is preserved, forming a prosodic unit: a syllable or a foot. The portion preserved will be continuous. This explains why **dat-dait* is impossible: *dat* does not correspond to any actual or possible syllable definable on the base string.

3.4 Total and partial reduplication

A conceptual problem already revealed in Marantz' original 1982 study was the artificial distinction created by this model between total and partial reduplication. Naively described, the difference between the two is that total reduplication repeats the base in its entirety whereas partial reduplication preserves only a portion of the base. But in the copy-and-association model, the two types must differ in two unrelated respects: partial reduplication, say CV reduplication, is the affixation of an empty sequence CV, followed by copy and association of base segments. Total reduplication not only affixes a different sort of item, a prosodic category Word or Foot, but also copies a different sort of string: the base segments *and* their associated syllabic or metrical structure.

The description of partial reduplication as affixation of segmentally empty C and V slots had initial appeal, because there was evidence for such units in phonology and morphology (cf. McCarthy 1979; Clements & Keyser 1983; among others). But the extension of the model to total reduplication made necessary notions like a segmentally and prosodically empty Foot or Word, whose formal content has remained obscure. We are accustomed to view the foot, the word(-level tree) or the syllable as abstract prosodic categories and we are familiar with conditions like *string X must have the structure of a binary foot*: but in the copy-and-association model what is needed are not prosodic conditions like this but rather concrete slots to associate copied elements to. The interpretation of Foot, Word or even Stem (Clements 1985) as fillable slots, on a par with C and V, was never supported by anything other than a desire to preserve the copy-and-association model.

There is good reason to maintain the naive view that total and partial reduplication differ only minimally. In some cases, it can be directly proven that what surfaces as partial reduplication begins derivationally as total reduplication, in the sense that the entire syllable structure of the base has been copied (cf. Lovins 1971 and §4.3 below). Both types of reduplication may be accompanied by tonal or segmental changes in the content of the copied base: we have discussed this phenomenon above, under the label of prespecified reduplication.

It is also important to note that the theory of prespecification emerging

from the copy-and-association approach to reduplication has made it impossible to deal with both cases in identical ways. Cases of prespecified partial reduplication were analysed (in Marantz 1982, following McCarthy 1979) as templates which combine free slots and slots prelinked to segments or features. This was a natural assumption in the context of the hypothesis that reduplicative templates are simply segmentally impoverished morphemes: there should be a continuum of specification from 'normal' morphemes, whose every slot has an associated segment, to purely 'skeletal' morphemes, completely lacking in segmental specifications. The expected in-between cases were identified as the prespecified templates. But this makes it impossible to analyse in the same way the prespecification associated with total reduplication. However we identify the object affixed in total reduplication, it is not a fixed sequence of CV slots: and if there are no fixed slots, there cannot be any prespecified slots. This problem was first detected by McCarthy & Prince (1986) in their discussion of echo words: I illustrate it with one of their examples, that of Kolami echo words:

(15)	pal-gil	'tooth'
	kota-gita	'bring it'
	iir-giir	'water'
	maasur-giisur	'men'
	saa-gii	'go' (cont. ger.)

This is a case of total reduplication accompanied by two changes: the first onset is replaced by *g* and the first nucleus by *i*. Had the syllable structure of the copy been fixed, say CVC, we could analyse it by affixing *giC* and by filling the empty C via reduplication. But the syllable structure of the affix is in this case completely dependent on that of the base. The result is that we must adopt a different technique: we must insert the onset *g* and the nucleus *i* into the copy.

It follows then that, within the copy-and-association model, two distinct procedures must underlie what looks like a single phenomenon: on the one hand, templates with prespecified slots; on the other hand, segment insertion. Nothing of substance justifies this formal distinction.

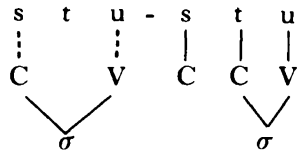
3.5 Transfer of syllable structure

It will be shown here that, in the general case, the syllabic position of a base segment is matched by that of the corresponding reduplicated segment. A segment syllabified as onset in the base is, in general, not reduplicated as part of the rhyme. A coda segment never surfaces as an onset under reduplication. Syllabically stray segments are not reduplicated as syllabified segments.

Some of these observations have been made in previous literature. Clements (1985) notes that the syllabicity of a segment in the base is preserved under reduplication: that, for instance, the onset *y* in a syllable like *ya* is not copied as a nucleus *i*. The effect of syllabically stray segments

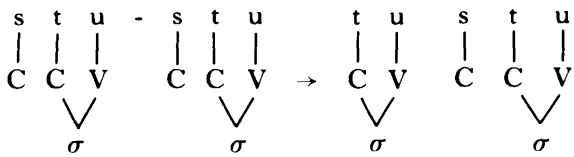
on reduplication was observed in Steriade (1982): a root *stu-*, with an initial stray *s*, reduplicates in Sanskrit as *tu-stu-*, not as **su-stu-*. The stray *s* from the root cannot appear as an onset *s* in the reduplicating syllable. Further syllabic transfer effects observable in Sanskrit reduplication were discussed in Steriade (1985).

I will suggest here that these observations illustrate the rule: syllabic position is in general preserved under reduplication. Granted this, we should note that syllabic transfer is as incompatible with a copy-and-association approach as the length transfer effect is. Consider for example the case of Sanskrit *tu-stu*, to be discussed in greater detail below. A copy-and-association derivation of this form will begin with affixation of a CV template and the copying of root segments:

(16)


Left-to-right association of floating segments to slots will yield **su-stu*. Note that the syllabically stray status of the base *s* cannot be reflected by its counterpart in the floating copied string.

The difficulty observed here stems, once again, from the fact that copying is selective, i.e. limited to segmental material, rather than total. Had reduplication started as a copy of the entire root morpheme, there would be no difficulty in explaining the syllabic transfer effect:

(17)


The simplified derivation in (17) shows the effect of principle (6) introduced earlier. Because the reduplicating template provides only for a monosyllable (not accompanied by unsyllabified segments) the unlicensed stray *s* is eliminated. What is being preserved of the copied root is the substring forming a CV syllable: *tu*.

3.6 Alternatives to copy and association

3.6.1 *Parafixation.* The phenomenon of length transfer has so far inspired the only substantial departures from the copy-and-association model. Clements (1985), to whom we owe the terminology of transfer, has suggested that reduplication involves the imposition of a template directly on the base. The template continues to be defined as a sequence of CV slots. No copying of segments takes place. Rather, the slots of the template are linked to the slots of the base and the template thus associated acquires segmental content by convention: a template slot will receive the same

segment as its associated base slot. The two Mokilese examples mentioned above will be analysed as follows:

```
(18) a. C  V  C
        |  |  |
        C  V  C  V  C  →  C  V  C  -  C  V  C  V  C
        |  |  |  |  |     |  |  |     |  |  |  |  |
        p  ɔ  d  o  k     p  ɔ  d     p  ɔ  d  o  k

     b. C  V  C
        |  |  |
        C  V  V  C  V  C  →  C  V  C  -  C  V  V  C  V  C
        |  \/   |  |  |     |  \/      |  \/   |  |  |
        s  ɔ    r  o  k     s  ɔ       s  ɔ    r  o  k[16]
```

Some of the problems listed above receive a natural solution in this way. In particular, length transfer falls out from the procedure of slot-to-slot association.

But other problems persist, and they stem from the fact that the templates of partial reduplication continue to be seen as actual sequences of CV slots rather than as conditions on the syllabic shape of the affix. The artificial difference between total and partial reduplication continues to exist. It continues to be unclear why association to discontinuous positions is possible in *kan-krand* but not in **dat-dait*. It is still necessary to stipulate, as Clements (1985) was the first to note, that Vs should be given priority in association.

3.6.2 *Reduplication as lexical look-up*. McCarthy & Prince (1987) present a different solution to the problem of quantitative transfer in reduplication. They note that this phenomenon has so far been attested only in languages with distinctive length and generalise this observation as follows: all and only lexically distinctive aspects of the base are transferred in reduplication. Lexically distinctive aspects include unpredictable mappings between skeleton and segments: where the skeleton is not in a predictable one-to-one correspondence to the string of segments, the unpredictable portion must be lexically encoded. What must be lexically encoded is being copied in reduplication. Reduplication is then not selective copying but rather lexical look-up.

The aspect of this theory which is directly responsible for explaining length transfer is the possibility of copying elements of syllable structure from the base. The fact that these must be *distinctive* rather than predictable elements is a separate aspect of the theory: it can be accepted or rejected on its own. I will suggest in § 5.5 that we should reject it, noting that non-distinctive properties of the base appear to be copied as well.

3.6.3 *Partial reduplication as total reduplication*. The idea that syllable structure is copied along with the base segments provides the groundwork

for a solution to the remaining problems raised here. Many of the answers are already implicit in McCarthy & Prince's (1987) study. Our proposal is to large extent a development of that work.

The central point of the theory sketched in §2 is that the first step in partial reduplication is always full reduplication: both the prosodic structure and the segmental substance of the base is copied. Where partial reduplication is observed, it is the result of operations which eliminate syllables or alter their shape. The latter class of procedures can be globally characterised as implementing requirements of syllabic markedness. Not every conceivable alteration of a syllable's shape is admitted but only those which lead to the creation of a syllable that is, in at least one respect, less marked than the original.

In this approach to reduplication most questions raised by the copy-and-association framework receive simple answers or else fail to arise.

Length is transferred in cases like Mokilese *sɔɔ-sɔɔrɔk* because the copied structure is the entire base, including its first, long, nucleus. The prefix is limited in this case to a heavy syllable. Because the weight condition is satisfied by the first syllable of the copied base, *sɔɔ*, this syllable is preserved as such and the remainder of the stem is eliminated.

The priority of Vs in association is eliminated as a principle as soon as the procedure of copying segments only is rejected. We will see in detail how one phenomenon that appears to support this principle can be explained: the Sanskrit intensive type *kan-i-krand*.

The question of discontinuity in association also fails to arise. Ilocano **dat-da.it* is impossible because the syllable *dat* cannot be defined through resyllabification or any other means in the copied base.

In general, the only structural differences between the base syllables and the surface syllables of the reduplicated affix will stem either from the V.CV → VC.V resyllabification induced by weight requirements (as in Mokilese *pɔd-pɔdok*) or from the imposition of syllabic markedness requirements (as in Sanskrit *kan-i-krand-*). The theory of reduplication proposed here *predicts* as the unmarked case the existence of syllabic transfer in reduplication.

3.7 Preliminary notes

The rest of the paper is divided into three sections. §4 is an analysis of two Sanskrit reduplication types: the perfect and the intensive. We will observe in both cases that the syllabic position of a base segment is preserved under reduplication. We will also observe that both reduplication types, although surfacing as partial CV and CVC reduplication, begin as complete copies of the base syllable. §5 documents the same observations on transfer of syllabic structure outside of Sanskrit.

The syllabic notation used here is the X notation due to Levin (1983, 1985): a modified version of the more familiar CV theory. Every segment has an associated skeleton position but syllabicity is not encoded in the skeleton: there are no Cs and Vs but just Xs. The difference between a

syllabic and a non-syllabic position is configurational: the syllabic X is the leftmost X of the rhyme. Some further discussion of the relevant issues of syllabicity and syllable-internal structure is provided in §§4.1.3 and 4.1.5. We will note that the argument presented can be recast in the moraic theory of Hyman (1985), provided that notions equivalent to onset and rhyme can be defined. A more systematic defence of the traditional division between onset and rhyme appears in Steriade (1988).

The graphic device used to represent syllabic constituent structure is bracketing rather than tree-graphics. I use the former in order to prevent confusion between two distinct views of syllable structure: the autosegmental one (Kahn 1976; Clements & Keyser 1983) and the metrical one (Kiparsky 1979, 1981; Steriade 1982; Levin 1985). The latter view is adopted and defended here. No brackets need be labelled: the structure [X[XX]] is interpreted as a syllable with an onset and a long nucleus (CVV). The structure [[X]] is an onsetless light syllable (=V). To distinguish open and closed syllables we follow Levin (1985) and recognise a rhyme-internal constituent, the nucleus: a CVC syllable will be represented by the structure [X[[X]X]].

4 Sanskrit reduplication

4.1 Background

The analysis of Sanskrit reduplication requires an introduction to the Sanskrit ablaut system.

4.1.1 *Sanskrit syllabics.* The underlying vowel inventory of Sanskrit consists of {a, i, u}, long and short. Surface *e* and *o*, both of which represent long vowels, result from the contraction of *ai*, *au* diphthongs. Consonantal sonorants may also be syllabic: syllabic *r* is present on the surface while the syllabic nasals *n* and *m* always surface as *a*.

Sanskrit possesses a number of hiatus resolution rules, whose effects are outlined below:[15]

(19) a. Shortening: V: → V/ — V
b. Contraction: ai → e (=[e:]); au → o (=[o:])
c. Coalescence: aa → a:; ii → i:; uu → u:
d. Glide Formation: ia → ya; ua → va

In some cases, when for predictable or unpredictable reasons Glide Formation fails to apply, a homorganic glide is inserted to separate a high vowel from a following vowel:

(20) Glide Insertion: ia → iya, ua → uva

Glide Insertion applies regularly at the boundary between the reduplicating syllable and the root: intermediate *i-ai-a*, *u-auc-a* fail to undergo Glide Formation (whose result would be **yaya*, **voca*) and surface with an inserted glide as *iyaya*, *uvoca*.

4.1.2 *Zero grade and Syncope*. Nominal and verbal roots alternate between three states: the full grade (in which the root syllable contains a nuclear *a*); the zero grade (in which the nuclear *a* is absent); and the extended or long grade (in which the nuclear vowel is lengthened). The alternations between full and zero grade correlate with accentual shifts, as seen below:[16]

(21)	root	full grade	zero grade	zero grade	
	pan	pa-pán-a	pa-pn-úr	pan-itá-	'admire'
	pat	pa-pát-a	pa-pt-úr	pat-itá-	'fly'
	baudh	bu-báudh-a (bubódha)	bu-budh-úr	budh-tá- (buddhá)	'wake'
	paiṣ	pi-páiṣ-a (pipéṣa)	pi-piṣ-úr	piṣ-ṭá-	'crush'
	smai	si-smái-a (sismáya)	si-smi-úr (sismiyúr)	smi-tá-	'smile'

The location of root *a* is unpredictable: in the next set of forms, *a* is seen to occur root-initially (in *aiṣ*, *auc*), root-medially (in *yaj*, *vac*), after two segments (in *vraɕc*) or after just one (in *vardh*):

(22)	root	full grade	zero grade	zero grade	
	aiṣ	i-áiṣ-a (iyéṣa)	i-iṣ-úr (i:ṣúr)	iṣ-tá- (iṣṭá-)	'seek, desire'
	yaj	i-yáj-a (iyája)	i-ij-úr (i:júr)	ij-tá- (iṣṭá-)	'offer'
	auc	u-áuc-a (uvóca)	u-uc-úr (u:cúr)	uc-tá- (uktá-)	'please'
	vac	u-vác-a	u-uc-úr (u:cúr)	uc-tá- (uktá-)	'speak'
	vraɕc	va-vráɕc-a	va-vr̥ɕc-úr	vr̥ɕc-ná- (vr̥kná-)	'cut up'
	vardh	va-várdh-a	va-vr̥dh-úr	vr̥dh-tá- (vr̥ddhá-)	'grow'

The unpredictable position of *a* suggests that the full grade reflects the underlying representation of the root. The same conclusion must be drawn from the fact that the full-grade form is invariably a heavy syllable, in contrast with the zero grade, which may but need not be heavy: compare the full grades of *ai* 'go', *sau* 'press', *smai* 'smile' with the corresponding zero grades *i*, *su*, *smi*. In its basic form – the full grade – a Sanskrit root is subject to a prosodic weight requirement: it must be a heavy monosyllable. The fact that this requirement is satisfied underlyingly may be obscured by the later operation of phonological rules. We conclude from this that the zero grade is derived from the full grade by the deletion of underlying *a*. The conditioning environment is lack of accent. As we shall see shortly, the deletion rule removes not only the segment but also its associated syllabic position. I formulate it in the X notation:

(23) *Syncope*

$$\begin{array}{l} a \\ | \\ X \rightarrow \emptyset \ / \ \text{if unaccented} \end{array}$$

Long *a:* is unaffected by Syncope, a fact predictable in terms of the constraints on geminates studied in Hayes (1986) and Schein & Steriade (1986). The vast majority of roots containing *a:* are invariant. Some apparent exceptions to this will be discussed below.

4.1.3 *Vocalisation*. In roots like *yaj* 'offer', *aiṣ* 'seek' (surface [eṣ]) the operation of Syncope yields the syllables *ij* and *iṣ*, where nuclear status has been transmitted to another vocoid. I will refer to this syllable-internal restructuring occasioned by Syncope as Vocalisation and will discuss below the conditions to which it is subject. In the cases discussed here, Syncope applies only if Vocalisation is applicable. More on this below.

The following observations can be made about Vocalisation. If the root syllable contains a sonorant in the rhyme, then only this sonorant can vocalise. Thus *ɕrau* 'hear' becomes *ɕru*, not **ɕṛv*, in the zero grade. Similarly, *dhvar* 'injure' and *syand* 'move on' become *dhvṛ* and *syṇd* (surface *syad*), rather than **dhur* and **sind*, even though the latter are well-formed syllables in Sanskrit. In certain cases, a rhyme sonorant cannot vocalise: if this happens, no other sonorant can vocalise either and Syncope fails to apply. Thus *svan* 'sound' fails to turn to *svṇ* in morphological contexts where a zero grade is expected; since *n* cannot vocalise, Syncope fails to apply and this root remains invariant *svan*. What is remarkable about such cases is that the onset sonorant also fails to vocalise: a root like *svan* does not become **sun*.[17]

In the few cases where the rhyme contains more than one sonorant, only the leftmost will vocalise: *saiu* 'sew' becomes *si:v* in its zero grade,[18] *kaunc* 'shrink' becomes *kunc*, not **kvṇc*. Of these, at least **kvṇc* is a well-formed intermediate representation (cf. *syṇd* from *syand* 'move', *vṇ* from *van* 'win', *dhvṇs* from *dhvans* 'scatter') and cannot be ruled out on phonotactic grounds.

In the absence of a rhyme sonorant, an onset sonorant may vocalise: we observe this in roots such as *svap* 'sleep', *vac* 'speak', *myakṣ* 'glitter', *yaj* 'offer', whose zero grades are *sup*, *uc*, *mikṣ*, *ij*. If the onset contains more than one sonorant, the rightmost will vocalise: *vraɕc* 'cut up' becomes *vṛɕc*, not **urɕc*. Once again, we note that there is nothing wrong with the *syllable* **urɕc*: what is ruled out is *urɕc* as the syncopated and vocalised version of *vraɕc*.

The facts presented so far can be understood in terms of a relational interpretation of syllable structure. The nucleus of a syllable, like the head of a foot, is configurationally defined as the leftmost position in the rhyme. When *a* is deleted by Syncope, a following tautosyllabic segment becomes automatically leftmost in rhyme and therefore nucleus. The config-

urational definition of the nucleus explains two facts: first, that a rhyme sonorant will vocalise in preference to an onset, regardless of how they compare in relative sonority (cf. *syand* → *syṇd*); second, that the leftmost rhyme segment will always be the one to vocalise (cf. *kaunc* → *kunc*). This automatic transfer of nuclear status is reminiscent of the transfers of headship within stress feet, which occur when the stressed syllable is deleted or turned into a glide (Al-Mozainy *et al.* 1985; Kenstowicz 1983; Harris 1986) and indicates that the same principles govern the organisation of metrical and syllabic constituents.

Vocalisation reassigns nuclear status subject to the general condition that only sonorants can be syllabic in Sanskrit, a condition expressed below in the form of a filter:

(24) $*\begin{array}{c}[-\text{son}]\\ |\\ \sigma[\ldots[X\ldots]]\end{array}$

We know independently that *i*, *u* and *r* are possible underlying nuclei: in particular, underlying syllabic *r* is seen in nouns such as *ṛṣi* 'seer', *vṛka* 'wolf', which are invariant and do not result from Syncope. The occurrence of syllabic nasals outside the cases created by Syncope cannot be determined, since an invariant syllabic nasal is indistinguishable on the surface from an invariant *a*: but nothing indicates that nasals should be excluded from the set of possible syllabics, at least in the early stages of Sanskrit.

When no rhyme sonorants are left after Syncope, and Vocalisation cannot apply without violating (24), the syllable is subject to the minimal restructuring described below:

(25) *Restructuring*
A syllable lacking a well-formed nucleus is restructured by reassigning an onset segment to the rhyme.

$[\ldots X_1[X_2\ldots]] \rightarrow [\ldots[X_1 X_2\ldots]]$

It is understood that the reassigned X_2 must be a possible nucleus: in Sanskrit this means that it must be linked to a sonorant. Since the restructuring is minimal, only the innermost onset sonorant will become nucleus. This explains the *vraɕc* → *vṛɕc* derivation and the exclusion of **urɕc*.

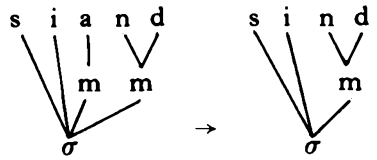
To summarise then, there are three mechanisms behind Vocalisation:

(26) *Vocalisation*
a. At every stage in the derivation, the nucleus is the leftmost rhyme segment.
b. Only sonorants can be nuclear (=(24)).
c. Restructuring (=(25)).

Since the onset–rhyme distinction will play a major role in the analysis, we may note at this point that existing theories of syllabic organisation can

provide an account of Vocalisation only to the extent that they incorporate this distinction, directly or indirectly. The point can be made by comparing two versions of the mora theory presented in Hyman (1985) and McCarthy & Prince (1986, 1987). A version mentioned by McCarthy & Prince (1987) has onset segments dominated directly by the syllable node and rhyme segments distributed among the two moras. Although neither the rhyme nor the onset corresponds in this view to a subsyllabic constituent, they have structural counterparts: what I call a rhyme segment corresponds to a segment dominated by a mora and what I call an onset segment corresponds to a non-moraic segment. This structure predicts the correct direction of Vocalisation, if not the proper syllabic weight of the output syllable:

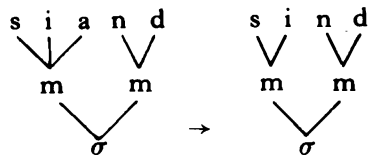
(27)



(= synd (→ syad))

The more widespread version of mora theory (Hyman 1985) assigns the entire onset and the first vowel to the initial mora (e.g. *sya* in *syand*), and the rest of the syllable to the second mora. The syllable peak in a case like *syand* can be identified as the highest sonority element associated with the first mora: in this case *a*. There is no structural equivalent in this theory for the notions onset and rhyme. The theory makes the systematically wrong prediction that a sonorant in the first mora (=an onset sonorant) will vocalise in preference to a sonorant in the second mora (=a rhyme sonorant):

(28)



(= *sind)

This will serve as the Sanskrit-internal justification for the onset–rhyme distinction.

4.1.4 *Syncope as a variable rule.* The applicability of Syncope depends, among other things, on the applicability of Vocalisation. When Vocalisation is strictly impossible, Syncope either fails to apply or, less frequently, applies only to an intervocalic *CaC* root.[19] What we observe in this section is that even when Vocalisation is possible, Syncope applies variably, depending on two factors: the relative sonority of the segment to be vocalised[20] and its structural distance from the underlying nucleus. Syncope is less frequent in roots where it leads to the vocalisation of a low sonority element than in roots where a high sonority segment would vocalise. Syncope is also less frequent in roots in which it leads to the

vocalisation of an onset sonorant. The term VOCALISABLE SEGMENT used below refers to a segment which would be designated as syllabic peak by Vocalisation if Syncope were to apply to the root. Thus *n* is vocalisable in *kvan*, but *v* is not: were Syncope to apply to this root, it would yield *kvn̥*, not *kun*. In contrast, *v* is vocalisable in *svap*, since no sonorant follows: when Syncope applies, we get *sup*. It must be emphasised at the outset that a vocalisable segment is not necessarily vocalised: *kvan* does not in fact undergo Syncope and its *n* never does become syllabic.

We note first the effect relative sonority has in the vocalisation of onset segments:[21]

(a) No roots are found in which an onset nasal vocalises: there are no alternations between full-grade *(C)naC* and zero-grade *(C)n̥C* (= surface *(C)aC*). For instance the onset *n* in roots like *ɕnath* 'pierce' or *naɕ* 'be lost' is never syllabic: there are no zero-grade forms **ɕath* (from **ɕn̥th*) or **aɕ* (from **n̥ɕ*). The same goes for *m*: the few examples of intermediate syllabic *m* all come from roots in which *m* is a rhyme segment. Thus *gam* 'go' alternates with *gm̥* (surface *ga-*) in its zero grade. But roots like *mad* 'be exhilarated' do not have zero-grade variants such as **m̥d* → **ad*. Both *mad* and *ɕnath* are invariable, as are all roots where only an onset nasal could vocalise.

(b) Onset *r* is less likely to vocalise than an onset vocoid: we observe a vocalised onset liquid in only five out of the twenty-nine roots of the form *(C)ra(C)* in which *r* is in principle vocalisable. In contrast, onset *i* and *u* are subject to vocalisation in seventeen of the twenty-eight roots containing a vocalisable onset vocoid.

Next, we observe the effect of relative sonority in the vocalisation of rhyme segments:

(c) The least sonorous among nasals, *m*, is less likely to appear vocalised than *n*: only six among the twenty roots of the form *Cam(C)* show a zero-grade variant *Cm̥(C)* (surface *Ca(C)*) as against thirty-six roots with rhyme *n* out of the forty-eight roots of the form *Can(C)*.[22]

(d) Nasals as a class are less likely to vocalise in the rhyme than the liquids *r*, *l*: there are sixty-eight roots like *bhranɕ* or *gam* with a vocalisable rhyme nasal, of which only forty-two show Syncope and Vocalisation. The rest are invariable. In contrast, of the eighty roots with a vocalisable rhyme liquid (e.g. *mard*), seventy-one have a syncopated zero grade with syllabic *r*.

(e) There is a small but discernible difference in the likelihood of Syncope between roots with vocalisable rhyme vocoids and roots with vocalisable rhyme liquids. There are seventy-five C_0aiC_0 roots, all of which have syncopated zero grades C_0iC_0. There are eighty-two C_0auC_0 roots, of which only one, *au* 'favour', fails to undergo Syncope. In contrast, of the eighty C_0arC_0 roots, at least nine are invariant.

Comparing now the vocalisation of onset and rhyme segments, we observe that the likelihood of Syncope goes down if it leads to the vocalisation of an onset sonorant.

(f) There are seventy-five roots containing a vocalisable rhyme *i*. All undergo Syncope. There are thirteen roots containing a vocalisable onset *i* (e.g. *myakṣ* or *tyaj*). Only seven undergo Syncope: the rest are invariant.

(g) There are eighty-one roots containing a vocalisable rhyme *u*: all but one syncopate. There are eighteen roots with a vocalisable onset *u* (e.g. *svap* or *tvakṣ*). Only ten syncopate.

(h) There are eighty roots with vocalisable rhyme *r* (e.g. *mard*), of which seventy-one syncopate and yield forms like *mṛd*, with syllabic *ṛ*. There are twenty-eight roots with vocalisable onset *r* (e.g. *gras*, *grabh*) and only four or five among them syncopate. For instance, *grabh* yields *gṛbh*, but *gras* remains invariant.

(i) There are forty-eight roots with rhyme *n*, of which thirty-six syncopate and yield syllabic *ṇ*. In contrast, of the six roots with vocalisable onset *n* (e.g. *nad*), none is syncopated. Given the very small number of roots with vocalisable onset *n*'s, we should not conclude that there is an absolute ban against their vocalisation: but rather that their vocalisation is very unlikely. The same holds for *m*.

These observations suggest that the applicability of Syncope–Vocalisation is gradient rather than categorical and depends on two distinct factors: the syllabic position (rhyme or onset) of the vocalisable segment within the input syllable and the inherent sonority of that segment. These two factors are responsible for the two tendencies observed:

(29) a. Syncope is less likely to apply if it leads to the vocalisation of lower sonority segments.
b. Syncope is less likely to apply if it leads to the vocalisation of onset segments.

The cumulative effect of these tendencies is that the most likely roots to have a zero-grade alternant resulting from Syncope–Vocalisation are roots containing a rhyme vocoid ((*C*)*ai*(*C*) or (*C*)*au*(*C*)); the least likely roots to have a zero-grade alternant are roots containing an onset nasal and an obstruent in the rhyme: roots such as *mad* or *ɕnath*. Roots containing vocalisable onset vocoids are predicted to vary in whether they undergo Syncope: indeed, the applicability of Syncope to this class appears to be random. For instance, *vas* 'shine' undergoes Syncope and becomes *us*, while homophonous *vas* 'clothe' remains invariant *vas* throughout. The same contrast can be observed between alternating *svap/sup* 'sleep' and invariant *svaj* 'embrace'.

The reader may wonder now whether the two tendencies outlined in (29) can replace the sum of mechanisms we call Vocalisation. They cannot. The one invariant aspect of this phenomenon is the fact that an onset sonorant never vocalises in a root that also contains a rhyme sonorant, regardless of how the two compare in relative sonority. Examples illustrating this point are roots such as *krand/krṇd* 'cry out' (not **krṇd*), *vanc/vṇc* 'move crookedly' (not **unc*), *van/vṇ* 'win' (not **un*), *yam/yṃ*

'reach' (not **im*), *syand/syṇd* 'move on' (not **sind*), *var/vṛ* 'cover' (not **ur*).[23]

The observations in (29) cannot predict this: only Vocalisation can.

4.1.5 *Vocalisation and underlying syllabicity distinctions.* In an earlier study (Steriade 1985), I had attributed the impossibility of Syncope in the invariant roots like *svaj* 'embrace' to the fact that they contain underlyingly non-syllabic vocoids. Alternating roots like *svap/sup* 'sleep' would contain potentially syllabic *u*: a vocoid without predetermined syllabicity. If *svaj* is underlying /swaj/ with an invariant, unvocalisable glide, then Syncope will not apply to this root because its output cannot be syllabified as **swj*. The principal attraction of this account was that it explained an independent fact about perfect reduplication: roots like *svaj* reduplicate as *sa-svaj-a* whereas roots like *svap* reduplicate as *su-svap-a*. The idea is that the underlying *w* of *svaj* cannot associate to the nuclear position of the perfect reduplication prefix; whereas the *u* of *svap* can.

There are, however, several considerations which made this account untenable, quite aside from the debated distinction between underlying glides and underlying vowels.

The clearest counterargument is the fact that the distribution of Sanskrit underlying glides is mysteriously restricted to a few positions within the verbal root. There are practically no underlying glides in the postnuclear position of the root: practically no roots such as *(C)ay(C)*, *(C)aw(C)* which fail to undergo Syncope and Vocalisation. The distribution of non-alternating *r* is similarly restricted: with one exception, *car* 'move', old roots with a postnuclear *r* alternate between full-grade *(C)ar(C)* and zero-grade *(C)ṛ(C)*. In contrast, there are numerous non-alternating *r*'s in the onset of Sanskrit roots: for instance *tras* 'be terrified', *prath* 'spread', *gras* 'devour', along with many others, have no variants with syllabic *r*.

A second reason to reject the underlying glides has to do with the difference in segmental structure between vowels and consonants. The syllable structure alone cannot distinguish between the vocoid of *svap* and the invariant glide of *svaj*: if a distinction exists, it must be encoded at the segmental level. Now, it *is* possible to establish a segmental distinction between *u* and *w*: the former could be analysed as a high back vocoid ([−consonantal, +high, +back]) while the latter could be a labial vocoid ([−consonantal, +round]). This may in fact be the right analysis for languages such as Maori (Krupa 1968), where *w* participates along with consonantal labials such as *p* and *m* in a rule of labial disharmony, whereas *u* does not (cf. Steriade 1987). We can even extend this type of analysis to the distinction between *i* and *y*: the former could be [−consonantal, +high, −back], while the latter could be a coronal vocoid [−consonantal, +coronal, −anterior]. The general idea is to use primarily consonantal features such as [labial] and [coronal] for non-syllabic sounds and to reserve use of the vowel features [high] and [back] for the syllabic or potentially syllabic sounds. But the problem is that in Sanskrit we must

distinguish not only invariably non-syllabic *y* and *w* from alternating *i/y*, *u/w* but also, to the same extent, the invariably non-syllabic *r* (of *car*, *gras*, *trap*) from the potentially syllabic *r* of *kar/kṛ* and *grabh/gṛbh*. There is no hope of distinguishing in segmental terms between syllabic and non-syllabic *r*: all *r*'s of Sanskrit are indisputably coronal segments, as shown by the fact that they participate equally in the rule of Nasal Retroflexion or Ṇati (cf. Schein & Steriade 1986). Nasal Retroflexion is triggered by invariably non-syllabic *r*'s (*trap-ana* → *trap-aṇa* 'abashed'), as well as by alternating *r*'s (*grah-ana* → *grah-aṇa* 'seized', *gṛbh-na-ti* → *gṛbh-ṇa-ti* 'seizes') and by invariably syllabic ones (*jṛmbh-ana* → *jṛmbh-aṇa* 'gaped'). Thus, the only segmental difference between the *r* of *trap* and that of *grabh* can be a diacritic feature such as [syllabic], whose specifications remain unpredictable. Such use of [syllabic] will undermine the significant prospect of accounting for the attested glide/vowel distinctions with independently needed differences in segmental composition.

I must add to this the obvious remark that glide/vowel distinctions are quite common and play a significant role in the underlying segmental inventory of languages such as Yokuts (Newman 1944), Berber (Guerssel 1986) and Spanish (Harris 1987): in contrast, underlying distinctions of syllabicity among consonantal sounds, including consonantal sonorants, are virtually unheard of. This relates to the fact that it is possible to distinguish in segmental terms between *w*, *y* and *u*, *i* but not between *r*, *l*, *m*, *n* and their syllabic counterparts. If correct, this observation suggests quite strongly that underlying distinctions between syllabic and non-syllabic elements can be made segmentally but not structurally: segments may contrast underlyingly in terms of their feature composition, not in terms of their association to a nuclear position. And, since the *r* of Sanskrit *prach/pṛch* cannot differ segmentally from the *r* of *gras*, we must conclude that the different behaviour of the two roots should not be attributed to a difference in the underlying status of the two *r*'s.

What then is the explanation for the fact that some roots undergo Syncope and Vocalisation while other roots do not? The answer comes if we shift focus to the contexts where the application of Vocalisation is unpredictable, away from the contexts where it is not. I have mentioned earlier that practically all postnuclear continuant sonorants {i, u, r} undergo Vocalisation. There is hardly any variation attested there; the attested variation, such as it is, concerns exclusively *r*, the lowest in sonority of the three segments. At the opposite end of the scale, we observed that no onset nasals ever vocalise. The segments to which Vocalisation applies variably are then just the rhyme nasals and the onset {i, u, r}. The existence of variation in precisely these cases is captured by the tendencies expressed above in (29): the factors that may inhibit Vocalisation are the structural distance of the sonorant from the nucleus and the low sonority of the segment. When favourable and unfavourable factors cancel each other out, Vocalisation will apply variably: thus a low sonority segment in the rhyme or a high sonority segment in the onset will be equally likely to vocalise or not to vocalise. What we see in the contrast between roots like *svap/sup*,

prach/pṛch and invariable roots like *svaj*, *gras* are the lexically frozen remnants of original variation: roots in which Syncope must have applied variably in the beginning were later lexicalised as belonging to a class marked to undergo Syncope or to a class marked not to undergo it. Synchronically, the fact that root-internal variation was mostly eliminated means that individual roots must be marked as undergoing or not undergoing Syncope. But it is interesting to note that the variation predicted by this account is occasionally attested within one and the same paradigm. Thus the roots *vakṣ* 'increase', *vac* 'speak' and *vaɕ* 'be eager' display both vocalised and unvocalised zero-grade forms: we have both *u-uc-úr* and *va-vak-ṣé* from *vac*, both *ukṣ-ant* and *va-vakṣ-é* from *vakṣ*, both *u-uɕ-ur*, *uɕ-itá* and *va-vaɕ-ur*, *vaɕ-itá* from *vaɕ*. The overall historical trend appears to be towards elimination of vocalised onset sonorants: the allomorphs *ukṣ*, *uc*, *uɕ* tend to disappear in post Rig-Vedic Sanskrit.

To summarise then, I have suggested an explanation for the selective failures of Syncope–Vocalisation observed among Sanskrit verbal roots. The explanation does not invoke a categorial distinction between potentially syllabic and non-syllabic sonorants: rather, it relies on the observation that low sonority segments and onset segments are less likely to vocalise than high sonority segments and rhyme segments. A variable interpretation of Syncope will explain why the rule applies unpredictably in only certain root types ((*C*)*ya*(*C*), (*C*)*va*(*C*), (*C*)*ra*(*C*), (*C*)*an*(*C*), (*C*)*am*(*C*)) and not in others. It will also explain why Syncope may apply variably within one and the same paradigm.

4.1.6 *A taxonomy of Sanskrit roots.* The verbal root in Sanskrit is monosyllabic and bimoraic. With few exceptions, a Sanskrit root consists of a string of segments that can be exhaustively analysed as a single syllable. There are no verb roots of the form CVCV or CV.V. There are no verb roots beginning or ending with clusters of consonants that cannot be tautosyllabic according to the syllabification patterns of Sanskrit. One exception is the fact that any root may be preceded or followed by *s*, even when the resulting cluster is otherwise known to be heterosyllabic. Thus several considerations indicate that the initial of roots like *stu* 'praise' and the final of *takṣ* 'fashion' contain an extrasyllabic *s* (cf. Steriade 1982). However, the possibility of root-initial extrasyllabic *s* parallels entirely the possibility of *word*-initial extrasyllabic *s*: in this respect verb roots have all the phonotactic properties of monosyllabic words.

Sanskrit verb roots cannot be light monosyllables in their full-grade forms. The simplest way to observe this is to note that there are no roots ending in short *a*: *pad* and *yaj* exist but not **pa* or **ya*.

Sanskrit roots may differ from one another, along a limited number of parameters. To appreciate these differences we must bear in mind the fact that the prototypical root is a closed syllable C_0aCC_0, whose postnuclear position is most frequently a sonorant. A limited number of deviations are attested from this type. There exists a small group of mostly late non-alternating roots whose nuclear vowel is not *a* but *i* or *u*: for instance *nins*

'kiss', *mu:rch* 'thicken', *rikh* 'creep' show no alternants with nuclear *a*. Thus the presence of *a* in the underlying representation of a root is subject to some variation. Note, however, that there are no non-alternating roots such as **nu* with short *u*: all roots lacking nuclear *a* have either long high vowels, like *mu:rch*, or contain closed syllables, like *rikh*. Conversely, all roots with a monomoraic zero grade like *Cu* have a bimoraic full-grade *Cau*: no roots alternate between **Cu* and **Cva* though some do alternate between *Cu* and *Cva:*. All these facts are reflexes of the general requirement that the root syllable be bimoraic in its underlying form, the full grade.

There exists a somewhat larger class of roots which alternate between a full grade such as *nai* 'lead' and a zero grade containing a long high vowel *ni:*. Compare *nai/ni:* with *mai* 'fix', whose zero-grade vowel is always short *mi*. The interesting detail is that alternations such as *nai/ni:* are restricted to the open syllable roots: there is not a single root alternating between full-grade **naiṣ* and zero-grade **ni:ṣ*.[24] Observe now that a closed syllable root such as *pais/piṣ* 'crush' is always bimoraic, in both its full and zero-grade alternants. Similarly, a root such as *nai/ni:* is always bimoraic. The difference between *nai/ni:* and *mai/mi* is then a difference in the syllabic weight of the root alternants: *nai/ni:* is always heavy, whereas *mai/mi* is heavy only in its underlying form, the full grade. Let's assume then that Sanskrit roots may also differ in the quantity of their zero-grade alternants: most roots have no restriction on the weight of their zero-grade form but some require that their zero grade be bimoraic. A root of this second class will lengthen its zero-grade nucleus: *ni:* results from this lengthening. The reason that roots such as **naiṣ*/**ni:ṣ* do not occur is that a zero-grade closed syllable like *niṣ* is already bimoraic without lengthening. It is important to note that roots ending in consonantal sonorants such as *jan* 'be born', *tan* 'stretch', *tar* 'pass' may belong synchronically to the same category: all of these roots have long nuclei in their zero grade. For instance *jan* 'be born' has the following paradigm: full-grade *jan* (*jan-ati*), prevocalic zero-grade *jn* (*ja-jn-úr*), preconsonantal zero-grade *ja:* from intermediate *jṇ:* (*ja:-tá*). The prevocalic zero grade, which results from resyllabification, is discussed below. The preconsonantal zero-grade *ja:* reflects directly the requirement that all allomorphs of this root contain a heavy syllable.

The condition which imposes a bimoraic zero grade on roots like *nai/ni:* or *jan/ja:* is in effect only before resyllabification: for instance the intermediate *ni-ni:-ur* is resyllabified through Glide Formation and surfaces as *ninyur*. In this form, the root syllable *ni:* not only fails to be bimoraic: it also ceases to exist as a syllable. The same remark can be made about *ja-jn-ur*, the prevocalic zero grade of *jan*. Similarly, the full-grade forms *nai* and *jan* appear as monomoraic in *na.ya.ti*, *ja.na.ti* from intermediate *nai-a-ti*, *jan-a-ti*.[25] This suggests that there exists a stage in the derivation which follows early phonological rules but during which syllable boundaries continue to coincide with morpheme boundaries: this stage is exemplified by strings like *ni.ni:.ur* (after Syncope, Vocalisation and Lengthening but before Glide Formation) or *pi.piṣ.ur* (after Syncope

and Vocalisation but before Resyllabification). Roots like *nai/ni:* must satisfy their weight requirements through lengthening at this intermediate stage. Further evidence for this level in the derivation will be presented in §4.2.1.2.

A number of old Sanskrit roots alternate between a full-grade syllable C_0*a:*C_0 and a zero grade in which *a:* is replaced by *i*. *ca:s/cis* 'instruct' belongs to this class. In general, however, long *a:* is not subject to Syncope (as the statement of this rule already implies) and the bulk of roots containing it are non-alternating: compare *ca:s/cis* with non-alternating *a:p* 'obtain', *a:s* 'sit', *kha:d* 'chew'. The historical roots of the *a:/i* alternation are discussed in Wackernagel (1957: 17).

The last parameter differentiating Sanskrit root types is the presence of a root extension consisting of *a:*. We observe that a number of roots whose full grade is *CRa:* (R = a sonorant) have zero grades *CR:*, with a long nucleus: for example *vya:/vi:* 'envelop', *cya/ci:* 'coagulate', *hva:/hu:* 'call'. Most of the roots subject to *CRa:/CR:* alternations are in fact morphologically complex: the *CR* sequence is the prevocalic zero grade of a *CaR* root while the *a:* is a fairly productive root extension. There are about fourteen pairs of roots with identical or related meanings and which differ in shape as follows: one variant has the form of a Sanskrit CVC root while the other variant contains the *a:* extension preceded by the zero-grade form of the root.[26] Examples are *dham* and *dhm-a:*, both of which mean 'blow', *dhi:* and *dhy-a:*, both 'think', *pai* 'swell, fatten' and *py-a:* 'fill up', *man* 'think' and *mn-a:* 'note', *jai* 'conquer' and *jy-a:* 'overpower', *hau* and *hv-a:* 'call'. In many cases, the simple and the extended root have distinct paradigms and distinct zero grades: thus the zero grade of *mn-a:* appears in *mna:-ta*, that of *pya:* in *pya:-ta*, in contrast with the zero grades of the unextended roots, which occur in *ma-ta* and *pi:-na*. In a few cases, however, the paradigm of the extended root appears to contain zero-grade forms based on the simple root: this may explain forms like *ji:-ta* from *jya:* 'overpower' (related to *ji(:)* 'conquer'). The conclusion we must draw then is that, for the most part, forms like *ji:-ta* do not evidence the regular conversion of a *Cya:* full grade into a *Ci:* zero grade but merely the optional omission of the *a:* extension from the formation of the zero grade.

To summarise, there are three structural parameters along which Sanskrit roots may differ from each other: (a) the presence or absence of nuclear *a* in the underlying form (= full grade); (b) the requirement that all root alternants be bimoraic as against the normal requirement that only the underlying root be bimoraic; (c) the presence or absence of the *a:* extension. The parameters are illustrated below:

(30)

	underlying *a*	
yes	vaks/uks̥	'increase'
no	uks	'sprinkle'
	all root alternants must be bimoraic	
yes	nai/ni:	'lead'

no	mai/mi	'fix'
	a:-extension	
yes	mn-a:	'note'
no	man/mṇ (=ma)	'think'

4.2 Reduplication

4.2.1 *Intensive reduplication.* Against this background, I present now a full-copy analysis of the Sanskrit intensive reduplication. Three syllabic transfer effects are discovered in the process: a segment syllabified as onset in the base cannot be syllabified as rhyme in the reduplicated copy; nor can a rhyme segment be reduplicated as onset. Finally, a syllabically stray segment from the base cannot appear in a syllable of the reduplicated morpheme. The analysis advocated here is then compared to those available in the copy-and-association framework. The conclusion will be that the existence of syllabic transfer effects falls out of the full-copy theory of reduplication; and that, in contrast, a copy-and-association analysis succeeds in characterising the data only by explicitly stipulating syllable transfer conditions on the output of reduplication.

4.2.1.1 *Basics.* In order to express a repeated or intensified action, Sanskrit verb roots can be augmented by a monosyllabic reduplicating prefix. This prefixed syllable is invariably heavy, has a fixed *a* as its nucleus, allows one sonorant segment in postnuclear position, and requires an onset consisting of at most one consonant. With few exceptions, the onset is obligatory.

In a number of cases, the intensive prefix is followed by an *i*, whose quantity varies: we have *dan-i:-dhvans-* (intensive from *dhvans/dhvṇs* 'scatter'), but *pan-i-pn-at* (from *pan/pṇ* 'admire'). There is reason to analyse forms like *dan-i:-dhvans-* as originally syllabified as *dan.i:.dhvans*, with an initial closed syllable. A preliminary argument for this intermediate syllabification is provided by the requirement that the postnuclear consonant of the intensive prefix be a sonorant: this condition can be understood if it holds of a coda position, given that the least marked codas consist universally of sonorants (Clements 1987). It cannot be understood if we view the intensive template as a mere sequence *CVC(i)*, where the syllabic position of the second C varies between coda (*CVC*) and onset (*CV.Ci*). Further evidence for the intermediate syllabification *dan.i:.dhvans* will emerge later, as we gain a better understanding of the mechanics of intensive reduplication.

The following are some instances of intensive reduplication. I list separately the intensive forms in which the root itself is in its full grade and those in which the root appears in the zero grade. Surface forms appear in parentheses underneath the more transparent intermediate forms. A postposed asterisk indicates a form constructed according to the observed rules, but not actually attested:

(31)	root	intensive form full grade	intensive form zero grade	
	nau/nu	nau-nau-i:ti (nonav-i:ti)	nau-nu- (nonu-)	'praise'
	vais/viṣ	vai-vaiṣ- (veveṣ-)	vai-viṣ- (veviṣ-)	'be active'
	kars/kṛṣ	kar-karṣ-* (carkarṣ-*)	kar-kṛṣ- (carkṛṣ-)	'plough'
	dhar/dhṛ	dhar-dhar- (dardhar-)	dhar-dhṛ-* (dardhṛ-*)	'hold'
	mard/mṛd	mar-mard-	mar-mṛd-	'rub, crush'
	pan/pṇ	pan-i-pan-*	pan-i-pṇ-at (panipnat)	'admire'
	gam/gṃ	gam-gam- (jang-gam-)	gam-i-gṃ-* (gan-i-gm-)	'go'
	pat/pt	pa:-pat- pan-i-pat-	pa:-pt-*	'fly, fall'

A few details in the derivation of these forms must be mentioned before we turn to the facts of central concern. The alternation between a palatal and a velar present in forms like *car-karṣ-* illustrates what appears to be a synchronic dissimilation rule whereby a reduplicated velar becomes palatal if in a syllable directly adjacent to the root syllable. The rule is optional if the two velars are not in adjacent syllables: we find both *cari-kṛ-* and *kari-kṛ-* from *kar/kṛ-* 'make'. The alternation found in *dar-dhṛṣ* illustrates the same type of dissimilation, this time involving aspiration. Once again, non-adjacent syllables undergo dissimilation only optionally, as intensives like *ghani-ghn-at* (from *ghan/ghṇ* 'slay') indicate. The intensives of nasal-final roots show the effects of place assimilation (*jang-gam-*).

The intensive of *pat* illustrates the general behaviour of coda obstruents: they are eliminated and, in the absence of a postnuclear sonorant, the nuclear *a* lengthens. A very small number of roots resort to an alternative strategy and insert a syllable final *n*: this explains *pan-i-pat-*.

The nucleus of the intensive prefix is an invariable *a*. The following examples indicate that *a* is part of the template and that its occurrence is not dependent on the underlying presence of *a* in the nucleus of the root syllable:

(32)	root	intensive	
	kri:d	kai-kri:d- (ce-kri:d-)	'play'
	ji:v	jai-ji:v- (je-ji:v-)	'live'
	su:d	sau-su:d- (so-su:d-)	'put in order'

The roots listed above are invariant and have no allomorphs with nuclear

a, yet their intensive prefixes have the usual shape *CaC*. Many roots of this type are late and their intensives are not attested in texts, but rather provided by grammarians. However, there is no doubt that they represent the genuine pattern, rather than a grammatical fiction: no intensive such as **ji:-ji:v-* is attested as an alternative to *je-ji:v-*. I conclude therefore that *a* is part of the intensive template.

4.2.1.2 *A full-copy analysis*. The intensive template is an invariable *CaX* monosyllable, with a simple onset and a sonorant coda. In the terms introduced in §2, this template represents the following parameter settings:[27]

(33) Weight parameters: monosyllabic foot (=heavy monosyllable)
Syllable markedness parameters:
obligatory onset: unmarked setting (=onset is obligatory)
complex onset: unmarked setting (=onset may not be complex)
sonorant coda: unmarked setting (=coda must be a sonorant)

The fixed nuclear *a* is the result of the following insertion rule:

(34) a. Insert *a* in the intensive stem.
b. Insertion site: first syllable, rhyme.

The derivations of two forms, *mar-mṛd-* 'crush' and *ya:-yaj-* 'offer', illustrate the analysis:

(35)

input:	mṛd	yaj
copy:	mṛd-mṛd	yaj-yaj
a-insertion:	mard-mṛd	BLOCKED (OCP)
removal of unlicensed material: obstruent coda:	mar-mṛd	ya-yaj
prosodic weight: lengthen rhyme:	n/a	ya:-yaj
output	mar-mṛd	ya:-yaj

Several points about these derivations should be made explicit. First, I assume that the formation of the intensive follows the application of Syncope and Vocalisation: in the case of *mar-mṛd-*, this means that the root has already been reduced to *mṛd*. Second, I assume that segmental insertions preserve the basic syllable structure of the input: the insertion of *a* in *mṛd*, yielding *mard* rather than **mrad*, shows that segmental insertions cannot displace rhyme segments into the onset. The insertion of *a* obviously means that the rhyme *ṛ* of *mṛd* will be demoted to a non-nuclear status, since *r* will no longer occupy the leftmost position in the rhyme: but all other aspects of the input syllable structure are preserved. Third, I note that *a*-insertion fails to apply in syllables which already contain an *a*. A possible interpretation of this fact, though not the only one, is that the Obligatory Contour Principle blocks the creation of a

tautosyllabic sequence of two identical vowels. A final remark concerns the ordering of the operations in (35). I have mentioned above that the matching procedures which implement parameter settings are either unordered or are transparently ordered. A case in point is the interaction between matching procedures associated with the parameters of prosodic weight and obstruent codas in the derivation of *ya:-yaj-*. In this case, what is being copied is a heavy syllable, *yaj*. Had the weight of the syllable been checked *before* the elimination of the obstruent coda *j*, vowel lengthening would not be called for, since *yaj* is heavy. But after *j* is eliminated, the syllable would surface as light: **ya-yaj*. I rule out such derivations on the grounds that the properties of the reduplicative template should be transparently reflected by the reduplication output: if the template requires a heavy syllable, the ultimate output of reduplication should be a heavy syllable.

I turn now to certain consequences of the analysis presented which go beyond the data examined so far.

4.2.1.3 *A syllable transfer effect: complex onsets in the intensive.* So far we have not considered the intensive reduplication of roots that have complex onsets. The relevant patterns are illustrated below:

(36)		root	intensive form full grade	intensive form zero grade	
	a.	krand/krṇd	kan-i-krand-	kan-i-krṇd- (kanikrad-)	'cry out'
		bhranɕ/bhrṇɕ	ban-i-bhranɕ- (bani:bhranɕ-)	bhan-i-bnrṇɕ (bani:bhraɕ-)	'fall'
		tvais/tviṣ	tai-tvais-* (tetves-*)	tai-tviṣ- (tetviṣ-)	'stir'
		dyaut/dyut	dau-dyaut-* (dodyot-*)	dau-i-dyut- (davidyut-)	'shine'
		dhvans/dhvṇs	dhan-i-dhvans- (dani:dhvans-)	dhan-i-dhvṇs- (dani:dhvas-)	'sound'
	b.	dhya:	da:-dhya:-	da:-dhya:-	'think'
	c.	svap/sup	sa:-svap-	sau-sup- (sosup-)	'sleep'
		grabh/gṛbh	ga:-grabh- (ja:-grah-)	gar-i-gṛbh- (jari:gṛh-)	'seize'
		vyadh/vidh	va:vyadh-	vai-vidh- (vevidh-)	'pierce'

Two observations can summarise the patterns seen in (36). First, the intensive prefix reflects the grade – full or zero – of the root syllable: compare *sa:-svap*, based on the full-grade root, with *sau-sup*, based on the zero grade. Second, if the root contains a complex onset, then its second member is eliminated, as in *kan-i-krand*, *sa:-svap*. These observations require no change in the analysis presented above. The fact that intensive reduplication follows – and therefore reflects the results of – Syncope and Vocalisation has already been mentioned. The onset simplification reflects

the fact that the intensive syllable cannot contain a complex onset. The manner in which the complex onset is simplified, by eliminating the non-initial consonant of the cluster, is predicted by the matching principle (7) discussed above.

Depending on the shape of the root, the intensives based on the full grade may or may not differ from those based on the zero grade. In the case of roots like [krand/krṇd], which have both onset and coda sonorants, the intensive prefixes based on the two grades are identical: e.g. *kan-i-krand* and *kan-i-krṇd*. In contrast, for roots like *svap/sup*, which have sonorants only in the onset, the intensive prefixes vary with the grade of the root: *sa:-svap* but *sau-sup*. This fact too follows from our analysis. Roots like *krand* vocalise after Syncope their remaining rhyme sonorant, hence *krṇd*. Although the nuclear vowel has been eliminated, such zero grades do not lead to a restructuring of the root syllable: in *krṇd*, *r* is still in the onset and *n* is still in the rhyme. The result is that the intensive syllable based on the zero grade of such roots will be identical to that based on the full grade:

(37)	input:	krand	krṇd
	copy:	krand-krand	krṇd-krṇd
	a-insertion:	BLOCKED (OCP)	krand-krṇd
	removal of unlicensed		
	material: complex onset:	kand-krand	kand-krṇd
	obstruent coda:	kan-krand	kan-krṇd
	prosodic weight:		
	rhyme lengthening:	n/a	n/a
	output:	kan-i-krand	kan-i-krṇd

In contrast to *krand/krṇd*, zero grade leads to syllabic restructuring in *svap/sup*-type roots: the onset sonorant must be reassigned to rhyme position (cf. (25) above). The consequence of syllabic restructuring for the shape of the intensive syllable can be observed in the derivations of *sa:-svap* and *sau-sup* shown below. Note again that the input to reduplication is a form of the root in which Syncope and Vocalisation, where applicable, have already operated:

(38)	input:	svap	sup
	copy:	svap-svap	sup-sup
	a-insertion:	BLOCKED (OCP)	saup-sup
	removal of unlicensed		
	material: complex onset:	sap-svap	n/a
	obstruent coda:	sa-svap	sau-sup
	prosodic weight:		
	rhyme lengthening:	sa:-svap	n/a
	output:	sa:-svap	sau-sup

Derivations for intensives like *ja:-grabh-* and *jar-i-gṛbh* (on *grabh* 'seize') or *va:-vyadh* and *vai-vidh* (on *vyadh* 'pierce') will proceed in identical fashion. In all such cases, we observe that segmental insertion preserves

the basic rhyme/onset division of the syllable in its immediate input: this explains why we get *sau-sup*, *garbh-gr̥bh*, instead of **sva:-sup*, **gra:-gr̥bh*.

A few forms appear to follow a different pattern. Some are easier to dismiss than others. To begin with the easiest, the root *mai/mi:* 'damage', has a Rig-Vedic intensive participle *mai-mya:ná* (surface *me-mya:ná*). What we observe here is that a surface onset *y* is copied in the intensive prefix as the rhyme *i*. Recall, however, that earlier discussion (§4.1.6) has made necessary the assumption that an intermediate syllabification exists, after Syncope and Vocalisation and before Glide Formation and Resyllabification, during which syllable boundaries coincide with morpheme boundaries. This can be the case in the derivation of *mai-mya:ná*, whose base is intermediate *mi:* in *-mi:-a:ná*. If the intensive is formed from a string still syllabified as *-mi:.a:.na*, rather than the surface substring *-mya:.na*, the presence of *i* in the rhyme of the intensive prefix *mai-* will be compatible with the pattern shown in (36). A second set of problematic forms is composed of two items: *dar-i-dra:-* from *dra:* 'run' and *mal-i-mluc-* from *mluc* 'set'. The root *dra:* is plausibly analysed as containing the *a:* extension mentioned earlier. It is conceivable then that the prefix *dar* in *dar-i-dra:-* is based on *dr̥* rather than on *dra:*. This will remove the inconsistency between this form and the cases seen in (36). Finally, I have no suggestion on how to deal with *mali-mluc-*, the only remaining aberrant form.[28]

Let us consider now a copy-and-association analysis of the intensives presented so far, and in particular of the data shown in (36). Within such a framework, the intensive template takes the form of a CVC syllable with a prespecified *a* nucleus and a coda carrying the restriction that only sonorants may associate to it:

```
(39) [X  [X  X]]
          |  |
          a[+son]
```

Consider next the derivation of forms such as *sau-sup*, *sa:-svap* and *kan-i-kr̥nd*. The first of these can be derived as below:

```
(40)  s   u   p          s   u   p
      ¦    \ \           |   |   |
    [X  [X   X]]  -  [X  [X   X]]
          |  |
          a[+son]
```

ultimate output: *sau-sup* > *so-sup*

In deriving *sau-sup* in this way, the assumption is made that a floating segment – *u* in this case – cannot attach to the slot already occupied by *a*.

Had we allowed this, only **sa:-sup* or **su:-sup* could be derived. We shall return below to the effect preattached material has on the association of copied segments.

The other two forms, however, cannot be derived:

(41)
```
s   u   a   p     s   u   a   p
:   .   .   .     |   |   |   |
[X  [X  X]]   -   [X  [X  X  X]]
    |   |
    a[+son]
```

ultimate output: **sau-svap* → **so-svap*

```
k   r   n   d     k   r   n   d
:   .   .   .     |   |   |   |
[X  [X  X]]   -   [X  [X  X  X]]
    |   |
    a[+son]
```

ultimate output: **kar-krṇd* → **kar-i-krad*

The expected forms *sa:-svap* and *kan-krṇd* will be derived correctly if we prevent the copy of onset segments from associating to a rhyme position. The required principle is (42):

(42) The copy of a segment syllabified as onset in the base cannot occur as a component of the rhyme in the reduplicated affix.

I will refer to this type of statement as a transfer condition.[29]

Assuming (42), the derivations will be as follows:

(43)

```
s   u   a   p   s   u   a   p     s   u   a   p   s   u   a   p
:   .   |       |   |   |   |     |   |   |       |       |   |
[X  [X  X]]   -   [X  X   [X  X]]→[X  [X  X]]   -   [X  X   [X  X]]
    |   |                           |___/|
    a[+son]                         a[+son]
```

ultimate output: *sa:-svap*

```
k   r   n   d     k   r   n   d
:   .   :   .     |   |   |   |
[X  [X  X]]   -   [X  X   [X  X]]
    |   |
    a[+son]
```

ultimate output: *kan-krṇd* → *kan-i-krad*

Note however that the syllabic transfer effect, which a copy-and-association model must directly stipulate, is predicted by the full-copy approach to reduplication: within such a framework, there is no possibility of generating forms like ***kar-krṇd*** and therefore no need for (42). The aspect of our analysis which guarantees the correct outcome in ***kan-krṇd*** is the natural assumption that segmental insertions will not disrupt existing subsyllabic constituency: *a*-insertion operating inside the copied syllable ***krṇd*** will preserve the onset–rhyme division of the input. The impossible ***kar-krṇd*** can be generated only if *a*-insertion operates incorrectly by positioning *a* in the middle of the onset. The same observation explains how we rule out ***sau-svap***: this form too could only result from a misapplication of *a*-insertion.

4.2.1.4 *A second syllable transfer effect: the intensives of onsetless roots.* I have noted above that intensive prefixes must have onsets. This statement characterises the fact that onsetless roots fail to form intensives. Thus intensives are entirely absent from the large class of vowel-initial roots like *ad* 'eat', *ai/i* 'go', *auṣ/uṣ* 'burn'. Moreover, roots which become onsetless in the zero grade through the application of Restructuring (rule (25)) have intensives based on the full grade but not on the zero grade: thus *yaj/ij* 'offer' and *vac/uc* 'speak' form their intensives exclusively from the full-grade form (*ya:-yaj*, *va:-vac*). One can tell what the intensive of an onsetless root would look like from the unique form *al-ar-ti*, dissimilated intensive of *ar/ṛ* 'go'.

Let us consider now whether the generalisation about onsetless intensive prefixes can be expressed in a copy-and-association analysis. At first sight it looks as if it is sufficient to simply require that the onset X in (39) be filled. However, the following derivation shows that this is not enough: the copy-and-association analysis will, unless assisted by further conditions, derive unattested patterns like *va:-uc* from an onsetless zero-grade *uc*:

```
(44) u   c                u   c          u                    u   c
     ⋮                    |   |          |                    |   |
     [X  [X   X]]  -  [[X  X]]   →   [X  [X  X]]  -  [[X  X]]
          |   |                                      |
          a[+son]     (association)                  a          (lengthening)
```

ultimate output: ***va:-uc-***

The fact that a derivable pattern like ***va:-uc-*** fails to occur may appear less striking than the fact that a pattern occurs which cannot be derived. We should note, however, that much of our data on the intensive is based not only on textual occurrence but also on the introspective judgment of Indian grammarians, who supplied non-occurring forms to the paradigms of many verb roots. It is remarkable then that forms such as ***va:-uc-*** were not supplied, despite the fact that zero-grade based intensives are

otherwise very common and despite the fact that the intensive prefixes of forms like **va:-uc* do have onsets.

The copy-and-association analysis can attribute the absence of **va:-uc-* to a second condition of syllabic transfer:

(45) Segments which are part of the rhyme in the root cannot occur as components of the onset in the reduplicated affix.

In other words, the reason why *va:-uc-* is ill-formed as a reduplication of *uc* is that *u*, the copy of a rhyme segment, has come to occupy an onset position. In contrast, in the unique form *al-ar-ti* (from *ar-ar-ti*), the rhyme position of *r* is correctly transferred to the prefix. The immediate consequence of (45) is that the only legitimate intensives formed from onsetless forms of the root will be onsetless themselves: an onsetless zero grade like *uc* can yield only **au-uc* (surface **ovuc*). The fact that such forms lack a prefix onset explains why the pattern is essentially non-existent.

Note again, however, that a full-copy analysis excludes non-existent **va:-uc* without the benefit of stipulations like (45). In a zero-grade syllable like *uc*, both *u* and *c* are part of the rhyme: insertion can place *a* only to the left of *u*, since a sequence of rising sonority *ua* is impossible in Sanskrit rhymes. Therefore onsetless *auc* is the only possible outcome of *a* insertion in *uc*. Our analysis predicts the following derivation: *uc-uc-* (copy), *auc-uc* (*a*-insertion), *au-uc* (obstruent coda removed), *ovuc* (contraction and glide insertion). No condition is needed to exclude **va:-uc*. For this reason, the simple statement that onsets are obligatory in the intensive prefix is sufficient to explain the virtual lack of intensives based on onsetless bases.

4.2.1.5 *A third transfer effect:* s–*obstruent clusters and their intensives.* One more transfer effect is illustrated by the following forms, drawn from the intensives of roots beginning with spirant–obstruent clusters:

(46)	root	intensive	
	stan	tan-stan-	'thunder'
	ɕcaut/ɕcut	cau-ɕcut- (coɕcut-)	'drip'
	skand/skṇd	kan-i-skand- (kaniskand-)	'leap'
	sparɕ/spṛɕ	par-i-spṛɕ	'touch'

The set of root-initial clusters that reduplicate in this way is limited to those formed by a spirant followed by an obstruent. The spirant is either *s* or a coronal spirant homorganic to the following consonant as in *ɕcut* or *ṣṭhi:v*. I will assume that we are dealing with *s* throughout, and that *ɕcut*, etc. result from assimilation.

The *s*–obstruent clusters are the only Sanskrit root-initial sequences of decreasing sonority. It can be shown that the word-medial *s*–obstruent clusters, as well as all sequences of decreasing sonority, cannot be onsets

in Sanskrit (Steriade 1982). By assuming that the same clusters cannot be onsets root initially either, at least not in the early stages of the derivation, we come closer to an explanation of the difference between reduplications such as *tan-stan* and *sai-smi* (from *smai/smi* 'smile'). The *sai-smi* pattern has been explained above: this root begins with a complex onset, whose second member is eliminated in the process of making it fit the intensive template. The *tan-stan* type is explained by noting that the root *stan* consists of more than one syllable: it consists of an unsyllabified *s* followed by a syllable. Since the intensive template licenses only one syllable, the syllabically stray *s* is eliminated by principle (6):

(47) input:

```
s   t   a   n
|   |   |   |
X  [X  [X  X]]
```

copy:

```
s   t   a   n   s   t   a   n
|   |   |   |   |   |   |   |
X  [X  [X  X]]  X  [X  [X  X]]
```

a-insertion: BLOCKED (OCP)

removal of unlicensed material: monosyllable:

```
t   a   n   s   t   a   n
|   |   |   |   |   |   |
[X  [X  X]]  X  [X  [X  X]]
```

prosodic weight: rhyme lengthening: n/a

output: tan-stan

We note again that the copy-and-association analysis must account for this data by postulating a third transfer condition:

(48) Segments which are not part of a syllable in the root cannot be part of a syllable in the reduplicated affix.

Condition (48) will block the association of the stray *s* to the prefix onset position, thus allowing *t* to fill that position in *tan-stan*. But, once more, the correct result is obtained in this case by stipulating effects that are predicted in the full-copy format.

4.2.1.6 *Other analyses of the intensive reduplication*. I consider now in more detail other alternatives to the full-copy analysis of intensive reduplication presented above. I will assume that simply incorporating the observations of syllabic transfer as language-specific output conditions on an otherwise standard rule of reduplication is not a satisfactory approach: for there is no reason to believe that these transfer effects are specific to the Sanskrit intensive and that they fail to obtain in other cases of re-

duplication. Rather, the phonology and morphology of the Sanskrit are such that they permit us to observe more clearly and unambiguously than elsewhere the functioning of these transfer effects. I will proceed then on the assumption that, under identical conditions, the syllabic transfer effects observed in Sanskrit will resurface in any other system of reduplication. This assumption is substantiated in §5.

We have already seen that an unadulterated Marantzian analysis cannot explain syllabic transfer. Let us consider now some minimal adjustments in Marantz' scheme and their effect on the analysis of the Sanskrit intensive. These adjustments are due to Kiparsky (1986), who, following on earlier proposals by Clements (1985), suggests the following association convention:

(49) To associate phonemic melodies and C-V templates, first link V slots to eligible phonemes, scanning from left to right or from right to left, and skipping no eligible phonemes. Then link C slots by the same procedure. (Kiparsky 1986: 13)

In addition, Kiparsky allows a free choice among the following conventions on the interpretation of preassociated material:

(50) The slots in a C-V skeleton may be pre-attached to distinctive features. These features may be *absolute* or *conditional*. An absolute feature on a slot takes precedence over the features of any phonemes which may link to it. A conditional feature...on a slot specifies the class of phonemes that may be associated to it.

We have seen that the preassociated *a* of the intensive is always interpreted conditionally: this means that the only base segment that can associate to the nuclear slot of the intensive prefix will be *a*.

By adopting condition (49) and the conditional interpretation on preattachment, we can derive a subset of the intensive forms discussed so far. The V slots mentioned by Kiparsky correspond to the rhyme-leftmost (or nuclear) Xs, while Kiparsky's C slots correspond to all other Xs. My annotation 'association to V or C' is shorthand indicating association to a nuclear or non-nuclear X:

```
(51) s  u  a  p     s  u  a  p
                    |  |  |  |
     [X    [X  X]] [X  X  [X  X]]   (copy and association to V)
           |   |
           a[+son]

     s  u  a  p     s  u  a  p
     :     |        |  |  |  |
     [X    [X  X]] [X  X  [X  X]]   (association to C)
           |   |
           a[+son]
```

```
s  u  a  p     s  u  a  p
|     |        |  |  |  |
[X    [X  X]]  [X  X  [X  X]]   (lengthening)
       |
       a
```

(sa:-svap-)

```
s    u  p     s  u  p
                |  |  |
[X   [X  X]]  [X  [X  X]]        (copy; association to V fails)
     |   |
     a[+son]
```

```
s    u  p     s  u  p
:    \        |  |  /
[X   [X  X]]  [X  [X  X]]        (association to C)
     |
     a
```

(sau-sup-)

```
k  r  a  n  d     k  r  a  n  d
         :        |  |  |  |  |
[X     [X  X]]    [X  X  [X  X  X]]  (copy and association
          |  |                                  to V)
          a[+son]
```

```
k  r  a  n  d     k  r  a  n  d
:     |  :        |  |  |  |  |
[X     [X  X]]    [X  X  [X  X  X]]  (association to C)
          |  |
          a[+son]
```

(kan-krand-)

The simple device of associating *a* first, to the nuclear position already specified as *a*, explains why *svap* reduplicates as *sa:-svap* and why *krand* reduplicates as *kan-krand*. In each case, the prior association of *a* keeps prenuclear segments like *r* in *krand* from associating to a postnuclear slot. In one case, that of *sau-sup*, the initial step of associating a segment to the nuclear position fails, because none of the base segments is an *a*. In this case one can only associate copied base segments to non-nuclear positions;

and nothing blocks the association of *u* to the postnuclear slot of the template.

Although this procedure comes close to deriving the onset transfer effect observed in (42), it does not succeed entirely. What ensures a correct outcome in the derivation of *sau-sup-* is a peculiarity of this root; the fact that it contains a single sonorant. Let us consider then the intensive stem based on the zero grade of the root *krand/krṇd*: *kan-krṇd-* (surface *kan-i-krad-*). The procedure inspired by Kiparsky's conventions will derive in this case **kar-i-krad-*, as demonstrated below. The reader is reminded that the starting point in the intensive reduplication is the root in the grade, full or zero, in which it appears in the surface stem:[30]

```
(52) k   r   n   d      k   r   n   d
                        |   |   |   |
     [X  [X  X]]       [X  X  [X  X]]  (copy; association to V fails)
         |   |
         a[+son]

     k   r   n   d      k   r   n   d
     ⋮   ⋱              |   |   |   |
     [X  [X  X]]       [X  X  [X  X]]  (association to C)
         |   |
         a[+son]
```

ultimate output: **kar-i-krad*

The same point can be made by using intensives such as *dav-i-dyut*, *pai-pri:-*, *ban-i-bhrṇc-*, *dhan-i-dhvṇs-*, *dau-dru-* and many others not listed here. The outcomes predicted by the analysis outlined will be, in these cases, **dai-(i)-dyut-*, **par-pri:-*, **bar-i-bhrṇc-*, **dhav-i-dhvṇs-*, **dar-dru-*.

The analysis based on convention (49) is not only incapable of deriving all instances of onset transfer, but also fails to offer an explanation for the transfer effects (45) and (48): it generates, like a standard copy-and-association analysis, **va:-uc* and **san-stan*.

Let us consider now a more radical departure from the spirit of Marantz' approach to reduplication. This proposal is due to Clements (1985), who suggests that the initial stages in reduplication involve a direct mapping of the template slots to the base slots. Clements operates with C and V slots and assumes that the V slots of the template affix first map onto the V slots of the base. Only after the V slots have been linked does one associate the C slots of the template to those of the base. In this respect Clements' approach is the direct precursor of convention (49) above. On the other hand, the procedure Clements advocates maps slots onto slots rather than segments onto slots and this may give it an advantage in analysing the patterns described here. As it turns out, however, an analysis that follows this procedure to the letter encounters almost the same difficulties as the one just reviewed. The problem can be observed by

comparing the derivation of ***kan-krand*** with that of ***kan-krṇd***: in order to derive ***kan-krand*** we must assume that only a slot associated to ***a*** can map onto the template position prespecified as ***a***, otherwise ****kar-krand*** cannot be blocked. But this very assumption makes impossible the derivation of ***kan-krṇd***:

(53)

```
                    a [+son]
                    |   |
template    C       V   C
                    ¦                 association to V
base        C C V C C
            | | | | |
            k r a n d

                    a [+son]
                    |   |
template    C       V   C
            ¦       |   ¦             association to C
base        C C V C C
            | | | | |
            k r a n d
```

ultimate output: ***kan-i-krand-***

```
                    a[+son]
                    | |
template    C       V C
                                      association to V fails
base        C C VC
            | | | |
            k r n d

                    a[+son]
                    | |
template    C       V C
            ¦         /
                                      association to C
base        C C V C
            | | | |
            k r n d
```

ultimate output: ****kar-krṇd-*** → ****kar-i-krad-***

A further difficulty is that Clements' procedure cannot explain the transfer of extrasyllabicity noted above. There is no reason why the initial C of the intensive template cannot associate with the syllabically stray C of *stan*, to yield ****san-stan***.

The reader may have noted, however, that a few modifications in Clements' hypothesis of slot-to-slot mapping may derive the desired result. What is needed is a recognition of the subsyllabic constituents rhyme and onset and the removal of the distinction between C and V. Instead of mapping Cs onto Cs and Vs onto Vs and instead of stipulating that the Vs link up first, the Sanskrit facts will be accounted for by an X-to-X mapping guided by the principle in (54):

(54) Map onsets Xs onto onset Xs and rhyme Xs onto rhyme Xs

(55) illustrates how this procedure derives ***kan-i-krand*** and ***kan-i-krṇd***:

(55)

```
                        a [+son]
                        |   |
template    [X        [X  X]]
            :           :   :
base        [X   X    [X  X   X]
            |    |    |   |   |
            k    r    a   n   d      (= kan-krand)

-----------------------------------------------------------

                        a [+son]
                        |   |
template         [X   [X  X]]
                 :        :
base             [X    X [X   X]
                 |    |  |   |
                 k    r  n   d      (= kan-krṇd)
```

It is easy to verify that, under a parafixation analysis, all transfer effects observed in Sanskrit can be subsumed by (54), including the fact that *uc* cannot reduplicate as ***va:-uc-*** and the fact that *stan* reduplicates as *tan-stan-*. Before drawing more general conclusions from this fact, we shall examine the perfect reduplication, which requires an even more drastic revision of the copy-and-association framework.

4.3 Perfect reduplication

This section demonstrates that the reduplicative perfect prefix, a surface CV syllable, starts out as a full copy of the root. The copied syllable undergoes Syncope and Vocalisation, where applicable. The resulting syllable is then simplified: its complex onset is reduced to its first member and its coda is removed. This procedure explains the transfer effects observed in the perfect reduplication as well as a number of other properties of this formation.

4.3.1 *Transfer effects in the perfect.* The reduplicative prefix marking

perfective aspect in Sanskrit is a light syllable which allows at most one segment in its onset. Unlike the intensive, the perfect prefix does not require that an onset be present. The nuclear segment must be a vocoid: no perfect reduplication allows a syllabic liquid or nasal as its peak.

I list below perfect reduplications illustrating the requirement that onsets be restricted to one segment:

(56)	root	perfect full grade	perfect zero grade	
	pat	pa-pát-a	pa-pt-imá	'fly, fall'
	ghas	gha-ghás-a (jaghása)	gha-ghs-úr (jakṣur)	'eat'
	prath	pa-práth-a*	pa-prath-é	'spread'
	kṣad	ka-kṣád-a* (cakṣáda)	ka-kṣad-é (cakṣadé)	'divide'
	mna:	ma-mná:-u	ma-mna:-úr* (mamnúr*)	'note'

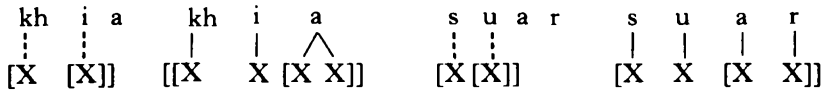
The reduplications of *kṣad* and *ghas* indicate that the perfect is also subject to the velar dissimilation and aspiration dissimilation rules operating in the intensive.

The next set of forms, based on roots beginning with C–Glide onsets, illustrates another facet of the transfer effect noted earlier: onset segments do not reduplicate as part of the rhyme:

(57)	khya:	kha-khyá:-u (cakhyaú)	kha-khya:-é (cakhyé)	'see'
	syand/syṇd	sa-syánd-a	sa-syṇd-é (sasyadé)	'move on'
	dhvans/dhvṇs	dha-dhváns-a* (dadhvánsa)	dha-dhvṇs-é (dadhvasé)	'scatter'
	svar	sa-svár-a	sa-svar-úr	'sound'

The remarkable fact illustrated by these forms is that the onset vocoid does not fill the nuclear position of the reduplicating syllable: we do not get **ci-khyau* or **su-svar-úr*. The significance of this fact becomes clear once we attempt a copy-and-association analysis of the pattern. The perfect prefix template will be a (C)V syllable: left-to-right association of segments to slots yields precisely the ungrammatical **ci-khyaú* and **su-svar-úr*:

(58)



ultimate output: **ci-khya:-* **su-svar-*

The copy-and-association analysis has to rely in this case on condition (42) in order to ensure the correct outcome: *ca-khya:-*, *sa-svar-*.

In contrast, a full-copy analysis of the perfect yields the correct forms without the assistance of output conditions. The perfect template is characterised as follows:

(59) Weight parameters: unfootable domain (=light syllable)
Syllable markedness parameters:
obligatory onset: marked setting (=onset may be missing)
complex onset: unmarked setting (=onset may not be complex)
vocoid nucleus: unmarked setting (=nucleus must be a vocoid)

The derivations of *sa-svar-* and *ca-khya:-* follow:

(60)			
input:		svar	khya:
copy:		svar-svar	khya:-khya:
removal of unlicensed material:	complex onset:	sar-svar	kha:-khya:
	light rhyme:	sa-svar	kha-khya:
output:		sa-svar	ca-khya:

The next set of forms illustrates the effect of extrasyllabicity transfer in the perfect: segments which are syllabically stray in the root do not surface as part of the reduplicating syllable:

(61)	root	perfect full grade	perfect zero grade	
	skand	ka-skánd-a (caskánda)	ka-skṇd-úr (caskadúr)	'leap'
	stambh	ta-stámbh-a	ta-stṃbh-úr (tastabhúr)	'prop'

A perfect stem like *ta-stambh* will be derived as follows (square brackets indicate the boundaries of the root syllable):

(62)		
input:		s[tambh]
copy:		s[tambh]-s[tambh]
removal of unlicensed material:	monosyllable:	[tambh]-s[tambh]
	light rhyme:	[ta]-s[tambh]
output:		ta-stambh-

The important step in this derivation is the reduction of the copied root *s[tambh]* to the syllable *tambh*. This is the joint effect of the condition which restricts the Sanskrit perfect prefix to a monosyllable and of principle (6). Note again that, while the full-copy analysis can invoke a principle of wide applicability to derive the *ta-stambh-* pattern, the copy-and-association analysis must resort to the stipulation in (48).

Before considering more complicated patterns of perfect reduplication, I must draw attention to the behaviour of roots which vocalise *r* in their

zero grade: corresponding to syllabic *r* in the root we find *a* in the reduplicated syllable:

(63)	root	perfect	perfect	
	sarj/srj	sa-sárj-a	sa-sṛj-é	'send forth'
	grabh/grbh	ja-grábh-a	ja-gṛbh-úr	'seize'

This detail illustrates the requirement that the prefix nucleus be a vocoid. Because Sanskrit is the only case known to me in which consonantal nuclei from the base are being actively avoided, I have no clear account of the matching operation by which this templatic requirement is being met, beyond the observation that *ṛ* is replaced by *a*. One point is clear, however: the replacement of *ṛ* by *a* in the perfect stems from the more general tendency of prosodic templates to enforce maximally unmarked syllable types.

4.3.2 *Syncope and Vocalisation in the perfect stem.* I now turn to the main point of our analysis of perfect reduplication: the demonstration that Syncope and Vocalisation apply to the reduplicated root before principle (6) takes effect to reduce the prefix to a CV syllable.

A number of properties of the perfect paradigm have not yet been examined. The first involves reduplications based on the full grades of roots containing postvocalic glides, like *baudh* 'wake'. The general rule is that such full grades reduplicate not the nuclear *a* but the postvocalic glide: we get *bu-baudh* rather than **ba-baudh*:

(64)	root	perfect full grade	perfect zero grade	
	baudh/budh	bu-baúdh-a (bubódha)	bu-budh-é	'know, wake'
	tvais/tviṣ	ti-tvaíṣ-a (titvéṣa)	ti-tviṣ-é	'be stirred up'
	ais/iṣ	i-aíṣ-a (iyéṣa)	i-iṣ-úr (i:ṣúr)	'seek, desire'
	ai/i	i-aí-a (iyáya)	i-i-úr (i:yúr)	'go'
	auc	u-aúc-a (uvóca)	u-uc-úr (u:cúr)	'please'

The second apparent anomaly is that roots of the *svap* class, which vocalise an onset glide in the zero grade, reduplicate on the pattern of *su-sváp-a*, *su-sup-úr*:

(65)	svap/sup	su-sváp-a	su-sup-úr	'sleep'
	vas/us	u-vás-a	u-us-úr (u:ṣúr)	'shine'
	myaks/mikṣ	mi-myákṣ-a	mi-mikṣ-úr	'glitter'
	yaj/ij	i-yáj-a	i-ij-é (i:-jé)	'offer'

In contrast, roots of the form *(C)Ga...*, which remain invariant and fail to vocalise their glide in the zero grade, follow the pattern observed earlier in (57): the onset glide fails to surface as nucleus in the reduplicating syllable:

(66)	svaj	sa-sváj-a	sa-svaj-é	'embrace'
	vaɕ	va-váɕ-a	va-vaɕ-a:ná	'be eager'
	yat	ya-yát-a	ya-yt-é (yeté)[31]	'stretch'
	tyaj	ta-tyáj-a	ta-tyaj-é	'forsake'

It should be emphasised that the difference between the *su-svap-* and the *sa-svaj-* patterns is not arbitrary: it correlates strictly with the independently observable behaviour of these roots in zero-grade environments. Roots of the *svaj* type are invariant, as can be seen in (66) from their zero-grade perfects: *sa-svaj-é*, etc. rather than **sa-suj-é* or **su-suj-é*. In contrast, roots of the *svap* class display the effects of Syncope and Vocalisation, as in *su-sup-úr* (rather than **sa-svap-úr* or **su-svap-úr*). The same contrast between the two root classes can be observed in non-reduplicative zero-grade formations, such as the *-tá* participle: the *svap* class has syncopated and vocalised participles like *sup-tá*, whereas the *svaj* class has participles like *svaj-tá* (surface *svaktá*).

The explanation for the two unexpected patterns – that of *bu-baudh* and that of *su-svap* – can be found in the following derivational scenario. Unlike the intensive reduplication, perfect reduplication precedes the application of Syncope and Vocalisation to the root morpheme. The first step in the derivation is to copy the entire root morpheme. Then Syncope and Vocalisation may apply, to both root and prefix. Since the prefix, unlike the root, is always unaccented, it will always undergo Syncope.[32] It is the syllable resulting from Syncope and Vocalisation that will then be reduced to the CV shape which the perfect prefix must meet. I derive below some of the forms that illustrate the workings of this analysis:

(67)	input:	baúdh-a	baudh-úr
	copy:	baudh-baúdh-a	baudh-baudh-úr
	Syncope/Vocalisation:	budh-baúdh-a	budh-budh-úr
	removal of unlicensed material: light rhyme:	bu-baúdh-a	bu-budh-úr
	output:	bu-bódh-a	bu-budh-úr
	input:	sváp-a	svap-úr
	copy:	svap-sváp-a	svap-svap-úr
	Syncope/Vocalisation:	us-vás-a	us-us-úr
	removal of unlicensed material: light rhyme:	su-sváp-a	su-sup-úr
	input:	tvaíṣ-a	tvaiṣ-úr
	copy:	tvaiṣ-tvaíṣ-a	tvaiṣ-tvaiṣ-úr

Syncope/Vocalisation: removal of unlicensed material: light rhyme:	tviṣ-tvaíṣ-a	tviṣ-tviṣ-úr
	tvi-tvaíṣ-a	tvi-tviṣ-úr
complex onset:	ti-tvaíṣ-a	ti-tviṣ-úr
output:	ti-tvéṣ-a	ti-tviṣ-úr
input:	aúc-a	auc-úr
copy:	auc-aúc-a	auc-auc-úr
Syncope/Vocalisation:	uc-aúc-a	uc-uc-úr
removal of unlicensed material: light rhyme:	u-aúc-a	u-uc-úr
output:	uvóca	u:cúr
input:	vás-a	vas-úr
copy:	vas-vás-a	vas-vas-úr
Syncope/Vocalisation:	us-vás-a	us-us-úr
removal of unlicensed material: light rhyme:	u-vás-a	u-us-úr
output:	uvása	u:ṣúr

The fact that the reduplicated prefixes of roots like *svap* or *myakṣ* go through Syncope and Vocalisation explains why an onset vocoid from the base corresponds to a prefix rhyme segment in forms like *su-sváp-a*, *mi-myákṣ-a*. This exception to the generalisation of syllabic transfer is only apparent: the glide takes on nuclear status not as a result of reduplication but as a consequence of Vocalisation. In this way we can maintain the generality of the syllable transfer effects and we can explain the fact that an onset glide from the root surfaces as nuclear in the perfect prefix only if it does so in other contexts where a zero grade is expected. In other words we explain the correlation between reduplication type and zero-grade formation observed in minimal pairs like *su-svap/su-sup vs. sa-svaj/sa-svaj*.[33]

Some of the more interesting consequences of our analysis can be observed by comparing three pairs of minimally different roots: *auc/uc* 'please' *vs.* invariant *au* 'favour'; *svap/sup vs.* invariant *svaj*; and, finally, *vas/us* 'shine' *vs.* invariant *vas* 'clothe'. We have seen that the application of Syncope/Vocalisation is somewhat idiosyncratic. Roots of the form (C)–G–V–Obst, where Syncope would lead to the Vocalisation of an onset vocoid, are almost evenly divided between those which undergo Syncope and those which do not: *svap*, *vas* 'shine' and *yaj* represent roots of this class to which Syncope applies, whereas *svaj*, *vas* 'clothe' and *yat* represent exceptions to the rule. With this in mind, consider now the derivation of the forms *sa-sváj-a*, *sa-svaj-é*: Syncope/Vocalisation fails to apply to both the root and to its reduplicated copy. Because Vocalisation does not apply, *v* retains its onset status in both the prefix and the root:

(68)	input:	sváj-a	svaj-aí
	copy:	svaj-sváj-a	svaj-svaj-aí
	Syncope/Vocalisation:	n/a	n/a-n/a
	removal of unlicensed		
	material: light rhyme:	sva-sváj-a	sva-svaj-aí
	complex onset:	sa-sváj-a	sa-svaj-aí
	output:	sa-sváj-a	sa-svaj-é

The same type of derivation explains the difference between *vas/us* 'shine' (*u-vas-a*, *u-us-úr*) and *vas* 'clothe' (*va-vás-a*, *va-vas-é*).

A third revealing contrast is that between *auc* 'please' and *au* 'favour': *a-au-a* (surface *a:va*) but *u-auc-a* (surface *uvoca*). Why does *u* appear in the prefix of *auc* but not in that of *au*? The critical difference between the two roots appears to lie in a difference between their zero-grade forms: the vocoid in *au* is never vocalised in the zero grade of this root, whereas that of *auc* is. The former invariably surfaces as *au-* (*av-* before vowel, *o-* before consonant) while the latter alternates between *auc-* and *uc-*. We can assume then that the two roots differ only in that *au* is an idiosyncratic exception to Syncope:

(69)	input:	aú-a	aúc-a
	copy:	au-aú-a	auc-aúc-a
	Syncope/Vocalisation:	n/a	uc-aúc-a
	removal of unlicensed		
	material: complex onset:	n/a	n/a
	light rhyme:	a-aú-a	u-aúc-a
	output:	á:va	uvóca

Certain aspects of Syncope and Vocalisation can now be used to explain systematic differences in the reduplication of roots containing glides. Recall that an onset glide will never vocalise in the zero grade if either (a) there is a sonorant in the rhyme or (b) there is a sonorant to its right in the onset. One consequence of this is that *v*-initial roots will reduplicate in the perfect as either *u-ROOT-* or as *vV-ROOT-* depending on which segments follow them. If a sonorant follows, the onset *v* is systematically unvocalisable: therefore it will always reduplicate as *v*, leading to the *vV-ROOT-* pattern. In contrast, if only obstruents follow, *v* may in principle vocalise and may give rise to the *u-ROOT-* reduplication type: whether this happens or not will depend on whether the individual root undergoes Syncope, as can be seen by comparing (65) with (66). To illustrate the fact that all roots in which initial *v* precedes sonorants reduplicate as *vV-ROOT-*, I show the derivation of the perfects of *vraɕc/vr̥ɕc* 'cut up' and *van/vṇ* 'win':

(70)	input:	vráɕc	vraɕc
	copy:	vraɕc-vráɕc-a	vraɕc-vraɕc-tám
	Syncope/Vocalisation:	vr̥ɕc-vráɕc-a	vr̥ɕc-vr̥ɕc-tám

removal of unlicensed material: complex onset:	n/a	n/a
light rhyme:	vṛ-vrá𝼈c-a	vṛ-vṛ𝼈c-tám
vocoid nucleus:	va-vrá𝼈c-a	va-vṛ𝼈c-tám
output:	va-vrá𝼈c-a	va-vṛk-tám
input:	ván-a	van-aí
copy:	van-ván-a	van-van-aí
Syncope/Vocalisation:	vṇ-ván-a	vṇ-vṇ-aí
removal of unlicensed material: complex onset:	n/a	n/a
light rhyme:	n/a	n/a
vocoid nucleus:	va-ván-a	va-vṇ-aí
output:	va-ván-a	va-vn-é

The same observation can be made about roots which begin with *y*. If only obstruents follow *y*, then *y* may vocalise in the zero grade, as in the root *yaj/ij* 'offer'. If it does, then this fact will be reflected in its reduplication pattern, which will be *i-ROOT-* (cf. *i-yáj-a/i-ij-úr*). In contrast, if a sonorant follows *y*, then the glide will never vocalise and its perfect reduplication will follow the *yV-ROOT-* pattern: this can be seen by considering the perfects of *yam/yṃ* 'reach' (*ya-yám-a*, *ya-yṃ-úr* → surface *yemúr*) or *yau/yu* 'unite' (*yu-yaú-a* → *yuyáva*, *yu-yu-úr* → *yuyuvúr*).

A final point illustrating the derivational relation between perfect reduplication and Syncope concerns long-vowel roots containing glides: roots like *va:* 'blow', *va:𝼈* 'bellow', *khya:* 'see', *dhya:* 'think', *ya:* 'go'. Because Syncope fails to apply to long *a:*, the onset glides of these roots will never vocalise, a fact that can be observed in their zero-grade forms: *va:-tá*, *va:𝼈-itá*, *khya:-tá*, *dhya:-tá*, *ya:-tá*. Since the glides do not vocalise, they cannot surface as nuclear in the perfect prefix. The perfect stems of the roots listed are therefore: *va-va:-*, *va-va:𝼈-*, *ca-khya:-*, *da-dhya:-*, *ya-ya:-*. The same observation can be made about long-vowel roots containing postvocalic glides: *ca:y* 'note', *ta:y* 'stretch', *dha:v* 'run' and *dha:v* 'rinse'. As a rule, these roots fail to syncopate: we observe zero-grade forms such as *ca:y-ya-te* ('note' passive), *dha:v-ita* ('run'), *dha:v-ya-te* ('rinse' passive). The perfect reduplications of such roots also reflect the absence of Syncope/Vocalisation: *ca-ca:y-a* (not **ci-ca:y-a*), *ta-ta:y-e* (not **ti-ta:y-e*), *da-dha:v-a*, *da-dha:v-e* (from 'run'; not **du-dha:v-a*, **du-dha:v-e*) and *da-dha:v-a*, *da-dha:v-ire* (from 'rinse'; not **du-dha:v-ire*).

More needs to be said about the derivational relation between reduplication and Syncope. Our analysis of the intensive relies on the assumption that Syncope applies before the intensive prefix is created. The analysis of the perfect assumes that Syncope applies after the root is copied as perfect prefix. The ordering Perfect > Syncope > Intensive can be independently supported by the observation that, although both the perfect and the intensive prefixes are unaccented and meet the description of Syncope, only the perfect undergoes Syncope. What remains somewhat

obscure is the non-cyclicity of Syncope: this rule apparently applies only once in the derivation of a verbal stem, to all morphemes that satisfy it simultaneously.

Before turning to an examination of the copy-and-association alternatives to this analysis, we should make its implications clear. Our general hypothesis is that partial reduplication combines two independent mechanisms: full copy and syllabic truncation. The analysis of perfect reduplication presented here exploits this hypothesis by allowing a distinct process – Syncope – to intervene between the two derivational steps of copy and truncation. It should be clear that no translation of this analysis can be provided in the language of copy and association, since in that framework partial reduplication does not go through a stage of full copy. What I consider next is the range of possible copy-and-association analyses of the Sanskrit perfect: we will see that none can explain the regularities reviewed in this section.

4.3.3 *Earlier analyses of the Sanskrit perfect reduplication.* In an earlier study (Steriade 1985), I had pegged the difference between roots like *svaj* (*sa-svaj-a*) and roots like *svap* (*su-svap-a*) on a hypothetical difference in the quality of their vocoids: *svaj* would contain invariably non-syllabic *v* while *svap* has a potentially syllabic *u*/*v*. This would explain the difference in reduplication pattern: the invariably non-syllabic *v* of *svaj* cannot associate to the nuclear position of the prefix. Some reasons to reject this view have been enumerated in §4.1.5. An additional argument against it and in favour of the analysis presented here is the generalisation that a vocoid will not reduplicate as nucleus if another sonorant in the same root is the one expected to vocalise. There are, for instance, twenty-two roots like *dhvans*, which contain a C–G–V–Sonorant sequence. In each case, the onset glide fails to reduplicate as peak: we get *da-dhvans*, *da-dhvṇs*, not **du-dhvans*, **du-dhvṇs*. In the analysis of Steriade (1985) these roots must be individually stipulated to contain [−syllabic] glides in their onsets, in order to explain why they reduplicate as they do. In the present framework this result follows from the independent properties of Vocalisation: in a root like *dhvans*, *n* will always prevent *u* from vocalising. In contrast, a root like *svap* has no sonorant that could prevent the vocalisation of the onset vocoid: this is why *svap* reduplicates as *su-svap-* while *dhvans* yields *da-dhvans-*.

A different idea used in earlier analyses of Sanskrit reduplication is the distinction between roots containing a segmentally empty nucleus (eventually specified as *a*) and roots containing an underlying *a*. Kiparsky (1986) and Steriade (1985) explain in this way reduplications like *bu-baudh*. The representation of this root is proposed to be *bVudh*, with a segmentally empty nucleus. The root *a* fails to be copied because it is not present as a segment when reduplication applies. I had suggested in the 1985 study that the applicability of Syncope provides an independent test of the difference between empty V and underlying *a*: only the former is subject to Syncope. Kiparsky uses this idea in order to derive, without

recourse to an underlying glide/vowel contrast, the difference between roots like *vas* 'shine' (*u-vás-a*, *u-us-úr*) and *vas* 'clothe' (*va-vás-a*, *va-vas-é*). The former *vas* 'shine' is underlying *uVs*, while *vas* 'clothe' is underlying *uas*. The difference in reduplication can then be made to follow. Kiparsky assumes that the V slot of the reduplicating prefix is always the first position to be filled by association:

```
(71)     u  s  -  u     s
         ⋮           |     |
      C  V        C  V  C      (ultimately u-vas)
```

In the case of *vas* 'clothe', the higher sonority of *a* makes it the nucleus of choice in the reduplicating prefix: this produces *va-vas-*:

```
(72)  u  a  s  -  u  a  s
      ⋮  |        |  |  |
      C  V        C  V  C      (ultimately va-vas)
```

The difference in the applicability of Syncope between *vas/us* and invariable *vas* follows again from the difference between V and *a*: only V undergoes Syncope. The latter root contains *a* and is therefore exempt from Syncope and Vocalisation.

This analysis, in both Kiparsky's version and in mine, leaves unexplained a number of facts: without a rhyme transfer condition, it cannot explain why vowel-initial roots like *aɕ* 'attain' invariably reduplicate as *a-aɕ* rather than as **ɕa-aɕ-*. One expects that at least some of these roots would contain V rather than *a*, in which case nothing should block derivations like (73):

```
(73)
          ɕ                 ɕ  ɕ           ɕ  ɕ  a     a  ɕ
          |                 |  |           |  |  |     |  |
      V   C→C   V  -  V     C→C   V  -  V   C→C  V  -  V  C
```

A distinct problem is raised by roots such as *van*, *yam* and *yat*, which undergo Syncope (cf. intermediate *va-vn-é*, *ya-ym-úr*, *ya-yt-é*), but do not vocalise their initial vocoid. These roots, although clearly attested as a type, can simply not be derived in Kiparsky's analysis: the applicability of Syncope indicates that they contain Vs, not *a*s, yet they unaccountably differ in reduplication from roots like *vac/uc*.

Further, any extensive use of the V/*a* distinction will have to explain why *pais*-type roots containing a postvocalic vocoid almost always reduplicate as if they contain V, whereas *svaj*-type roots containing a postvocalic obstruent and a prevocalic glide frequently reduplicate as if they contain *a*. We have argued in §4.1.4 that these facts follow from the independently observable conditions under which Syncope and Vocalisation apply. The analysis presented here explains why the outcome of

Syncope and Vocalisation should also be reflected in the results of perfect reduplication.

Finally, recall the behaviour of roots containing glides and long *a:*. Because *a:* is not subject to Syncope, such morphemes do not vocalise their glides in either the reduplicated prefix or in the root: the nuclear vowel of the prefix will therefore always be *a*. In terms of the distinction between *a* and V, such roots will have to be analysed as uniformly containing *a:*. But this fact too is left unexplained: once empty Vs are allowed in the grammar, there is no principled reason to exclude empty *long* Vs.

I would now like to discuss a hypothetical alternative. One may consider accepting one element of the analysis proposed here, the hypothesis that Syncope and Vocalisation apply to the copied root, without accepting the other, namely our mechanism of template satisfaction. For concreteness, such a proposal could be couched in the terms of the parafix theory proposed by Clements (1985), with the modifications introduced above, in (54):

(74) a. Prefix a copy of the root.
b. Apply Syncope and Vocalisation to root or copy if either is unaccented.
c. Parafix a CV (=[X[X]]) unit to the copy.
d. Associate slots of the parafix to slots of the base: map onset X onto onset X and rhyme X onto rhyme X.
e. Replace the prefix with the parafix.

The derivation of a perfect like *ti-tvaiṣ-* would proceed as follows under this analysis:

(75)
```
t  u  a  i  ṣ        t  u  a  i  ṣ
|  |  |  |  |        |  |  |  |  |
[X  X  [X  X  X]] - [X  X  [X  X  X]]      by (a)

-----------------------------------------------------------

t  u  i  ṣ        t  u  a  i  ṣ
|  |  |  |        |  |  |  |  |
[X  X  [X  X]] - [X  X  [X  X  X]]         by (b)

-----------------------------------------------------------

t  u  i  ṣ        t  u  a  i  ṣ
|  |  |  |        |  |  |  |  |
[X  X  [X  X]] - [X  X  [X  X  X]]         by (c)

[X     [X]]

-----------------------------------------------------------
```

```
 t   u   i   ṣ        t   u   a   i   ṣ
 |   |   |   |        |   |   |   |   |
[X   X  [X   X]]  -  [X   X  [X   X   X]]        by (d)
 |       |
[X      [X]]

-----------------------------------------------------------------

 t       i        t   u   a   i   ṣ
 |       |        |   |   |   |   |
[X      [X]]  -  [X   X  [X   X   X]]            by (e)
```

The telling detail here is the need for step (e), whereby the parafix replaces the prefix. A standard parafixation analysis would normally linearise the parafix to its base and would preserve both; but in the case under consideration the normal procedure would yield **ti-tviṣ-tvaiṣ-* rather than the expected *ti-tvaiṣ-*. This is why step (e) is necessary. Once the need for (e) is made clear, the parafixation analysis in (74) emerges as a notational equivalent of the analysis advocated here: the steps of parafixation, slot-to-slot association and replacement mimic entirely the effects of the mechanism of template satisfaction proposed earlier.[34]

5 The typology of syllabic transfer

We have so far operated under the assumption that the syllabic transfer effects observed in Sanskrit are not specific to that language. We must consider now what evidence would bear on the universality of these effects. In this section I outline the nature of the evidence, review relevant cases, and discuss how they would fare under alternative models of reduplication.

5.1 Onset transfer

One can observe the effect of onset transfer under two kinds of circumstances:

(a) If the language allows complex onsets $C_1 C_2$ such that at least C_2 is a potentially nuclear segment, and if the shape of the reduplicating syllable is CV(C), then onset transfer or its absence can be observed.

(b) When the reduplicating syllable is extensively prespecified, the effect of onset transfer is again observable, given certain additional assumptions. Specifically, the effect is revealed as soon as we attempt a copy-and-association (or parafixation) analysis based on the conditional interpretation of prespecified segments (cf. (50) above).

5.1.1 *Onset transfer effects with C–Glide clusters.*

5.1.1.1 *Klamath.* The conditions outlined in (a) above are encountered in the reduplication system of Klamath (Barker 1964). The relevant process is the CV reduplication marking distributive forms of the verb and noun and nominal diminutives. Klamath allows numerous syllable-initial clusters, including clusters whose second member is a glide, *y* or *w*. The glides of Klamath are potentially syllabic, as shown by the fact that, under appropriate conditions, they syllabify as vowels. (I assume here, in its general outlines, the analysis of Klamath glide vocalisation proposed by Levin 1985.) For instance, the stem *-qyoʔaqs* 'shaman' loses its initial vowel when a prefix is added: the result, intermediate *-qyʔaqs*, is resyllabified by a process reminiscent of Sanskrit Vocalisation and *y* becomes the peak of the new syllable, yielding *-qi:ʔaqs*.[35] The glide *w* behaves in identical fashion: it vocalises between consonants and yields long or short *o*. Having observed that the Klamath glides *can* come to occupy a nuclear position, we must note that in prevocalic position (e.g. in strings like *qyo-*) the glides are part of the onset, not the rhyme: they do not add to the weight of the syllable, as indicated by the stress facts reported by Barker (1964: 35–37). We may now consider the reduplication patterns of Klamath roots beginning with C–Glide sequences. The data below indicates that such roots form their CV prefixes by copying their first consonant and first vowel: the onset glides are skipped:[36]

(76)	stem	distributives diminutives	
	dye:mi	de-dye:m'-a	'be hungry'
	cwek'	ce-cwe:k'-atk	'be tough (meat)'
	c'wa:m	c'a-c'wa:m-a:k	'mullet'
	qyoʔaqs	qo-qyoʔaqs (qoqi:ʔaqs)	'shaman'
	t'wini:q'	t'i-t'wini:q'-atk (t'it'oni:q'atk)[37]	'berdache'

Notice that there is no restriction against having glides in the onset position of the prefix: a root-initial glide will always be copied, as forms like *we-we:c'a* 'slobber', *y'o-y'ott'is* 'marksman' indicate. Thus the only possible interpretation of the facts in (76) is that in Klamath onset segments cannot be reduplicated as components of the rhyme.

5.1.1.2 *French.* French hypocoristics offer a similar example. I rely here on Plenat's (1984) insights into this formation: the central point of Plenat's study of hypocoristic morphology is that the onset or rhyme status of a segment in the original name is always preserved in the hypocoristic. The most widespread hypocoristic type is what Plenat calls an ONOR, a sequence of Onset–Nucleus–Onset–Rhyme, where the initial syllable is a reduplicated version of the second. In the following examples the portion of the base noun which is overlooked by the hypocoristic formation is placed in parentheses:

(77)	(Vic)tor	toto, totor	(Al)fred	fefed
	Tho(mas)	toto	Bri(gitte)	bibi, bribri
	Paul	popol	(Chan)tal	tatal
	Pau(lette)	popo	(Fran)çois	sasa, swaswa
	Claire	keker, keke	Lou(is)	lulu
	Pierre	pepe, pyepye, pipi		

We must note first that the mapping observed here must obtain between *syllables* of the base and syllables of the hypocoristic template, not between base segments and template slots. Thus Plenat remarks that *popol* is an appropriate hypocoristic for *Paul* but not for *Paulette*: the reason being that *l* is an onset in *Paulette* ([po.let]) and cannot occupy a rhyme position. This indicates that the first step in the formation of this type of hypocoristic is the reduction of the whole noun to one of its syllables: and *Paulette* can be reduced to either *let* or to *po* but not to *pol*, since this is not a syllable in the input. In the simplest cases, the original syllable removed from the base noun is itself subjected to CV reduplication and no further changes apply: hence *popol*, *popo*. There are, however, several other options. The syllable extracted from the base may be the target of an optional process reducing complex onsets to simple ones: this process is illustrated by hypocoristics like *fefed* (from *Alfred*); its optionality can be observed in the variants *bribri*, *bibi* (from *Brigitte*). In our terms, a condition barring complex onsets may be imposed: if imposed, it is satisfied in the familiar way, by eliminating the non-initial member of the onset cluster.

Onset transfer is clearly observable in hypocoristics based on syllables like *Pierre* (*pyer*). I note first that a glide–vowel sequence is ambiguous in French: the *wa* of *oiseau* behaves phonologically like an onsetless nucleus, whereas the *wa* of *watt* behaves like an onset–nucleus sequence (Kaye & Lowenstamm 1984). Both analyses are available for a syllable like *Pierre*. Assuming that *y* is in the onset, our approach predicts that the process of reducing *pyer* to a CV syllable will yield *pe*, hence, with CV reduplication, *pepe*. Assuming that *y* is the first member of the nucleus, we predict that the CV equivalent of *pyer* will be *pi*, hence *pipi*. Note now that a copy-and-association analysis which disregards the original syllabic position of the base segments can only derive *pipi*, not *pepe*: the problem raised by the French case is then identical to that of Klamath.[38]

5.1.2 *Onset transfer effects with prespecified syllables: Nicobarese.* We turn now to the onset transfer effects observable in prespecified templates.

Three points about prespecification have been raised so far. The first is that if templates are not strings of slots then they cannot contain prespecified slots either. The mechanism of full-segment prespecification must be replaced by the insertion of the relevant segment. The second point is that the mechanism of prespecification breaks down in any case, as soon as we stop dealing with fixed-template reduplications and attempt to analyse prespecified full reduplication. The third point is internal to a

model which continues to make use of prespecified slots in fixed-template reduplication: the interpretation of slots prelinked to segments must be conditional rather than absolute, in the sense of (50). A segment may link either to a free slot or to a slot preattached to an identical segment. This guarantees the correct derivation of Sanskrit intensives like *sau-sup-* (see above (51)). The alternative convention – the absolute interpretation in (50) – will yield **sa:-sup-* in this case.

Having made this clear, let us consider the evidence for onset transfer provided by prespecified reduplications. In Nicobarese, a reduplication process derives verb stems from roots (Radhakrishnan 1981; Carden 1984). The pattern of reduplication is this: a root syllable C_1VC_2 is copied as *ʔuC*$_2$. Three further changes apply within the reduplicating syllable: *u* becomes *i* before a coronal; a syllable-final consonant is deleted unless it is a nasal or oral stop; finally, a syllable-final palatal becomes alveolar:

(78)	root	reduplicated	
	tuak	ʔuk tuak	'pull; pull up'
	cim	ʔum cim	'weep'
	rong	ʔung rong	'split'
	cac	ʔit cac	'word; pray, read'
	ʔas	ʔi ʔas	'the sneeze; to sneeze'
	yaw	ʔu yaw-yen	'feel; long for'
	huy	ʔi huy-a	'fly up and down'
	yaʔ	ʔu ʔyaʔ	'leave something, lay an egg'

Abstracting away from the effect of the phonological rules mentioned, the template of Nicobarese reduplication is a syllable *ʔuC*. A standard copy-and-association analysis involving a prespecified CVC template will have to somehow insure that the coda segment in a form like *cim* ends up in coda position. Since prelinked segments, if used at all, must be interpreted conditionally, we are faced with the choice of derivations shown below:

(79)

```
c   i   m     c   i   m          c   i   m     c   i   m
                |   |   |                      |   |   |
[X  [X  X]]   [X  [X  X]]      [X  [X  X]]   [X  [X  X]]
 |   |                          |   |
 ʔ   u                          ʔ   u

output: ʔum-cim                output: *ʔic-cim
```

In the right-hand derivation association proceeds left-to-right. Since the initial *c* of *cim* cannot link up to the first C of the prefix, it is expected that it will continue to search for an eligible C position: but when the empty C is found, we get **ʔuc-cim* (surface **ʔic-cim*) instead of *ʔum-cim*. The correct result is achieved in the left-hand derivation, where association proceeds right-to-left. The problem here is that we have derived the right form at the cost of reversing the expected direction of association: left-to-

right for prefixes. Alternatively, the copy-and-association analysis can derive *ʔum-cim* by stipulating a syllabic transfer condition like (42).

None of these problems arises if the change in procedures is the more drastic one advocated here: *ʔum-cim* is derived by complete copy (*cim-cim*) followed by onset substitution (*ʔim-cim*) followed by nucleus substitution (*ʔum-cim*).

The interest of the Nicobarese case extends beyond the evidence it provides for syllabic transfer. The analysis of Sanskrit has led us to assume that the first step in reduplication is making a complete copy of the base. Before this copy is matched against a template, various phonological rules may apply. In the Sanskrit perfect, after the base syllable is copied, Syncope and Vocalisation may apply to it. It is only the syllable resulting from these rules that is matched against the CV prefix. This is why *paiṣ* and *miakṣ* reduplicate as *pi-paiṣ-* and *mi-myakṣ-*. A similar phenomenon is found in Nicobarese. The derivation of items like *ʔi-ʔas* indicates that the prefix coda starts out as containing whatever the base coda contains. We must have intermediate *ʔus-ʔas* and use *s* as a conditioning factor for the rule changing *u* to *i* before a coronal. Only later can *s* be eliminated.

5.2 Rhyme transfer

We consider now the rhyme transfer effect. There are several circumstances which may reveal its presence, but the attested cases all involve prespecified templates.

5.2.1 *Gothic*. A pattern essentially identical to that found in the Sanskrit intensives of onsetless roots is encountered in the Gothic perfect. The Gothic root (Braune 1973) is prefixed in the perfect with a CV syllable whose vowel is a fixed *e*.[39] Thus *het* 'be named' yields *he-het*; *le:t* 'let' becomes *le-lo:t* (with root ablaut); *fres* 'try' becomes *fe-fres*. A vowel-initial root like *ok* 'increase' becomes *e-ok*, not **ke-ok*. What prohibits the occurrence of *k* as the onset C of the reduplicating prefix is the fact that *k* is a coda in the base. The rhyme transfer effect observed here follows directly from a derivation consisting of copy (*ok-ok-*), *e*-insertion with the usual preservation of syllabic constituency (hence *ek-ok-*), followed by the removal of the prefix coda (*e-ok*). Further aspects of Gothic reduplication are discussed below.

5.2.2 *Tzeltal*. Continuing the survey of the evidence for rhyme transfer, we consider next the prespecified reduplicating suffixes of Tzeltal (Berlin 1963). A relevant case is *Cun*, a suffix to intransitive verbs. Its suffixation to verb roots yields effects like the following: *s-t'im-t'un* 'sounds and movement of a guitar string', *s-cep-cun* 'movement of cargo in shoulders', *s-t'an-t'un* 'walk about taking off clothes', *s-poc-pun* 'sounds of wings flapping wildly'. Imagine a copy-and-association analysis of this case. Since we are dealing with a suffix, we expect, following Marantz' (1982) observations, that the unmarked mode of associating the copied base

segments will be right-to-left. But this will yield **s-t'im-mun* instead of *s-t'im-t'un*. One might think of explaining the impossibility of **s-t'im-mun* as an OCP effect. But, in fact, adjacent identical segments are allowed to occur across morpheme boundaries in Tzeltal: Berlin reports forms like *s-lihkil-lihk* 'his, one after one after...' [*sic*]. There is then no independent reason to exclude **s-t'im-mun* in a copy-and-association approach to reduplication. The alternative presented here will copy the base syllable (*s-t'im-t'im*) and will insert *u* in the nucleus (*s-t'im-t'um*) and *n* in the coda *s-t'im-t'un*). This explains the transfer effect. Further examples of the same sort are discussed by Kiparsky (1986).

One notes that a homogeneous class of superficial counterexamples to Marantz' (1982) observed correlation between the direction of affixation and that of association in reduplicative structures (left-to-right association in prefixes; right-to-left in suffixes) can be explained as being the result of transfer constraints. Thus if one attempts a copy-and-association analysis of the reduplicative prefixes of Nicobarese, one has to impose a marked right-to-left direction of association in order to prevent copies of onset segments from associating to coda slots. Conversely, a copy-and-association analysis of the reduplicative suffix of Tzeltal must proceed left-to-right in order to avoid placing the copy of a coda segment in the onset. These problems do not arise in the present framework, where no copied segments are being linked to slots.[40]

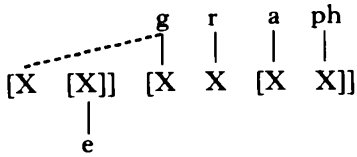
5.3 Transfer of extrasyllabicity

We consider now the cross-linguistic evidence for the transfer condition (48), which governs the reduplication of extrasyllabic segments.

5.3.1 *Greek*. Ancient Greek nominal reduplications of the type *porphu:ra:* 'purple dye' offer some sporadic examples of the effect seen in Sanskrit *kan-i-skand-* and *tan-stan-*. The relevant Greek forms are *ka-skandiks* 'wild chervil' (related to *skandiks* 'spring onion') and *ko-skulmat-ia* 'leather cuttings' (related to *skulmat-* 'hair plucked out'). Greek *sk*, like all initial obstruent clusters, is not a possible onset sequence: this point is argued further in Steriade (1982).

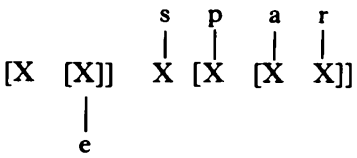
The better attested perfect reduplication also appears to display a contrast between the behaviour of initial onsets and that of heterosyllabic initials. In this case, however, the phenomenon is unrelated to the transfer of extrasyllabicity we are interested in. For instance *graph-* 'write', whose initial is a possible onset, reduplicates in the perfect as *ge-graph-*; whereas *sper-* 'sow' or *kten-* 'kill' reduplicate as *e-spar-*, *e-kton-* (both with root ablaut). The pattern is discussed more fully in Steriade (1982), where it is argued that the perfect prefix is not the result of reduplication proper but rather is a case of gemination-at-distance. Forms like *ge-graph* are derived by spreading the initial *g* onto the C position of a prefix *Ce*:

(80)



In order to derive perfects like *e-spar-*, a condition is suggested which blocks the spreading initiated by extrasyllabic segments. Only the onset *p* can spread in *spar*: but *p* is blocked by the intervening *s*:

(81)



The result is that no spreading occurs in roots with heterosyllabic initials like *spar-*: this would explain the apparent absence of reduplication.

This analysis cannot be maintained: either the Greek perfect is a true case of reduplication, in which case we cannot explain why *spar* fails to yield *pe-spar-*, or else it does involve spreading, in which case nothing really explains why extrasyllabic *s* should not spread. An alternative would be to suggest that *e-spar-* results from dissimilated *se-s.par*: dissimilation would apply just in case reduplication creates a syllable containing two identical consonants. In *ge-graph-*, where the two consonants are identical but not tautosyllabic, dissimilation fails. A virtually identical dissimilation rule operates in the Sanskrit perfect: reduplicated and syncopated *pa-pc-úr* (from *pac* 'cook') is syllabified *pap.cúr* and then dissimilated to *paicúr* (surface *pecúr*).[41] Both in Sanskrit and in Greek dissimilation applies just in case the identical segments have become tautosyllabic.[42]

5.3.2 *Gothic and Klamath.* An unusual pattern of reduplication is observed in the Gothic perfect (Kiparsky 1979; Cairns & Feinstein 1982): when the initial cluster is of decreasing sonority, it is copied in its entirety. Thus Gothic *grot* (with initial onset *gr*) reduplicates as *ge-grot*, whereas *sto* (with initial stray *s*) reduplicates as *ste-sto*. All Gothic root-initial clusters of decreasing sonority (*s*–obstruent) reduplicate *in toto*, like *st* in *sto*. However, the Gothic facts can be analysed in a number of different ways (cf. Ewen 1982), and, before we propose an analysis of this pattern in terms of syllabic transfer, less ambiguous evidence for the effect must be produced. The evidence comes from Klamath.

We have mentioned before that Klamath has a CV reduplicating prefix marking distributive action and plurality in verbs as well as diminutive and plurality in nouns. The fact is that this prefix has an allomorph CCV. The distribution between CV and CCV is in part complementary: only CCV is used with roots that begin with clusters other than stop–sonorant. Thus root initials like *kt*, *kp*, *sk*, *lm*, *lw*, *wt*, *sl*, *sm*, *sʔ* invariably reduplicate

both members, as seen in (82). Roots which begin with a CV sequence use, inevitably, the CV allomorph of the reduplicating morpheme. Finally roots which begin with an obstruent stop followed by a sonorant reduplicate either the first member or both members: both the CV and CCV allomorphs are attested in such cases. This is illustrated by (83):

(82)	root	reduplicated	
	lwot-	lwo-lwot- (lwolo:t-)	'clothe a person'
	nc'oq'o:l-	nc'o-nc'oq'ol- (nc'onsq'o:l-)	'curl hair'
	sdagal-	sda-sdagal	'pick up a live object'
	tqe:w'	tqe-tqe:w'-	'break with a blow'
	kp'a:k'a	kp'a-kp'ak'-	'shatter with a blow'
	swinys	swi-swinys (swiso:nis)	'singer'
	sn'ogys	sn'o-sn'ogys (sn'osngis)	'policeman' ('habitual catcher')
	sʔab	sʔa-sʔab-	'tells a myth'

(83)				
a.	pnia:k'-	pi-pnia:k'-	'little wild onions'
	p'nandi:la	p'na-p'nandi:la	'bury underneath'
b.	c'lekLa	c'e-c'lekLa (c'ec'ləkLa)	'put massive object down on top'
	clo:q'	clo-clo:q'-atk	'is smooth, slippery'
c.	gmay	ga-gmay (gagmi)	'tease, play a joke'
	qma	qma-qma-	'little basket hat'
d.	q'lamc'	q'a-q'lmac'-a	'close the eyes'
	q'la:j	q'la-q'la:j-	'little blueberries'
e.	q'nac'i:q	q'a-q'nac'i:q- (q'aq'nc'i:q-)	'wink, blink, squint'
	qme:W	qme-qme:W	'stop gradually'
f.	q'wanq'	q'a-q'wanq'-	'limp around'
	q'yapga	q'ya-q'yapga	'lie on their sides'

The forms in (83) are grouped in quasi-minimal pairs, to show that virtually identical clusters of obstruent + sonorant have two unpredictable options in reduplication.[43] One type of root-initial clusters whose behaviour under reduplication cannot be observed are those composed of stops followed by glottalised or aspirated sonorants. The roots beginning with such sequences do not have attested reduplications.

Following loosely the analogy of Gothic, we may propose that stop–sonorant clusters are syllabified as onsets in Klamath, whereas all other consonant clusters contain a syllabically stray initial. This view fits in with the known generalisations about onset clusters (Greenberg 1978): if any sequence is expected to be a complex onset, it is the sequence composed of the least sonorous segments (the stops) followed by the most sonorous

ones (the sonorants). The distribution between CV and CCV allomorphs of the prefix will be identical to that found in Gothic: CCV is prefixed only to roots beginning with an extrasyllabic segment.

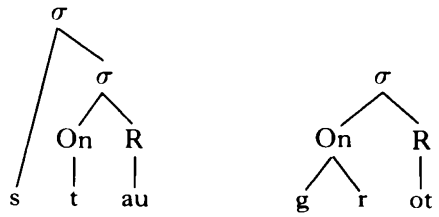
What must still be explained is the dual behaviour of the complex onsets: the fact that *q'la* can reduplicate as either *q'a-q'la* or as *q'la-q'la*. A deeper look at the phonology of Klamath sheds light on this. There are two groups of syllable-dependent processes in this language: an early class of rules, including the one which deletes *ə* in open syllables (cf. Clements & Keyser 1983), and a later class, exemplified by the rules of devoicing and deglottalisation. The latter has been extensively discussed by Kingston (1985), who demonstrates that the contexts in which underlyingly glottalised segments lose their glottalisation can be generally characterised as *everywhere except in onset*.[44] The syllable-dependent statement of the deglottalisation rule must assume that Klamath allows complex onsets of a limited sort: stops followed by plain (non-glottalised, unaspirated) sonorants. Thus any word-final and preconsonantal obstruent loses its glottalisation, except when followed by a plain sonorant. Similarly, preconsonantal and word-final glottalised sonorants lose their glottalisation, with only a few exceptions. This pattern can be understood if deglottalisation affects all segments outside the onset position. The stop–sonorant clusters, being onsets, will not be affected by deglottalisation. The same remarks can be made about the neutralisation of voicing contrasts in Klamath: before a plain sonorant, i.e. in onset position, stops show voicing contrasts, but in word-final position and before all other consonants the contrast is neutralised in favour of the voiceless stops. Thus the rules of devoicing and deglottalisation are conditioned by precisely the type of syllable structure that we must assume in explaining why stop–sonorant clusters are the only ones which may reduplicate as CV.

Kingston (1985) notes however that the syllable structure required for the analysis of deglottalisation and devoicing contradicts the assumptions necessary in the analysis of the early syllable-dependent rules of Klamath: in particular, the relatively early rule which deletes *ə* in open syllables identifies *all* consonant clusters, including those composed of stops plus sonorants, as heterosyllabic: thus in a form like *seləq'yo:la*, *ə* fails to delete despite the fact that it precedes the stop–glide sequence *q'y*. In order to explain the failure of *ə* deletion, we must assume, with Clements & Keyser (1983), a syllabification like *se.ləq'.yo:.la*, with *ə* in a syllable closed by *q'*. But, in order to explain the failure of deglottalisation, we must assume *se.lə.q'yo:.la*, with *q'* as part of the onset. Kingston decides to solve the paradox by postulating a resyllabification process whereby early *se.ləq'.yo:.la* (the stage at which *ə*-deletion may apply) is turned into *se.lə.q'yo:.la* (the stage at which devoicing and deglottalisation may apply). Whether or not this solution is synchronically adequate, it is clearly an apt internal reconstruction of two phases in the history of Klamath syllabification: an early phase during which all clusters are heterosyllabic and a later phase during which a limited set of clusters

(stop–plain sonorant) are allowed to form complex onsets. Assuming then that we are dealing with two historical stages, we may note that the two patterns of reduplication attested with stop–sonorant clusters correspond to these two stages: the early syllabification is reflected by archaic reduplications such as *q'la-q'la:j-*, whereas the current syllabification is reflected by *q'a-q'lamc'-*. We are led then to identify the *q'la-q'la:j-* pattern of reduplication as a morphological archaism. It is interesting to note that Ancient Greek also went through a shift in syllabification, which likewise left relics in the form of reduplication doublets: this issue is discussed in Steriade (1982).

The Klamath evidence shows unambiguously that clusters syllabifiable as onsets reduplicate differently from other initial clusters. This conclusion strengthens the case for a similar analysis of the Gothic contrast between *ge-gro:t* and *ste-sto*. It remains to explain now how the Gothic and Klamath total reduplication of initial extrasyllabic consonants differs from that of Sanskrit and Greek. There are two possible analyses of the *in toto* reduplication type: one is to assume, with Kiparsky (1981) and Cairns & Feinstein (1982), that initials like *st* are syllabically incorporated when reduplication applies and that they are structurally different from complex onsets. Kiparsky, for instance, advocates the adjunction of stray segments directly to the syllable node: *grot* and *stau* will then differ as follows:

(84)



Let's refer to the segments adjoined directly to the syllable node as ADJUNCTS. The structural difference between a complex onset and an adjunct–onset sequence can now be exploited: we could assume that the prefix syllable of Gothic and Klamath is restricted to having a simple onset but does not bar the presence of adjuncts. The difference between Sanskrit and Gothic/Klamath could be attributed to the fact that Sanskrit reduplication applies before adjuncts are formed.

Alternatively, we may avoid the structural complexity entailed by the difference between adjunct and onset and explain the Gothic/Klamath pattern as due to the fact that prefixes may possess certain phonotactic properties of words: in particular, the possibility of an initial extrasyllabic element. If so, the prosodic category of the reduplicating affix in Gothic and Klamath is not a plain syllable but rather a minimal word (W) containing a CV syllable. The possible presence of an initial extrasyllabic segment in the prefix mirrors a phonotactic property of Klamath and Gothic words.

5.3.3 *Latin*. Latin is the only other language known to me which attests the reduplication of initial clusters containing stray consonants. Reduplication is an unproductive means of forming perfect verb stems in Latin: indeed, it is so unproductive that no verbs beginning with complex onsets (obstruent–liquid) have attested reduplicated perfects. A few verbs beginning with *s*–obstruent clusters have their reduplicated perfects preserved: these are *ste-* (perfect *ste-t-i:*), *spond-* (perfect *spo-pond-i:*), *scid-* (perfect *sci-cid-i:*). An analysis of this type could be modelled on Broselow & McCarthy's (1983) analysis of infixation as affixation to a prosodic category which does not coincide with the stem. The Latin reduplicated CV morpheme is affixed not to the verb root but to its first syllable: since in *spond-* the first syllable is *pond*, *s* being stray, the CV prefix will directly precede this syllable. The derivation will be: *s.pond-* by syllabification of the base, *s-pond-pond-* by copy and affixation to the syllable, *s-po-pond-* by coda simplification, *spo.pond-* by stray adjunction.

I summarise below the possible reflexes in reduplication of root-initial clusters containing extrasyllabic consonants. In the examples, *stV* stands for an initial cluster with a stray member and *grV* stands for a fully syllabified initial onset cluster:

(85) i. If the base of reduplication is the morpheme:
  a. if reduplication affixes a CV(C) syllable:
     then *stV* yields *tV-stV-*, *grV* yields *gV-grV*.
     Examples:
     Sanskrit perfect, intensive reduplication: *tu-stu-*
     Greek nominal reduplication: *kan-skand*
  b. if reduplication affixes a minimal CV(C) word constituent:
     then *stV* yields *stV-stV-*, *grV* yields *gV-grV-*.
     Examples:
     Gothic perfect reduplication: *ste-sto-*
     Klamath distributive, plural, diminutive reduplication: *sda-sdagal-*

ii. If the base of reduplication is the syllable:
  a. if reduplication affixes a CV syllable:
     then *stV* yields *s-tV-tV-*; *grV* yields *gV-grV-*.
     Examples:
     Latin perfect reduplication: *s-po-pond-*
  b. if reduplication affixes a minimal CV word constituent:
     then results are indistinguishable from those in (ii.a) above, since only the base can be copied.

Note that all possible combinations of the parameters emerging from our analysis give rise to attested patterns: there are no unexpected holes in the paradigm.

5.4 Lack of transfer: the *pɔd-pɔdok* type

We must turn now to the only circumstance under which syllabic transfer does not obtain. This involves the case of a monosyllabic reduplicating template affixed to a polysyllabic base. If the template consists of a heavy syllable, we get results like the following from Mokilese (Levin 1985; McCarthy & Prince 1986):

(86)	base	reduplicated	
	pɔdok	pɔd-pɔdok	'plant'
		pɔɔ-pɔdɔk	
	kookɔ	koo-kookɔ	'grind coconut'
	wi.a	wii-wi.a	'do'
	di.ar	dii-di.ar	'find'

The Mokilese case involves a prefix syllable that must be heavy: to satisfy this requirement a base syllable like *wi* in *wi.a* lengthens. Where a coda can be provided, the weight requirement is met in two alternative ways: either by lengthening (*pɔɔ-pɔdok*) or by coda incorporation (*pɔd-pɔdok*).

I have suggested above that the proper analysis of the *pɔd-pɔdok* type involves resyllabification in the copied base: *pɔ.dok-pɔ.dok* (copying) → *pɔd.ok-pɔ.dok* (resyllabification) → *pɔd-pɔd.ok* (condition (6) reduces the polysyllabic string to a monosyllable). However, a more attractive analysis of this reduplicative pattern has been proposed by McCarthy & Prince (1987), as a step in their argument that all and only the distinctive aspects of the phonological string are copied in reduplication. I review their analysis below.

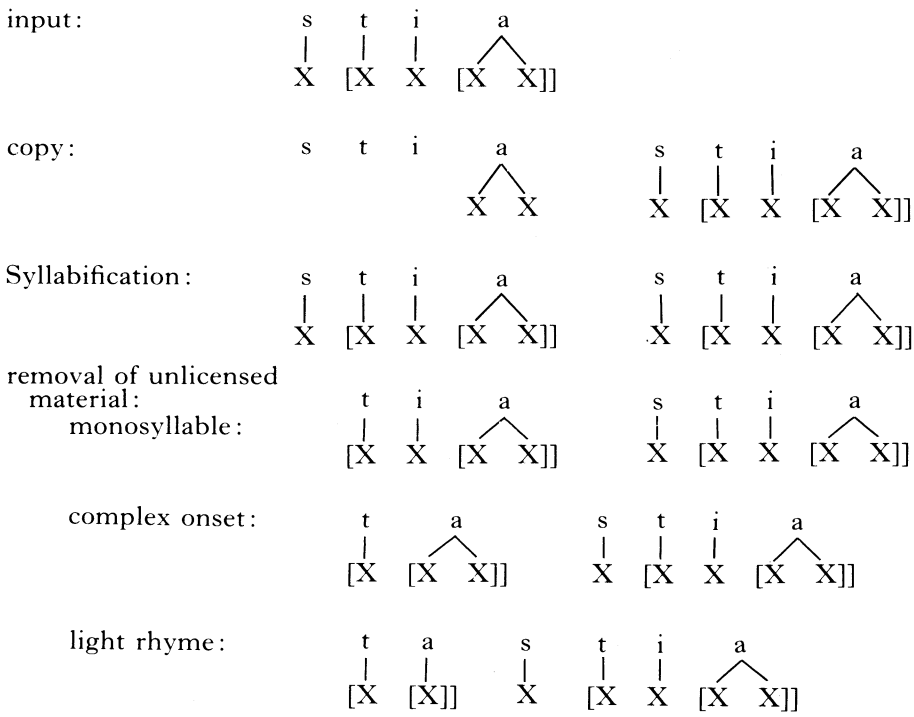
5.5 Is transfer restricted to distinctive information?

The fundamental hypothesis of McCarthy & Prince (1987) is that only distinctive information is transferred from the base to the reduplicated affix: what is inserted as the reduplicative affix is a segmental string with indications of length, if distinctive, but not of syllable structure, since the latter is predictable. Normally this will correspond to the lexical entry of the base; but the string copied may also correspond to what Kiparsky (1982) calls a 'cyclic output' (the result of completing the phonological operations associated with a given cycle), if the cyclic output is distinct from the lexical entry. (What counts as distinct turns out to be of great import for this idea, as will be observed shortly.) The procedure stemming from McCarthy & Prince's hypothesis of distinctive transfer is then to insert in the affix position an unsyllabified version of the base. The normal syllabification procedures will then apply to the copy, subject to the condition that syllabification stops once the end of the template has been reached. The unsyllabified remnant will be later eliminated. This procedure offers an ideally simple analysis of cases like Mokilese *pɔd-pɔdok*: the base may be already syllabified *pɔ.dok* but what gets copied is just the plain underlying string *pɔdok*. It is on this string that one CVC syllable is

now defined by the normal syllabification process of the language: this yields *pɔd.(ok)-pɔ.dok*, where the parenthesised portion indicates the portion left unsyllabified, later to be removed.

Although this may not be obvious, the evidence for syllabic transfer presented here can be made compatible with the hypothesis that only distinctive information is subject to transfer. We can copy the unsyllabified base, syllabify a portion of it corresponding to the number of syllables required by the template, eliminate the rest, and then strip down the remaining syllables if the syllabic markedness parameters require this. A derivation illustrating this is that of Sanskrit *ta-stya*: 'stiffen' (perf.):

(87)



output: *ta-stya:*

McCarthy & Prince should not be held responsible for the analysis in (87): its only purpose is to show how the central idea of their study can be made compatible with the syllable transfer effects discussed here.

More interesting from the point of view of the distinctive transfer hypothesis is the analysis of prespecified templates, such as the *CaC* syllable of the Sanskrit intensive. In order to properly determine the locus of *a*-insertion in the intensive prefix, the syllable structure of the base must be transferred as well. Thus the derivation of intensives like *dan-dhvṇs-* requires intermediate *dhvṇs-dhvṇs*, where *u* is in the onset and *n* in

the rhyme. We must insert *a* in the rhyme in order to produce the intermediate *dhvans-dhvṇs-* from which surface *dan-dhvas* can be derived. Now if reduplication inserts the mere string of segments {dh, u, n, s}, the syllabification rules of Sanskrit will generate *dhuns*: from *dhuns*, *a*-insertion will yield *dhauns*, hence **dau-dhvṇs-*. This establishes the need to copy syllables rather than segments in this case. But the required transfer of syllable structure in intermediate *dhvṇs-dhvṇs-* is justifiable within McCarthy & Prince's hypothesis: after Syncope and Vocalisation have applied, syllabic status *is* distinctive in Sanskrit, precisely because it creates oppositions like *vṇ vs. un*. Thus, if the hypothesis of distinctive transfer is upheld, then what we have called syllabic transfer in this study may in fact break down into two distinct classes of phenomena: (a) the independent syllabification of the reduplicated affix followed by syllabic truncation, which happens to yield results identical to those reached in the base (as in the derivation shown in (87)): and (b) real copying of the derived syllabification of the base, in cases like the Sanskrit intensive, where a distinctive opposition has been created.

What is doubtful, however, is whether the distinctive transfer hypothesis is compatible with the segmental phonology of reduplication. The answer to this question will ultimately hinge on how *distinctive* is defined, something we shall not attempt here: nonetheless the following two reduplications are likely to prove problematic under any definition.

The first case of non-distinctive transfer involves Javanese and has been dealt with extensively by Kiparsky (1986). I will mention it only briefly. Javanese rounds word-final *a* to ɔ and laxes all vowels in closed syllables. The output segments of both rules are absent from the underlying inventory; yet reduplication transmits to the affix the effect of both rules:

(88)		underlying	surface	reduplicated	
	a.	donga	do.ngɔ	do.ngɔ-do.ngɔ	'prayer'
		donga-ne	do.nga.ne	do.nga-do.nga.ne	
	b.	abur	a.bʊr	a.bʊ.r-a.bʊr	'flight'
		abur-e	a.bu.re	a.bu.r-a.bu.re	

The examples in (88a) show that the vowel quality of the prefix-final *a* depends on whether its stem counterpart is word-final or not. The examples in (b) show that the laxness of *u* in the prefix *abur* depends not on the shape of its own syllable, but on whether its stem counterpart is in a closed or open syllable. Both facts are explained if reduplication carries over the effects of *a*-rounding and closed-syllable laxing. In evaluating the distinctive status of the derived *u*/*ʊ* opposition one should bear in mind that, aside from the cases of reduplication mentioned, the two are in surface complementary distribution. The same goes for the distribution between *a* and ɔ.

The second case of non-distinctive transfer is due to Stevens (1968, 1985), who shows that Madurese reduplication applies after a number of phonological rules. The two relevant ones are tensing harmony and nasal

harmony. Both rules are allophonic in the sense that there is no underlying or derived lexical contrast in vowel tenseness or in vocoid nasality: tense vowels and nasal vocoids are exclusively the products of these rules. The occurrence of tense vowels and nasal vocoids within a Madurese word is as predictable as the V.CV syllabification of a VCV string. Yet derived nasality and tensing are carried into the reduplicating affix, as the following examples, taken from Stevens (1968, 1985), show:

(89)	root	underlying stem	surface stem	reduplication	
	khoa	khoa	khuwA	wA-khuwA	'caves'
	neat	neat	nẽỹãt	ỹãt-nẽỹãt	'intentions'
	barampa	barampa-n	bArAmpan	pan-bArAmpan	'several'
	oba	-oba	-obA	-bA-obA	'change'

In these examples, *u* and *A* are the tense counterparts of *o* and *a*. Tensing harmony is initiated by an aspirated or voiced obstruent and proceeds rightwards until the first nasal or obstruent is encountered. Thus tensing harmony applies to the end of the word in *khuwA* but is blocked in the final syllable of *bArAmpa*. Note now that the reduplicated syllable of *wA-khuwA* must be copied with tenseness, since tense harmony does not go right-to-left (cf. *-obA*, not **-ubA*). Note also that tensing harmony does not apply *after* reduplication, since **-bA-obA* fails to become **-bA-ubA*. The same point can be made about vowel nasalisation, a left-to-right harmony rule initiated by nasals and blocked by any consonantal sound: the nasal quality of the prefix in *ỹãt-nẽỹãt* must be derived in the base *neyat*, before reduplication applies.

It has been suggested (by R. A. Mester, cited in Kiparsky 1986), that reduplication in Madurese proceeds differently from the normal cases: the whole stem is copied, after which a truncation rule (independently attested in the Madurese compounds: see Stevens 1968: 102 and above) reduces the first member to its last syllable. But Madurese truncation is in fact indistinguishable from the normal process by which a base is made to fit a fixed template: what can be defined is not the string removed by truncation but the string (a monosyllable) emerging from truncation. Thus disyllabic *neyat* truncates to *yat*, trisyllabic *barampan* truncates to *pan*. This point is made explicitly in McCarthy & Prince (1986), in connection with Madurese.

However, let us accept as real the distinction, disputed here, between truncation and base-to-template matching. Let us envision an analysis of Madurese which proceeds by fully copying the stem, by applying tensing and nasalisation within the copy, and finally by reducing the copy to its final syllable. Having done this, we have no reason left to exclude the same strategy from any other instance of reduplication: in which case, nothing can prevent the *de facto* transfer of non-distinctive aspects of syllabic division. Pseudo-Mokilese *po.dok*, *an.dip* could then be reduplicated by copy and syllabification (*po.dok-po.dok*, *an.dip-an.dip*) and then reduced by truncation to their initial syllables, to yield *po-po.dok*, *an-an.dip*. It is

precisely the fact that this pattern is not attested that appears to have led McCarthy & Prince to the hypothesis of distinctive transfer. But if transfer of non-distinctive segmental properties is in fact attested, as suggested in Kiparsky (1986) and here, then the fact that Pseudo-Mokilese is an impossible type of reduplication must be explained differently.

While we have not found an alternative explanation, we have made two conjectures which redefine the problem. First, we have suggested (§2.3.1) that syllable-reduplication does not in fact exist and that templates always have a fixed prosodic weight. Second, we have proposed that a heavy monosyllabic template may be satisfied by resyllabification (V.CV→ VC.V) in the copied base. The first conjecture rules out Pseudo-Mokilese. The second gives an account of real Mokilese.

A bit of evidence for this approach is suggested by some of the French hypocoristic data analysed by Plenat (1984). The template of a French nickname is strictly disyllabic, with a first light syllable and a second syllable of variable weight: CVCV(C). It thus corresponds to a quantity-sensitive iamb. Some of the formations mentioned above illustrate the fact that the second syllable can be either heavy or light: *iza*, *zabel*, *zabe* (all from *Isabelle*), *domi*, *minik*, *mini* (from *Dominique*). What is interesting is the fact that forms like **izab*, **domin*, although compatible with the template requirements, are not possible derivatives of *Isabelle* and *Dominique*. An analysis like ours, which does not adhere to the hypothesis of distinctive transfer, can explain this fact. The nickname's base is not the lexical entry of the proper name but its syllabified form: *i.za.bel* and *do.mi.nik*. From this base, we obtain the hypocoristic by letting principle (6) eliminate all but two syllables: this yields *do.mi* and *i.za* (by left-to-right application of (6)), as well as *mi.nik*, *za.bel* (right-to-left application of (6)). The coda-less *za.be*, *mi.ni* result from the optional imposition of a syllabic markedness condition which bars codas. We exclude **i.zab* and **do.min* by noting that the iambic template is met regardless of the weight of the foot-final syllable: since that syllable need not be heavy, resyllabification is not justified and fails to apply. In contrast, the principles McCarthy & Prince appeal to in their analysis of the *pɔd-pɔdok* pattern will predict in the case at hand that **izab* and **domin* are acceptable. The hypocoristic's base is the unsyllabified lexical entry: /izabel/ and /dominik/. We apply syllabification to create the two syllables allowed by the template. In syllabifying left-to-right, we have the option to incorporate the stray *b* as coda in **izab*; and, since syllabic incorporation is maximal, this option must be taken. We are forced to derive **domin* in the same way. In analysing what went wrong here we must question not McCarthy & Prince's adoption of the idea that syllabification applies maximally – since that principle has clear uses elsewhere – but their hypothesis that templates are imposed on lexical entries devoid of predictable information.

6 Conclusion

In the preceding sections we have supported the generalisation that the syllabic position of a reduplicated segment corresponds, in the general case, to that of its base counterpart.

This generalised syllabic transfer effect follows in part from the mechanism of template satisfaction introduced here, which consists largely of the truncation of existing syllables (as dictated by principle (6)). In cases of reduplication like Sanskrit *sa-svaj*, truncation reduces a copied syllable to a simpler version of itself, without altering the constituency of surviving segments. The transfer effect illustrated by *sa-svaj* is the fact that the onset *u* is eliminated rather than assigned nuclear status (which would have produced **su-svaj*). What explains the transfer effect is the fact that the CV syllable required for the perfect prefix is obtained by trimming down, with preservation of constituent structure, the existing CCVC syllable *svaj* until it satisfies the template requirements. Other syllabic transfer effects also follow from the truncation approch advocated here. The transfer of extrasyllabicity seen in Sanskrit perfects like *ta-stya:-* follows from the fact that, in the process of making *stya:* fit a CV template, a string which exceeds one syllable (extrasyllabic *s* plus *tya:*) is necessarily reduced to one syllable (*tya:*, later *ta*). There is therefore no possibility for extrasyllabic *s* to fill any slot in a monosyllabic template: this rules out **sa-stya:* and thus explains the transfer of extrasyllabicity illustrated by this class of roots.

We must emphasise here the link between our conception of template satisfaction and the idea that templates are not strings of concrete, fillable slots, but rather abstract conditions on the prosodic weight and syllabic organisation of strings. The idea that templates are sets of conditions makes it inevitable that we should abandon the view (originated by McCarthy 1979 and perpetuated by Marantz 1982) that templates are satisfied – or 'filled' – by the association of segments to slots: for if the template is not composed of slots to be filled, template satisfaction cannot be equated with association, the process of filling them.

The syllabic transfer argument against association as a means of template satisfaction carries over to its elaboration found in Clements' (1985) study: although Clements avoids the step of segmental copy in reduplication and although he recognises certain aspects of syllable transfer, he continues to view templates as strings of slots and template satisfaction as the association of these slots, albeit not to segments but to other slots. The consequence of this, as already pointed out, is that Clements' procedure cannot explain all instances of syllable transfer.[45]

In analysing prespecified templates, we have had occasion to consider other facets of syllable transfer. We have suggested that that prespecification represents segment insertion rather than segment preattachment to a template slot: this proposal was dictated by our rejection of templates as strings of slots. The discovery of new types of transfer effects in prespecified reduplication has confirmed this idea. For instance,

we have explained why Sanskrit forms intensives like *kan-krṇd* rather than **kar-krṇd* (with a copy of onset *r* in rhyme position) by analysing the fixed *a* nucleus of the intensive prefix as inserted into the copied root syllable *krṇd*. The unmarked assumption that insertion respects the constituent structure of the input accounts for the fact that the site of *a*-insertion is between *r* and *ṇ* (at the beginning of the rhyme) rather than between *k* and *r* (in the middle of the onset). A similar explanation was offered for the fact that the prespecified Gothic *Ce* prefix yields reduplications like *e-ok* rather than **ke-ok*: *e* is inserted into the copy of the base syllable *ok* and insertion cannot displace coda *k* into onset position.

Our main hypothesis, that partial reduplication is the joint effect of total reduplication plus truncation, was confirmed by an analysis of the Sanskrit perfect prefix. We have observed that a complex set of regularities characterising the paradigm of perfect reduplication can be explained by simply allowing two independent rules of Sanskrit (Syncope and Vocalisation) to intervene between total copy and truncation.

We have not yet provided direct evidence for the other mechanism attributed here to partial reduplication: the removal of copied syllables. The following may serve as a preliminary answer to this question. Kela, a Bantu language of Zaire, forms diminutives and augmentatives by prefixing a reduplicated syllable. The resulting patterns, reported by Forges (1977: 54–56), are seen below:

(90)	pòpà	pò-pòpà	'spider'
	sóngó	só-sóngó	'tree'
	sùkú	sǔ-sùkú	'hat'
	pùdú	pǔ-m̀-pùdú	'bird'
	bódò	bô-ḿ-bódò	(unglossed)
	èdè	èd-èdè	'man'
	èsé	ès-êsé	'bone'

In the first two cases, the first syllable appears to be copied with its associated tone. The next three forms indicate that both tones of the base appear in the reduplicating syllable, in the form of a contour tone. Why this happens is explained by the last two forms, from roots beginning with onsetless syllables. In order to explain *èsêsé* we must start from an intermediate *èsé-èsé*: a normal contraction rule will yield the surface form, in which the syllable resulting from contraction bears both tones of the input syllables. It appears then that the apparent partial reduplication of Kela starts out as total reduplication and is only later reduced to a monosyllable. Before this happens, the VV contraction rule applies (*èsé-èsé* → *èsêsé*) and its application forestalls further simplification of the prefix. In cases like *sǔ-sùkú*, where VV contraction is inapplicable, the second syllable must be actively removed in order to meet the requirements of the monosyllabic template: however its tone survives by associating leftwards.

The Kela paradigm is reminiscent of the case of Sanskrit perfect reduplication in that both languages show how the application of general phonological rules to the copied base may preempt the template satis-

faction procedures of syllable elimination and simplification. In Sanskrit a root like *ai* 'go', whose zero grade is *i* (cf. *i-tá*), reduplicates as *i-ái-a*, *i-i-úr*. In this case, Syncope and Vocalisation are entirely responsible for the simplification of the original syllable *ai* to *i*: the application of these phonological rules makes unnecessary that of the syllable trimming procedures which are normally needed to reduce a complex syllable to the (C)V shape required in the perfect.

We have pointed out (§1.2) that the template satisfaction procedures consisting of syllable elimination and simplification are not exclusively a concomitant of reduplication. The same point was made concerning segmental insertion as a substitute for prespecification: morphologically governed segment insertion is not limited to either partial or to total reduplication but occurs independently in cases of ablaut, infixation or in more complex morphologies like that of the Kaingang plural.

These considerations lead us to recognise in every instance of modified reduplication a step of total copy. This conclusion has implications that go beyond templatic morphology. The copy-and-association analysis of reduplication was built on the assumption that partial copy, more specifically the copy of segmental tiers, is a possible phonological operation. The nature of copying is relevant not only for reduplication but also for the analysis of purely phonological phenomena like assimilation. As long as partial copy was a formal option, assimilation could be viewed as either spreading or as copying. But in fact, studies of the output of total and partial assimilation indicate that spreading is always the only mechanism involved (cf. Goldsmith 1979; Schein 1981; Steriade 1982; Hayes 1986). At the conclusion of this study of partial reduplication we can offer a simple explanation for this fact: selective or partial copy is not in the inventory of primary phonological operations. For this reason, it cannot be involved in assimilation, reduplication or any other morpho-phonological process.

NOTES

* I wish to thank Morris Halle for giving me encouragement and ideas in the course of writing this study. Thanks also to Diana Archangeli, Morris Halle, Bruce Hayes, Barry Schein and two *Phonology* reviewers for comments on an intermediate draft.

[1] The expression BASE OF AFFIXATION, to be used repeatedly in this study, must be clarified. I follow Broselow & McCarthy (1983) in assuming that all affixes, including reduplicative ones, may define their locus of attachment in either prosodic or in morphological terms. An affix may attach to either a root (a morphological constituent) or to a syllable, a rhyme, or a foot (prosodic constituents). The prosodic or morphological constituent to which the affix is attached is its base. For a reduplicative affix, the base provides not only an edge as the point of attachment but also the thing to be copied.

[2] The compound names like *Marie-Alice* show that a hypocoristic must preserve a syllable from *both* compound members, presumably in order to improve recoverability: without such a condition the hypocoristic of *Marie-Alice* would be either *mari* (left-to-right) or *ali*, *alis* (right-to-left), forms indistinguishable from the original compound's members.

[3] In the interest of brevity, I simplify considerably Wiesemann's description and omit a number of additional options for expressing pluralisation.

[4] The vowel inventory of Kaingang contains *a*, *e*, *o*, *y*, *i*, *u*. The vowel *y* is high and central, and thus the [+high] counterpart of *a*. Judging from Wiesemann's data, the penultimate raising appears to occur only before nasals: *g*, the segment which most often conditions raising, is phonetically realised as a velar nasal.

[5] The insertion of *g* into the rhyme of *tav* would result in an impossible sequence of two coda segments: **tagv* or **tavg*. This problem is resolved by dropping the underlying coda *v*. See also §2.2 below.

[6] Prosodic templates do not appear to exceed the size of a binary foot: I have not encountered a template corresponding to an unbounded foot, although such cases can be imagined. This gap can be explained if we adopt Prince's (1985) reduction of unbounded feet to binary feet expanded by Stray Syllable Adjunction.

[7] Interestingly, however, other varieties of Ilocano appear to be more persistent in enforcing the weight requirement of the reduplicative template: in the dialect described by Vanoverbergh (1955: 221), forms like *da-da.it* acquire a heavy prefix by geminating the stem-initial consonant: *dad-da.it*. Gemination applies only in the progressive reduplication, not across other morphemic boundaries: this strengthens our claim that the progressive prefix requires rather than tolerates a heavy syllable. A different dialect of Ilocano is currently being studied by Bruce Hayes, who reports (personal communication) that the form cited is pronounced *da:-daʔit*, with lengthening of the prefix vowel.

[8] Tubatulabal (Swadesh & Voegelin 1939) is not a counterexample to this generalisation, because its reduplicative template allows codas, albeit of a limited sort.

[9] A statement of the syllabic markedness hierarchy appears in Kaye & Lowenstamm (1981).

[10] This cancellation of marked syllabic options may be more generally a property of affixes. For instance, the Sanskrit affixal syllables are, with very few exceptions, of the form CV(C), in contrast with the stem morphemes, which frequently allow up to three consonants in the onset and extra-heavy rhymes of VVC or VCC shape. Sanskrit non-reduplicative prefixes (e.g. *prati-* 'back') behave in this respect and others like separate stem morphemes.

[11] Other templates excluded from McCarthy & Prince's list but not from mine are: (a) the disyllabic foot with simple onsets (cf. French hypocoristics like *teri* from *Thierry* or *fefed* from *Fred*); (b) the heavy but open syllable *CVV* (cf. Papago reduplication in Hale 1970); (c) the template with obligatory onsets (cf. the Sanskrit intensive analysed below).

[12] Cf. Clements (1985); Kiparsky (1986); McCarthy & Prince (1986, 1987).

[13] Bruce Hayes (personal communication) points out that the base *dait* is pronounced as [daʔit], with a *ʔ* arguably present in the input to reduplication. For this reason, a more secure example illustrating McCarthy & Prince's point would be Mokilese *dii-di.ar* 'is finding' (**dir-di.ar*).

[14] We must assume that some additional provision allows certain C-to-V mappings in this framework. The problem will not arise in a parafixation model based on the X-skeleton, for which see Levin (1985).

[15] The data comes from Whitney (1885, 1889). The letters ⟨e⟩ and ⟨o⟩ used in traditional transliteration denote long vowels. The letter ⟨v⟩ is the orthographic reflex of Sanskrit [w]. On the non-spirantised pronunciation of Sanskrit ⟨v⟩ see Varma (1961) and Mishra (1972), who summarise the views expressed on this subject in the Sanskrit grammatical tradition.

[16] I list intermediate forms, some of which never surface as such. For instance I omit systematically the effects of the *ruki* rule and of Brugmann's Law, which causes lengthening of the root syllable under certain circumstances (cf. Collinge 1985: 13 and references there). Where relevant, the corresponding surface forms are added in parentheses, underneath the intermediate form.

[17] I have found only two apparent deviations from this pattern: the roots *bhram* 'wander' and *ɕrambh* 'trust' have the nominal zero-grade forms *bhṛm-á*, *bhṛm-i*, and *ɕṛmbh-á*, in which *r* appears to be the syllabic peak. One of these roots, *ɕrambh*, also has proper zero-grade forms attested: *ɕrab-dha*, *a-ɕrabh-at* from *ɕrṃbh-ta*, *a-ɕrṃbh-at*. A possible explanation for these aberrant forms is the fact that the original zero-grade forms *ɕrṃbh-*, *bhrṃ-* were probably hard to distinguish from *ɕṛmbh-*, *bhṛm-*.

[18] The length of *si:v* will be discussed below. The zero grade for it alternates between *si:v* in contexts where *v* can be an onset (before a vowel or *y*) and *syu:* in contexts which force the entire sequence, including *u*, to be tautosyllabic: thus *syu:-tá* (syllabified *syu:.ta*) but *si:v-ya-ti*, *si:v-aya-ti* (syllabified *si:.vya.ti*, *si:.va.ya.ti*). I take forms like *si:v-ya-ti* to indicate that the basic form of the zero grade is *si:v* and that a later rule turns a *Ci:u* syllable into surface *Cyu:*.

[19] This second possibility is illustrated by forms such as *pa-pt-imá*, *ja-ks-úr* from the roots *pat* and *ghas*. Space limitations prevent a full discussion of the patterns resulting from such applications of Syncope. They are not relevant to an understanding of reduplication.

[20] On the notion of relative sonority see, for instance, the discussion in Selkirk (1984). Further proposals and a discussion of the role of relative sonority in Sanskrit phonology are provided in Steriade (1982).

[21] The figures are based on the list of roots in Whitney (1885). I have excluded from the count poorly attested roots or roots whose zero grade is attested only in Epic and Classical Sanskrit, on the grounds that many roots tend to become invariant in these late periods. I have also excluded roots like *dhya:/dhi:*, which can be analysed as based on the zero grade of *dhai* plus an *a:* extension. On this type, see §4.1.6. I provide the absolute numbers rather than percentages, because some root types have significantly fewer members than others.

[22] The fact that non-coronals like *m* can count as less sonorous than the corresponding coronal segments, in this case *n*, is established for Sanskrit in Steriade (1982). An indication of this is the fact that *mn* onsets exist (as in *mna:* 'note') whereas *nm* onsets do not.

[23] In a few cases, *vṛ* sequences surface as *u:r*. (The length of *u* in this context is due to an independent rule: there are no tautosyllabic *ur* sequences with short *u* in Sanskrit.) For instance, *dhvar* 'injure' has both the expected zero-grade *dhvṛ* (in the aorist *dhvṛ-siṣ-ṭa* and the root noun *dhvṛt*) and the *u:r* form, in the desiderative *du-dhu:r-ṣ-ati*. The *u:r* forms are likely to be the result of a separate process which turns tautosyllabic sequences of *v* and *r* into *u:r*. This process affects not only *vṛ* strings but also *rv*, as in the zero-grade *cu:r* of the root *carv* 'chew'.

[24] Some roots may vary in the selection of their full-grade or zero-grade allomorphs: for instance *hi:d* 'be hostile' has an alternate full-grade form *hed* (=*haid*). The relevant point is that the distribution between *hi:d* and *hed* is not that between zero-grade and full-grade alternants: both *hi:d* and *hed* occur in contexts where the full grade is expected.

[25] In one case, however, resyllabification is accompanied by compensatory lengthening in the root syllable: this happens in roots with the form *Caiu*. For instance, the root *saiu* 'sew' alternates between the full-grade *sev* (as in *sev-ati*), the zero-grade *si:v* (in *si:v-ya-te*, *si:v-aya-ti*) and a second form of the zero-grade *syu:* (as in *syu:-ta*). The same type of alternation is attested with the roots *daiu* 'play', *daiu* 'lament', *sraiu* 'fail' and *ṣṭhaiu* 'spew'. Abstracting away from length, the distribution between alternants like *Civ* and *Cyu* is straightforward: *Civ* appears where *v* can resyllabify as an onset (*si:.vya.ti*, *si:.va.ya.ti*) while *Cyu* occurs when the *iu* sequence must be tautosyllabic (*syu:.ta*). The key to the double zero-grade *si:.vya.ti vs. syu:.ta* is the fact that Sanskrit does not allow two distinct high vowels in its rhyme. There are no surface syllables such as *Cuy*(*C*) or *Ciw*(*C*). Thus in contexts where *iu* must be tautosyllabic, the string *iu* is reanalysed as *yu*, hence *syu:-ta*. What I must leave unexplained is the fact that the bimoraic count of the root syllable is maintained in this one

case even after resyllabification: all root alternants resulting from resyllabification are bimoraic. It seems clear, however, that the explanation for this fact must be tied to the observation that the sequence *iu* cannot belong to a single rhyme in Sanskrit. All and only the *Caiu* roots behave in this fashion.

[26] The length of the *a:* extension is obviously predictable: an extended *CCa:* root will be bimoraic, whereas a form **CCa* will not.

[27] This template happens to be identical to that of a non-reduplicative formation discussed by Poser (1984a): the fixed shape of client names as used by Japanese bargirls. The name of the client is reduced to a heavy syllable which must end in a sonorant, a shape identical to the Sanskrit intensive prefix. Where no sonorant coda exists in the original syllable, the vowel is lengthened. To this syllable, which corresponds to the initial one of the base name, one adds the prefix *o-* and the suffix *-san*. The identity between the reduplicative template of the intensive prefix and the non-reduplicative one of the Japanese client names underscores our thesis that the templatic aspect of reduplicative morphology is independent of reduplication proper.

[28] This form not only raises formal difficulties for the analysis of the intensive reduplication: it is also suspiciously similar to a couple of nominal forms *malimluc* and *malimluca* 'robber, thief, demon'. There is no process of nominal reduplication that could have created these forms. The intensive form is likely related to these nominals, and whatever explains them may shed light on its formation.

[29] The term *transfer* was first used in this sense by Clements (1985), who was primarily concerned with the transfer of vowel length and syllabicity from the base to the reduplicated affix.

[30] To simplify the picture, the optional *i* which appears in *kan-i-krad-* is not represented. Its presence is irrelevant to the effect observed.

[31] The intermediate *ya-yt-é* is not derived by Vocalisation but by a subcase of Syncope not discussed in this study: the same subcase as that responsible for zero grades such as *pa-pt-úr* on *pat* 'fly, fall'. Vocalisation and Syncope fail to apply to *yat*, in all cases: compare for instance the participle *yat-tá* (not **it-tá*) with that of the variable root *yaj/ij:*, *ij-tá* (surface *iṣṭá*). Like *yat*, all roots listed in (66) are systematic exceptions to Syncope/Vocalisation.

[32] See however below for some qualifications to this statement.

[33] We find, in the old layers of Sanskrit, a couple of exceptions to this: the roots *syand* and *dyaut* reduplicate as *si-syánd-a*, *di-dyut-é*. The expected reduplication from *syand* is found post Vedically in *sa-syand-a*. I note that all these apparently exceptional prefixes contain a vowel flanked by coronals. It is quite possible that a fronting rule ($V \rightarrow i$/Cor *y* —) applied sporadically in the perfect in the earlier stages of the language: similar phenomena are found in the reduplication of certain Igbo dialects (Clark 1986), of Nicobarese (Radhakrishnan 1981; and below) and of Tsimshian (Ritter 1986). When the coronals are absent, the fronting effect is absent too: *khya:* 'see' reduplicates as *ca-khya:-u*, *ca-khya:-úr* (surface *cakhyúr*). Supporting this analysis is the fact that we never encounter perfects of the type **du-dviṣ-a* or **du-dvaiṣ-a*: if *si-syand-a* were analysed as an exception to the onset transfer effect, then one would be led to expect **du-dvaiṣ-a* as well.

[34] For discussion of the respects in which parafixation and affixation may not be equivalent, see McCarthy & Prince (1986, 1987).

[35] The length of the vowel resulting from a vocalised glide is analysed in Clements & Keyser (1983) and Levin (1985).

[36] An alternative mode of reduplicating C–Glide sequences is discussed below.

[37] C' stands for a glottalised consonant; capitalised sonorants are voiceless.

[38] An additional factor that may play a role in the behaviour of glides in French hypocoristics is the fact that certain glides are transparently underlying vowels: thus *Louis*, *chouette* are optionally disyllabic *lu.i*, *šu.et* in many French dialects. The fact that one of the hypocoristics of Louis is *loulou* ([lu.lu]) is surely related

to the existence of the disyllabic pronunciation *lu.i.* I am grateful to Dominique Sportiche for pointing out these facts to me.

[39] The Gothic spelling uses a digraph, transliterated as ⟨ai⟩ for short *e* and ⟨au⟩ for short *o*. I replace the digraphs with symbols closer to the reconstructed phonetic values in order to clarify the phonological content of the reduplicating prefix.

[40] We may ask then what is left of Marantz' generalisation: if it does not hold of the association of segments to slots, what type of phenomena does it cover? The generalisation may be restated as follows: where there is a disparity in the number of syllables between the reduplicative affix and the base, the affix being shorter than the base, the choice of copied syllables to be preserved in the affix will depend on the direction of affixation. Prefixes will preserve syllables from the left edge of the base; suffixes will preserve syllables from the right edge. McCarthy & Prince (1986) discuss this issue and sketch some plausible suggestions on how to deal with a number of residual counterexamples not discussed in the text. One recalcitrant case, Madurese, will be discussed below.

[41] For further details see Kiparsky (1986) and Steriade (forthcoming).

[42] Old Indo-European 'reduplicated' presents such as Latin *si-sto:*, Greek *hi-ste:-mi* (from reconstructed *si-sta:-mi*) could be analysed as resulting from the spreading rule, without dissimilation. This would explain the absence of syllabic transfer: the fact that extrasyllabic *s* surfaces in onset position. Note that our claim concerning transfer of extrasyllabicity has a possible escape hatch only with formations analysable as resulting from spreading: CV prefixes with a fixed vowel. A spreading analysis would have been impossible with a CVC or longer template or with a CV prefix in which both the segmental quality of the C and that of the V reflected root segments.

[43] Barker (1964: 85, 111) says as much in his discussion of the distributive morpheme but he misleadingly abbreviates the class of sonorants with the letter N, which gives the impression that only stop–nasal clusters show variation. Also Barker seems to be unaware of the fact that all *sCV* sequences of Klamath reduplicate as CCV, with no attested variation. There are very numerous roots with *s*–sonorant initials and they invariably follow the CCV pattern.

[44] This negative statement, *everywhere except in onset*, is made necessary by the fact that word-initial glottalised consonants also lose their glottalisation if they are not part of an onset. It is clear, as Kingston indicates, that the crucial factor in determining the loss of laryngeal specifications is the lack of release: only onset consonants are released.

[45] It is harder to tell whether the procedure of template matching envisioned by McCarthy & Prince (1987) is compatible with the results reported here, because the reduplication of more complex syllabic structures is not discussed in that study. However, McCarthy & Prince's main idea, that the main step in reduplication involves not copying but lexical look-up, can be embedded into an analysis of reduplication essentially equivalent to the one advocated here. The derivation shown in (87) illustrates this.

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