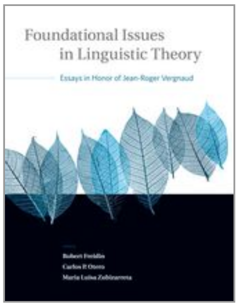


Foundational Issues in Linguistic Theory: Essays in Honor of Jean-Roger Vergnaud
Robert Freidin, Carlos P. Otero, and Maria Luisa Zubizarreta

Print publication date: 2008
Print ISBN-13: 9780262062787
Published to MIT Press Scholarship Online: August 2013
DOI: 10.7551/mitpress/9780262062787.001.0001

Reduplication

Morris Halle

DOI:10.7551/mitpress/9780262062787.003.0014

[−] Abstract and Keywords

This chapter examines the descriptive problems of reduplication that have been observed in the languages of the world and offers an explicit formalism that provides a unified account of the different kinds of reduplicative systems described in the literature. It argues that there are only three kinds of reduplication: simple, partial, and augmented. Simple reduplication copies a single sequence of segments in a word, while partial and augmented reduplication copy a single sequence of segments. Partial and augmented reduplication are examples of simple reduplication, in which deletions (partial reduplication) or additions (augmented reduplication) occur at the edges of the copied strings. The chapter proposes a framework where brackets are inserted around a segment sequence by readjustment rules linked to a morpheme that is perhaps otherwise phonetically null. In this approach, reduplications sometimes interact with other rules of the phonology or morphology. An account of metathesis is implicit in the formalism for partial reduplication.

Keywords: reduplication, languages, simple reduplication, segments, augmented reduplication, deletions, partial reduplication, additions, brackets, metathesis

This chapter attempts to illustrate a formalism for expressing the main types of reduplication that have been noted in the languages of the world. The formalism is an amalgam of ideas in Raimy 2000 and Frampton 2004, with my own attempts to deal with various aspects of reduplication. Explaining the formalism and showing how it accounts for the three different kinds of reduplication that are now known turned out to require more text than I had originally expected. Because of the great length of this part of the study, the chapter does not include a critical discussion of my differences with Raimy and Frampton, or with many of the other studies of reduplication, including Marantz 1982, Broselow and McCarthy 1983, McCarthy and Prince

1986, Steriade 1988, McCarthy and Prince 1995, Hume 2004, Fitzpatrick and Nevins 2004, and Fitzpatrick 2004. It is my plan to deal with these matters in a separate study.

The most important conclusion of the present study is that there are three (and only three) kinds of reduplication: simple reduplication, partial reduplication, and augmented reduplication. Simple reduplication (discussed in section 13.1) involves the copying of a sequence of contiguous segments in a word. Partial and augmented reduplication (discussed in sections 13.2–13.3 and 13.4–13.6, respectively) are, basically, instances of simple reduplication with end corrections. Partial reduplication can be viewed as simple reduplication in which a terminal (beginning or end) subsequence is omitted, whereas augmented reduplication is simple reduplication with the pre- or postposing of a terminal subsequence of the reduplicated string.

To distinguish these three reduplications I make use of special junctures that are inserted into the segment sequence by readjustment rules. Since these junctures are formal objects that are beyond the interpretive capabilities of the machinery that runs the human vocal tract, these junctures have to be eliminated in the course of the derivation of the output sequence. The proposal below is that these uninterpretable elements are eliminated by special rules that also relinearize the segment sequence (rules (7), (20), and (45)). Although the relinearization rules are strikingly similar, I am unable at this point to express this similarity in an appropriate formal **(p.326)** way. One of the main aims of my further study of reduplication phenomena is to fill this crucial gap.

13.1 About Reduplication

Like parts of a piece of music, parts of a word can be repeated, and this fact, called reduplication in the technical literature, is used in languages the world over to signal differences among grammatically related forms. Some examples of this process— taken from Raimy 2000— are given in (1).

(1)

a. *Mangyarrayi (p. 135)*

Nonpast	*Past*[15]	
go	gur	Default complementizer
a	ar	Resumptive complementizer
an	ar	Interrogative particle

b. *Agta (pp. 127–128, stresses omitted)*

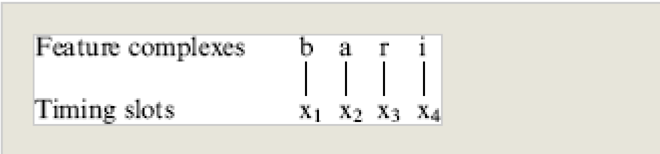
a.	*Mangyarrayi (p. 135)*		
	gabuji	g-ab-ab-uji	old person(s)
	jimgan	j-img-img-an	knowledgeable one(s)
	yirag	y-ir-ir-ag	father(s)
	wa̱gij	w-a̱g-a̱g-ij	child(ren)
b.	*Agta (pp. 127–128, stresses omitted)*		
	pusa	pus-pus-a	cat(s)

kaldi̱	kal-kal-di̱	goat(s)
jyanitor	jyan-jyan-itor	janitor(s)
takki	tak-tak-ki	leg(s)
uffu	uf-uf-fu	thigh(s)
bari	bar-bar-i	(my whole) body

In Mangyarrayi (1a) the plural is signaled by repeating the substring beginning with the vowel of the first syllable and ending with the consonant(s) preceding the vowel of the second syllable. In Agta (1b) the plural is signaled by repeating the substring that starts at the beginning of the word and ends with the consonant that follows the first vowel of the word. What is especially noteworthy in the examples in (1) is that the repeated material is always a contiguous subsequence; except for being contiguous, however, the substrings do not possess well-recognized linguistic properties. For example, in both sets of examples in (1), the substrings are not coextensive with either the morphemes or the syllables that make up the word.

It is assumed below that words and morphemes are sequences of discrete segments (phonemes) and that each segment is a complex of distinctive features. Following the widely accepted practice introduced in Goldsmith 1976, the phonetic features of a segment are formally distinguished here from its timing slot. This is illustrated in (2) with the Agta word /bari/ ‘body’.

(2)



(p.327) Each of the letters in the top line of (2) stands for a complex of features, whose internal structure will not be further analyzed here. As indicated in (2), the x’s in the bottom line stand for the timing slots to which the feature complexes in the top line are linked.

It is widely assumed in phonology, usually without discussion, that segments are concatenated into sequences, and this fact is reflected in the left-to-right order of the letters that represent the segments in the usual phonological representation. Hence a sequence such as /kæt/ is not identical to the sequence /tæk/, although the two sequences are composed of the same segments. To make explicit the conventions that distinguish /tæk/ from /kæt/ Raimy 2000 introduces a formal device for concatenating two segments in a sequence. This device is represented here by an arrow, and the notation “a → b” means “a precedes b.” In this notation, the string /b → a → r → i/ differs from the strings /i → b → r → a/ or /b → r → i → a/, and so on, in the obvious way. Implicit in representation (2) is the assumption that the concatenators are placed not between consecutive feature complexes but rather between their timing slots.

In the familiar phonological transcription, a given segment is preceded and/or followed by at most one other segment. In the formalism illustrated in (2), this means that the timing slot linked to a given feature complex can have no more than two concatenators: one on its left and the other on its right. This restriction is, of course, quite natural for surface representations of speech events because the vocal tract— the machinery that humans with intact hearing use for producing the acoustic speech signal—is so constructed that it can pronounce only one phoneme at a time. While this restriction must hold of the output representations of the phonology, that is, of the representation that the vocal tract uses to articulate the words, there is no reason to suppose that this restriction must also hold of representations other than the surface representation—in particular, of the representations that figure in the internal (mental) computations of the output string.

Raimy’s crucial innovation was to admit phonological representations where a phoneme has more than the two concatenators in (2). Specifically, Raimy admits phonological representations that, in addition to the “linear” concatenators in (2), also include what might be called “extralinear” concatenators, illustrated in (3).

(3)

The extralinear concatenator shown below the sequence of timing slots in (3), which Raimy has called LOOP, has a direction opposite that of the linear concatenators.

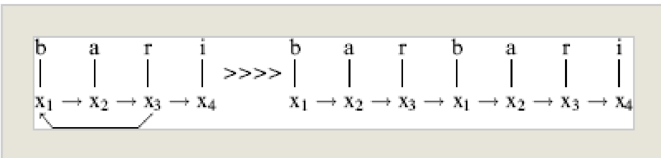
As noted, such extralinear concatenators cannot appear in the surface representation—that is, in the bottom line of the computation—because the human **(p.328)** speech machinery (our lips, tongue, velum, glottis, and so on) cannot handle representations where a given segment is followed (or preceded) by more than one other segment. As noted, however, this restriction does not apply to the representations at other stages in the computation of an utterance, and Raimy’s work has demonstrated the utility of this enrichment of the phonological notation.

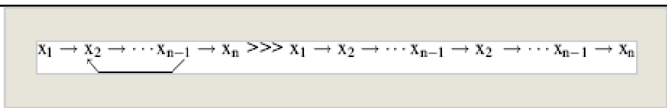
The existence of uninterpretable elements in intermediate representations raises the question of how such uninterpretable elements are removed from the representation. The answer adopted here, following Raimy’s and Frampton’s lead, is that such uninterpretable elements are removed at the same time that the string is relinearized. Specifically, to remove the uninterpretable LOOP it is necessary to produce two copies of the string delimited by the LOOP. This is illustrated in (4).

(4)

The *relinearization* rule responsible for the transformation in (4) is of the form (5).

(5)

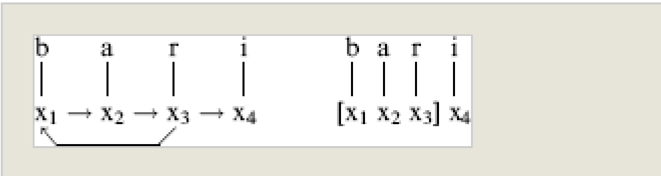




Rule (5) is the device made available by Universal Grammar (UG)—the human language capacity—to ensure that the sequences in the output of the phonology include no uninterpretable configurations. Rule (5) converts an “unreadable” sequence on its left into the one on its right that is fully legible by the output device. It is the particular way in which the uninterpretable LOOP concatenator is eliminated by the relinearization rule (5)—that is, by repeating (copying) the subsequence enclosed by the LOOP—that makes the LOOP a suitable notation for reduplication.[1] It is shown below that (5) is ordered with respect to particular phonological rules and also with respect to other relinearization rules. Additional relinearization rules are given below (see (20) and (45)).

The graphic means employed to this point to represent concatenators of various sorts have resulted in sequences of considerable typographic complexity. To simplify the representations and to make them clearer, I have replaced Raimy’s concatenators and LOOPs utilized above with a set of junctures, following here in many respects the lead of Frampton 2004. Specifically, below I have systematically omitted the linear concatenators and reflected the order of elements by their left-to-right position in the line. The extralinear LOOP concatenator was represented above by an arrow pointing in a direction opposite that of the linear concatenators. All LOOPs share this property of pointing in a direction opposite that of the linear concatenators. LOOPs differ from one another in where they begin and where they end. These terminal points can be marked by a pair of junctures inserted into the sequence at ap **(p.329)** propriate points. I have chosen to use square brackets ([,]) to mark the terminal points of the LOOPs. Given these conventions, the representation in (4), reproduced on the left-hand side of (6), can be replaced by the one on the right-hand side of (6).

(6)



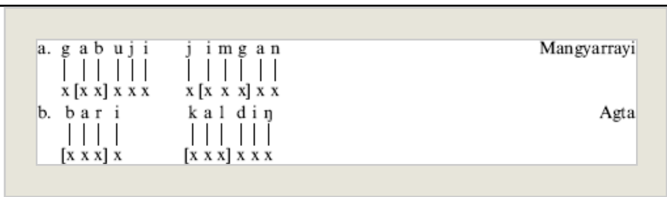
In (7) I have restated the relinearization rule (5) in the junctural notation.

(7) x_1 [x_2 … $x_{n\ 1}$]x_n ⟩⟩⟩ x_1 x_2 … x_{n-1} x_2 … x_{n-1} x_n

In both sets of examples in (1) there is no reduplication in the singular; in Mangyarrayi and Agta reduplication serves to signal the plural of the different words. This implies that there are no junctures in the singular form of these nouns, and that the junctures are inserted by special readjustment rules. Specifically, it is supposed here that in both Mangyarrayi and Agta, the exponent of the plural morpheme is phonetic zero, but that notwithstanding its lack of phonetic substance, the plural morpheme in both languages triggers readjustment rules that insert square-bracket junctures (i.e., our notational equivalents of Raimy’s LOOPs) into the underlying junctureless segment sequence of the stems when these are in construction with a plural morpheme. The effects of the readjustment rules of the two languages are illustrated in (8), with some forms from (1).

(8)

The readjustment rules for the plurals in Mangyarrayi and Agta respectively are stated in (9).[2]



(9)

a. *Mangyarrayi (1a)*

i. Insert a [juncture to the left of the timing slot linked to the first vowel of the word.

ii. Insert a] juncture to the right of the timing slot linked to the consonant directly preceding the second vowel of the word.

b. *Agta (1b)*

i. Insert a [juncture to the left of the first timing slot of the word.

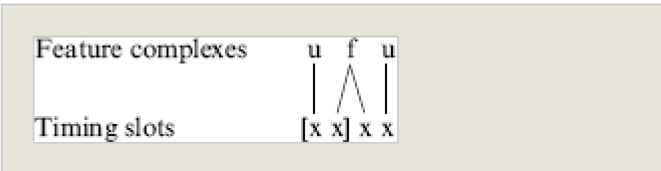
ii. Insert a] juncture to the right of the timing slot linked to the consonant directly following the first vowel of the word.

(p.330) It is worth noting at this point that segment length is not one of the phonetic features in the universal set. Vowel length and consonant gemination are expressed formally by linking a feature bundle to two consecutive timing slots. This fact explains why in Agta geminate consonants in the underlying representation appear ungeminated in reduplicated forms. By inserting a] juncture after the timing slot following the first vowel in the word, rule (9bii) ensures that an ungeminated consonant will appear in the output. This is shown in (10).

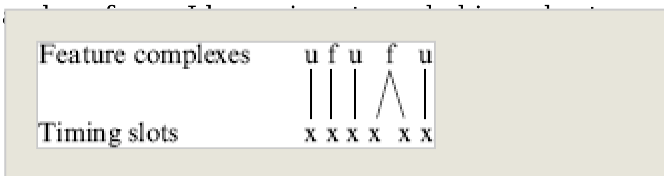
(10)

The relinearization rule (7) applies to (10) and converts it into (11), from which the square-bracket junctures, which are illegible to the output device, have been removed by relinearization.[3]

(11)



The output form (11) is atypical in that in (11) it is possible to determine that the initial two timing slots are the result of relinearization. This is generally not the case. As illustrated in (4) with the Agta example *barbari* 'my whole body' (which is a plural and therefore subject to reduplication), elimination of the square-bracket junctures makes it impossible to detect which of the repeated substrings represents the original bracketed sequence ("the base") and which is the one generated by the rule ("the reduplicant"). This distinction between base and reduplicant, which is central in many theories of reduplication, plays no role in any of the examples below account for reduplication and similar processes elsewhere. The theory developed here thus has fewer means to characterize the data, yet, as shown below, produces adequate accounts of all relevant facts. I take this outcome as support for the theory of this study.



In most cases discussed below the timing slots are copied together with the feature complexes to which they are linked. In these representations the distinction between timing slot and the features linked to it can be eliminated without the representations losing any of their perspicuity. The simplified representations in (12), where each of the alphabetic letters is assumed to stand both for a feature complex and for its associated timing slot, therefore commonly appear in place of the more complex representations in (8).

(12)

a. g[a b] u j i   j [i m g] a n

b. [b a r] i   [k a l] d i ŋ

(p.331) 13.2 Partial Reduplication

The examples reviewed to this point were all cases of full reduplication, where a contiguous substring of a phoneme sequence was repeated. In intermediate representations fully reduplicated strings are delimited by pairs of square-bracket junctures of opposite direction, as shown on the left in (13). The surface string on the right is then generated by relinearization rule (7).

(13) A[BCD]E ⟩⟩⟩⟩ A-BCD-BCD-E

In addition to full reduplication, there exist, as noted, also partial reduplication and augmented reduplication. The latter share in common the fact that they are instances of full reduplication, with modifications that affect terminal substrings in the fully reduplicated sequence.

In partial reduplication, illustrated in (14), a terminal (initial or final) subsequence of the fully reduplicated string is deleted. In intermediate representations the deleted subsequence is delimited by an angle-bracket juncture that is paired with the square bracket of opposite direction at the end of the reduplicated string. Special relinearization rules to be discussed below generate the surface string shown on the right.

(14) A[B⟩CD]E ⟩⟩⟩⟩ A-CD-BCD-E

A[B⟨CD]E ⟩⟩⟩⟩ A-BCD-B-E

In the case of augmented reduplication, which is discussed in sections 13.4 through 13.6, a terminal subsequence is repeated outside the reduplicated string, as shown in (15), where in the intermediate representations on the left the repeated subsequence is delimited by a square-bracket juncture in boldface paired with the square bracket of opposite direction at the end of the reduplicated string.

(15) A[B]CD]E ⟩⟩⟩⟩ A-B-BCD-BCD-E

A[B[CD]E ⟩⟩⟩⟩ A-BCD-BCD-CD-E

The readjustment rules (see (9)) that insert the different kinds of juncture responsible for reduplications are subject to the prohibition in (16).

(16) Between a juncture internal to a reduplicated string and the square-bracket juncture of opposite direction that terminates the reduplicated string, there may be no intervening juncture of the same direction as the terminal juncture.

The restriction (16) rules out intermediate representations such as those in (17a), while allowing those in (17b).

(17)

a. A[B⟨C⟩D]E A[B[C]D]E A[B⟨C]D]E

b. A[B]C⟩D]E A[BC⟩ [D]E

(p.332) In this and the following section I focus on partial reduplications, where only a part of the original string is reduplicated. I begin the discussion with the two cases in (18): those in (18a) are examples of reduplication in the plural formation of certain nouns and of a class of adverbs in Madurese from Marantz 1982, while those in (18b) are examples of intensive or pejorative verb formation in Levantine Arabic from Broselow and McCarthy 1983.

(18)

a.	*Madurese*		
	estre	tre-estre-an	‘wives’
	buwa?	wa?-buwa?-an	‘fruits’
	maen	en-maen-an	‘toys’
	garadus	dus-garadus	‘fast and sloppy’
b.	*Levantine Arabic*		
	barad	bar-ba-d	‘shaved unevenly’
	marat	mar-ma-t	‘cut unevenly’
	laff	laf-la-f	‘wrapped (intensive)’
	hall	hal-ha-l	‘untied, undid’

In the examples in (18a) from Madurese, reduplication is triggered by the noun plural suffix /-an/ as well as by the adverb-forming morpheme whose exponent is phonetic zero. The reduplication does not result in the entire stem /garadus/ ‘fast’ being copied; instead, only the *final* syllable /dus/ is copied, and the copied syllable appears *before* the base sequence. Similarly, in the Arabic examples in (18b), again, not the entire initial CVCV or CVC portion of the stem is copied, but only its *initial* CV part, and here the reduplicated substring appears *after* the initial CVC. In summary, in partial reduplication an abstract sequence ABC becomes either BC-ABC or ABCAB. Significantly, it is always a terminal—initial or final—subsequence that is missing from the reduplicated form. It is as though the terminal subsequences were deleted from the fully reduplicated string (i.e., #A#BC-ABC or ABC-AB#C#).

To deal with partial reduplications of this kind, a new type of juncture is introduced. These new junctures, which are the counterpart of Raimy’s JUMP concatenators, are represented below by angle brackets, and they are subject to further restrictions. First, an angle bracket may appear only inside a substring marked for reduplication (i.e., inside a substring delimited by a pair of square brackets). Second, an angle bracket is always paired with the nearest square-bracket juncture of opposite direction. In particular, a right angle bracket is paired with the nearest left square bracket, and a left angle bracket is paired with the nearest right square bracket. This is shown in (19) with two examples from (18).

(19)

a. [gara⟩dus] ⟩ ⟩ ⟩ dus-garadus
b. [b⟨ar]ad ⟩ ⟩⟩ bar-b-ad

(p.333) The relinearization rules for strings containing angle brackets are given in (20).

(20)

a. x_1 [x_2 x_3⟩x_4]x_5 ⟩⟩⟩ x_1 − x_4 x_2 x_3 x_4 − x_5
b. x_1 [x_2 ⟨x_3 x_4]x_5 ⟩⟩⟩ x_1 − x_2 x_3 x_4 x_2 − x_5

As suggested in Harris and Halle 2005, a good way of visualizing partial reduplication is to view it as a two-step procedure: in the first step the string delimited by the (external) square brackets is copied in its entirety, and in the second step the substring delimited by the angle bracket is deleted. This is illustrated in (21).

(21)

a. x_1 [x_2 x_3⟩x_4]x_5 ⟩⟩⟩ x_1− x_2 x_3 x_4 − x_2 x_3 x_4 − x_5 ⟩⟩⟩ x_1 x⟩x_2 x_3 x_4 x_2 x_3 x_4 x_5
b. x_1 [x_2 ⟨x_3 x_4]x_5 ⟩⟩⟩ x_1− x_2 x_3 x_4 − x_2 x_3 x_4 − x_5 ⟩⟩⟩ x_1 x_2 x_3 x_4 x_2 xx_3 x_4 x_5

In the enriched notation just introduced, the facts from Madurese in (18a) are the result of the readjustment rules (22a), and their effects are illustrated in (22b).

(22)

a.

i. Insert a] juncture to the right of the (timing slot linked to the) last stem segment.
ii. Insert a [juncture to the left of the (timing slot linked to the) first stem segment.
iii. Insert a ⟩ juncture to the right of the (timing slot linked to the) onset of the last stem syllable.

b. [g a r a⟩ d u s] ⟩⟩⟩ ~~g~~ ~~a~~ ~~r~~ ~~a~~ d u s g a r a d u s /dus-garadus/
[m a⟩e n] an ⟩⟩⟩ ~~ma~~en-maen-an /en-ma-en-an/

The Levantine Arabic examples are accounted for by the readjustment rules in (23a), with the effects illustrated in (23b). These rules are triggered by a special intensive/pejorative affix (represented in (23b) as I/P), which is adjoined to the stem in the morphology. Because its phonetic exponent is zero, it does not appear in the output, but the morpheme triggers the rules in (23a).

(23)

a.

i. Insert a [juncture to the left of (the timing slot linked to) the first stem segment.
ii. Insert a] juncture to the right of (the timing slot linked to) the penultimate stem consonant.

iii. Insert a ⟨ juncture to the left of (the timing slot linked to) the penultimate stem vowel, and, in the absence of such a vowel, to the penultimate stem consonant.

b. barad I/P ⟩⟩⟩ [b ⟨a r] a d ⟩⟩⟩ bar-ba̸r̸r-ad /bar-b-ad/
laff I/P ⟩⟩⟩ [l a ⟨f] f ⟩⟩⟩ laf-laf̸-f /laf-la-f/

13.2.1 The Perfect in Attic Greek and a Note on Kolami Echo Words

An interesting example of partial reduplication is the perfect formation in Attic Greek, as discussed in Steriade 1982, 195–208, which is also the source of the **(p.334)** examples in (24). Steriade remarks that “the perfect reduplication pattern breaks up into four subclasses” as shown in (24). The sets in (24a–b) illustrate the perfect of consonant-initial verbs, whereas those in (24c–d) show the perfect of vowel-initial verbs.

(24)

a.	sper	e-sper-m-ai	‘sow’
	strep^{h}	e-strop^{h}-a	‘turn’
	kten	e-kton-a	‘kill’
	gno:	e-gno:-k-a	‘know’
	blasta	e-blaste-k-a	‘sprout’
b.	lu:	le-lu:-k-a	‘untie’
	klep	ke-klop^{h}-a	‘steal’
	tla:	te-tla-men	‘endure’
	pneu	pe-pneu-k-a	‘breathe’
	grap^{h}	ge-grap^{h}-a	‘write’
	bri:t^{h}	be-bri:t^{h}-a	‘be heavy’
c.	angel	a:ngel-k-a	‘announce’
	et^{h}el	e:t^{h}ele:-k-a	‘want’
	op^{h}el	o:p^{h}e:le:-k-a	‘owe’
d.	od	odo:d-a	‘smell’
	ager	aga:ger-k-a	‘collect’
	eger	ege:ger-m-ai	‘awaken’

As (24a) shows, in certain consonant-initial verbs the perfect stem takes the /e/ prefix, which in Greek grammars is known as the Perfect Augment. In a second class of consonant-initial verbs, shown in (24b), the perfect stem is formed by reduplication of the first stem consonant and infixation of the /e/. Thus the perfect everywhere is marked by the /e/ augment, but the verbs in (24b) are subject, in addition, to /e/ infixation, which, as shown below, is a simple case of partial reduplication. Verbs of the latter class are therefore subject to a readjustment rule, which inserts the junctures shown in (25b).

(25)

a. e-sperm-ai e-kton-a
b. [e⟩-l] u: -k-a ⟩⟩⟩⟩⟩ ø ⟩ lelu: -k-a
[e⟩ − p]neu-k-a ⟩⟩⟩⟩⟩ ø ⟩ pepneu-k-a

Steriade 1982 argued that the difference between the two sets of consonant-initial stems is phonetically predictable: stems beginning with a single consonant and those beginning with a [voiceless stop] + sonorant and [voiced stop] + /r/ undergo reduplication, whereas stems beginning with other consonant clusters do not. She connected this fact with the Greek syllabification of word-initial consonant clusters and found **(p.335)** supporting evidence for this in the treatment of verbs with stem-initial /bl/ and /gl/ of which many have perfect forms with or without reduplication. According to Steriade, the word-initial clusters of these verbs are ambiguous metrically in Greek poetry, suggesting that before /l/ the initial voiced stop may or may not have been syllabified as a syllable onset. Generalizing this to the treatment of /gl/- and /bl/-initial verbs, Steriade proposed that the /e/ augment undergoes partial reduplication in verbs where the consonant is in the onset of the syllable following the /e/ augment, but not where the consonant and /e/ are tautosyllabic.

The readjustment rules for the Greek perfect are given in (26a) and their effects are illustrated in (26b).

(26)

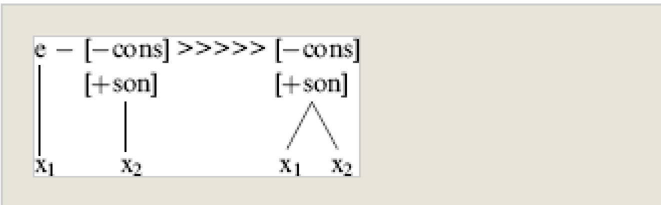
a.

i. Insert a [juncture before (the first timing slot of) the augment.
ii. Insert a] juncture after (the timing slot linked to) the first consonant of the root, provided that augment and stem consonant are heterosyllabic.
iii. Insert a ⟩ juncture after (the timing slot linked to) the augment /e/.

b. e − (V)C X ⟩⟩⟩⟩ [e ⟩ − (V) C] X[4]

To account for the perfect forms of the vowel-initial verbs in (24c,d), we need to add the well-supported assumption that Attic Greek is subject to a phonological rule that replaces a sequence /e+V/ by a long version of the second vowel, as shown in (27).

(27)



Rule (27) accounts for what Sihler (1995, 485) has called the “quantitative augment.” According to Sihler, this augment “entailed the lengthening of a word-initial vowel. It arose by imitation of paradigms in which the usual augment *e*- contracted with the initial vowel of the root (or a laryngeal) to make the corresponding long vowel.”

The vowel-lengthening rule (27) alone accounts for the forms in (24c). It clearly fails to account for the behavior of the vowel-initial verbs in (24d). The forms in (24d), however, need no additional machinery beyond that introduced above, for they fall out directly once it is seen that, like the verbs in (24b), the verbs in (24d) are subject to partial reduplication due to the application of the readjustment rules (26a). This is shown in (28).

(28) [e⟩ -od] -a ⟩⟩⟩ od-e-od-a ⟩⟩⟩⟩ od-o:d-a
[e⟩ -ag] er-k-a ⟩⟩⟩ ag-e-ager-k-a ⟩⟩⟩ ag-a:ger-k-a

In sum, the /e/ augment is the exponent of the perfect in all Greek verbs, with a subset of these undergoing partial reduplication in (26a). The surface effects of **(p.336)** partial reduplication in consonant-initial stems are strikingly different from the surface effects in vowel-initial verbs, but that is fully accounted for by (26a) and (27).[5]

There is thus a single unified treatment of the augment in Greek for both vowel-initial and consonant-initial verbs. This result, however, is available only if the facts are represented in the notation that has been introduced here; without this notation, the result is not expressible or even conceivable, and one is forced to adopt unhelpful, opaque accounts like that of Sihler 1995, 488–489. The unified account of the Greek augment above thus provides important empirical support for the theory introduced here.

I conclude this section with a brief look at the echo words in Kolami (29a), a case of partial reduplication that is the mirror image of the Greek augment, and was also discussed by Steriade 1988, 89. Whereas in Greek the augment is a prefix that is partially reduplicated, in Kolami it is a suffix, the echo suffx /gi/, that is subject to partial reduplication. I have stated the Kolami readjustment rules in (29b) and have illustrated their effects in (29c) with two of the examples from (29a).

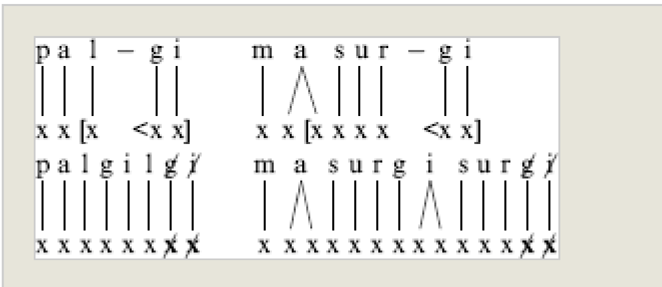
(29)

a.	pal	pal-gi-l	‘tooth’
	kota	kota-gi-ta	‘bring it’
	iir	iir-gi-ir	‘water’
	maasur	maasur-gii-sur	‘men’
	saa	saa-gii	‘go’ (cont. ger.)

b.

i. Insert a ⟨ juncture before the suffix /g i/
ii. Insert a [juncture after the first timing slot linked to a vowel
iii. Insert a] juncture at the end of the word

c.



As shown in (29c), in Kolami it is necessary to make explicit the fact that reduplication junctures are inserted on the tier of timing slots rather than among the feature complexes of the segments. Like the reduplication in Greek, that of Kolami affects a contiguous sequence of timing slots. In Greek the string consisted of the augment plus timing slots of the stem up to and including the first consonant; in Kolami the affected string is the suffix plus the timing slots preceding it, up to (but not including) the first vowel slot of the stem. In both languages the affix appears only once in the output (and hence is delimited by an angle-bracket juncture).[6]

(p.337) 13.3 Metathesis

As the examples in section 13.2 showed, a string of the form AB can be subject to partial reduplication of two kinds, for in a string AB either A or B may undergo partial reduplication:

[A ⟩ B] ⟩⟩⟩ BAB   [A ⟨ B] ⟩⟩⟩ ABA

In the former case, exemplified by the Greek augment, the output is of the form BAB; in the latter, that of the Kolami echo words, the output is of the form ABA. The question to be investigated next is what output is produced by a string where both A and B are subject to partial reduplication. Such a sequence is subject to both relinearization rules (20a) and (20b), and, as shown in (30), this produces as output the sequence BA.

(30) [A⟩ ⟨B] ⟩⟩⟩ A̸BAB̸ ⟩⟩⟩ BA

This is a result of the greatest interest because it shows that implicit in the notation for partial reduplication is also a treatment of metathesis, a widely attested phonological process. As observed by Hume (2004, 204), there is at this time “no unified, explanatory account of why metathesis occurs, why it favors certain sound combinations and why we obtain the outputs that we do.” In this section I show that Hume’s questions are answered by the theory developed here.

The first thing to be noted about metathesis is that it affects contiguous sequences of segments and never involves noncontiguous sequences.[7] Thus, while there are metathesis operations with the effect of AB ⟩⟩ BA or AB-C ⟩⟩⟩ C-AB or A-BC ⟩⟩⟩ BC-A, there are no instances of metathesis of the form ABC ⟩⟩⟩ CBA (setting aside the special cases mentioned in note 7). This follows directly from the notation. As mentioned earlier, angle brackets can be inserted only inside a sequence enclosed in square brackets. As a result, the only well-formed sequences of a sequence ABC containing a pair of angle brackets are those in (31), and as shown there, none of the three results in the output CBA.

(31)

a. [A⟩ ⟨BC] ⟩⟩⟩ A̸BC-AB̸C̸ ⟩⟩⟩ BC-A
b. [AB⟩ ⟨C] ⟩⟩⟩ A̸B̸C-ABC̸ ⟩⟩⟩ C-AB
c. [A⟩ B ⟨C] ⟩⟩⟩ A̸BC-ABC̸ ⟩⟩⟩ BC-AB

(31c) is of particular relevance, for it shows that when a pair of angle brackets are inserted between elements that are not contiguous, the result is something other than metathesis.

Many of the examples cited by Hume are triggered by loss of an intermediate element. This is true of her examples from Balangao (1), Hungarian (2), Basaa (4), Udi (10), Elmolo (9), and Hixkaryana (28). The obvious reason for this correlation is that **(p.338)** deletion in these cases generates the required contiguity of the elements without which metathesis cannot occur. Although contiguous subsequences of segments figure in almost every metathesis example in Hume’s paper, this striking fact is not even mentioned.

As illustrated in (31a,b), a subsequence of two (or more) elements may metathesize with a single elements. An example of this type in Hume’s paper is that of the Mutsun plural suffix /mak/ in

(15) (p. 224), which surfaces as /kma/ after stems ending with a vowel. By contrast, the locative suffix /tak/ surfaces—in the same context— as /tka/. These differences are accounted for by positing for these two suffixes the slightly different readjustment rules shown in (32).

(32)

a. [m a⟩⟨k] ⟩⟩⟩ k-ma

b. t [a⟩⟨k] ⟩⟩⟩ t-k-a

On the account proposed here, metathesis is a special case of partial reduplication. A well-known example that also supports this consequence is the treatment of vowel-liquid sequences in the Slavic languages. A strong tendency, to which all Slavic languages were subject at one stage in their history, is the replacement of closed syllables with open syllables. One aspect of this general development was the replacement of word-medial midvowel + liquid rimes. As shown in (33), in Russian (and other East Slavic languages) these closed syllables were converted into open syllables by partial reduplication (termed pleophony, Russ. *polnoglasie* in the handbooks), while elsewhere (e.g., in Polish) the rimes were subject to metathesis. (For more discussion, see Bräuer 1961, 78ff.)

(33)

IE *berz-a	Russ. berez-a	Pol. brzoz-a	‘birch’
IE *golv-a	Russ. golov-a	Pol. g̨ow-a	‘head’
IE *g^{h}ord	Russ. gorod	Pol. grod	‘town’
IE *vols	Russ. volos	Pol. w̨os	‘hair’

In the present formalism the two rules have the respective forms in (34), where C stands for consonant, V for [–high] vowel, and R for liquid.[8]

(34)

a. Pleophony C [V ⟨R] C X ⟩⟩⟩ C V R V C X East Slavic

b. Metathesis C [V ⟩ ⟨ R] C X ⟩⟩⟩ C R V C X South/West Slavic

The historical relatedness of these development is reflected in the obvious similarity of the notations in (34a) and (34b).[9]

13.3.1 Kaingang

A particularly instructive example of the relation between total and partial reduplication is provided by the plural formation of Kaingang, as discussed by Steriade 1988 on the basis of data in Wiesemann 1972.[10] In Kaingang, the plural is signaled in a **(p.339)** variety of ways—in particular, by final-syllable reduplication (35a), insertion of /g/ in the penultimate rime (35b), and raising of penultimate vowel to [+hi] (35c). Each of these three changes alone is a sufficient signal of the plural, but a given change may also co-occur with one or both of the other changes. Thus, penult /g/ insertion may co-occur with penult V raising, as shown in (35d); or reduplication may co-occur with /g/ insertion as shown in (35e), or with penult raising, as shown in (35f); and all three of these stem changes may co-occur, as shown in (35g). At the end of each set of examples in (35) I have given the formula for the type of reduplication the set undergoes.

(35)

a.	*Final-syllable reduplication*			
	kry	kry-kry	‘irritate’	
	jengag	jengag-gag	‘roasted meat’	jen[gag]
b.	*/g/ insertion*			
	kavi	ka-g-vi	‘stretch’	
	juryn	ju-g-ryn	‘sharpen’	ju[ryn⟩⟨-g]
c.	*Penult V raising*			
	kagje	kygje[11]	‘knot’	
d.	*Raising and /g/ insertion*			
	jakajen	jaky-g-jen	‘turn, twist’	
	pafam	py-g-fam	‘quiet’	
	pefam	pi-g-fam	‘quiet’	pe[fam⟩⟨-g]
e.	*Reduplication and /g/ insertion*			
	ne	ne-g-ne	‘bury’	
	tav	ta-g-tav[12]	‘turned’	[tav⟨-g]
f.	*Reduplication and penult V raising*			
	gon	gun-gon	‘swallow’	
	?og	?ug-?og	‘drink’	[?og]
g.	*Reduplication, /g/ insertion, and penult V raising*			
	tav	ty-g-tav	‘turned’	
	tam	ty-g-tam	‘cover’	
	pov	pu-g-pov	‘divided’	
	kavej	kavi-g-vej	‘dirty’	ka[vej⟩⟨-g]

I assume that in Kaingang the plural has two exponents: /g/ and zero, and both of these exponents may trigger reduplication and/or penult V raising. If /g/ is chosen as plural exponent it automatically triggers the readjustment rules in (36d), which as shown in (38) produces Penult /g/ insertion

(36)

a. Insert] at the end of the word—that is, after the /g/ exponent of the plural.

b. Insert [before the onset of the last syllable.

(p.340) c. Insert ⟨ before the /g/ exponent of the plural.

d. Insert ⟩ before ⟨ (optional).

After relinearization the sequences are subject to the phonological rules of the language, among which the two rules in (37) are of special importance.

(37)

a. V ⟩⟩⟩ [+high] in env.___ σ # #penult raising (opt).

b. Glides are deleted in env.___ C.

In the derivations in (38) I have shown the effects of applying these rules to some of the plural forms cited in (35). In the derivations below, the top line shows the underlying form, where the plural exponent is j (phonetic null) in /jengag/, but /g/ elsewhere. The different rules are listed on the left, and the abbreviation “dna” means that the rule does not apply.

(38)	jengag	tav-g	kavej-g	kavi-g	pafam-g
(36)	jen[gag]	[tav⟨-g]	ka[vej⟨-g]	ka[vi⟩⟨-g]	pa[fam⟩⟨-g]
(20)	jengag-gag	tav-g-tav	kavej-g-vej	ka-g-vi	pa-g-fam
(37a)	dna	ta-g-tav	kave-g-vej	dna	dna
(37b)	dna	dna	kavi-g-vej	dna	py-g-fam
	‘roasted meat’	‘turned’	‘dirty’	‘stretch’	‘quiet’
	(35a)	(35e)	(35g)	(35b)	(35d)

In all examples in (38) the plural morpheme /g/ is infixed before the last stem syllable. In the second and third examples there is partial reduplication, whereas in the fourth and fifth examples there is metathesis. Formally the difference between these two sets of forms results from the absence versus presence of a right angle bracket inserted by the optional application of rule (36d). The perspicuous character of the derivations must be taken as empirical support for the notations introduced above and for the theory that underpins them.

13.4 Augmented Reduplication in Tigre with a Digression on Tigre Syllabification

The intricate facts of Tigre reduplication discussed in this section indicate the need for further enrichment of the theoretical machinery. In Rose 2003, my main source of Tigre data, all verbal forms are cited in the third-person masculine perfective (see her note 1). Most of her examples therefore end with the phonetic exponent of this suffix, short or long /a/. Because this suffix plays no role in what follows, I have systematically omitted it in the forms I cite. Moreover, in citing Tigre forms below I have also omitted surface syllabification and have given the forms without the many schwa vowels that appear in Rose's paper. These schwa vowels are inserted by the syllabification algorithm discussed in section 13.4.1, which while straightforward, is intricate in a way that seems worth the digression below.

(p.341) 13.4.1 Digression on Tigre Syllabification

The most important fact about surface forms of Tigre words is that the appearance of (most) schwas in surface strings is readily predictable from a metrical analysis of schwaless strings, utilizing to this end the theory of footing of Idsardi 1992, 2004. The utility of the Idsardi formalism for purposes of the computation of word stress has been documented in a series of papers, some of which are listed in the references to Halle and Idsardi 2000. The Idsardi formalism has been shown by Purnell 1997 to serve correctly for the computation of the tone contours of words in many tone languages in Africa and elsewhere. The analysis in this section is one of the first to show that footing and metrical structure of the Idsardi theory also account for complicated facts of syllabification.

The sequences of timing slots that constitute words are grouped into feet and then syllabified by means of the rules in (39). The insertion of parentheses into a sequence of timing slots divides the sequence into feet; in particular, a left parenthesis foots all elements on its right, and a right parenthesis foots all elements on its left. The feet are thus defined by single unpaired parentheses. Timing slots that are neither to the right of a left parenthesis nor to the left of a right parenthesis remain unfooted. Each foot has a head, which is either its leftmost or its rightmost element.

(39)

a. Insert a right parenthesis) (boldface) juncture after a timing slot projecting from a vowel.[13]
b. Insert right parentheses) iteratively from left to right, starting at the left edge and skipping two timing slots after each insertion. (No insertion between the timing slots of a long vowel.) Feet are left-headed.
c. Insert /e/ (schwa) after the head of a foot if no vowel follows the head.

I have illustrated the application of these rules in the syllabification of Tigre words in (40a).

(40)

a. ktb ⟩⟩⟩ kt)b ⟩⟩⟩ kət)b ‘write’
mssl ⟩⟩⟩ ms)sl) ⟩⟩⟩ məs)səl) ‘resemble’
ma:sl ⟩⟩⟩ ma:)sl) ⟩⟩⟩ ma:)səl) ‘be diplomatic’
dna:gs ⟩⟩⟩ dn)a:)gs) ⟩⟩⟩ dən)a:)gəs) ‘become scared’
kta:tb ⟩⟩⟩ kt)a:)tb) ⟩⟩⟩ kət)a:)təb) ‘write a little’
b. gfr-ko ‘I whipped’ ⟩⟩⟩ g)fr)-ko) ⟩⟩⟩ gə)fər)-ko)
But gfr-a:‘he whipped’ ⟩⟩⟩ gf)r-a:) ⟩⟩⟩ gəf)r-a:)
dnga:gs ‘become a little scared’ ⟩⟩⟩ d)ng)a:)gs) ⟩⟩⟩ də)nəg)a:)gəs)

The footing of the forms in (40b) does not follow directly from the rules in (39). To obtain the footings in (40b) it is necessary to posit an additional rule, which like (39a) is ordered before (39b). This rule inserts a right parenthesis *after* the leftmost timing slot. I have represented this juncture, like the junctures inserted by rule (39a), with a **(p.342)** boldface parenthesis. According to Rose (2003, 110, note 2), this additional rule is needed to handle forms with consonant-initial suffixes; it therefore does not apply in /gefr-a:/ ‘he whipped’, where the suffix begins with a vowel. As the last example in (40b) shows, this special rule also applies to some forms without consonant-initial suffix, but my understanding of Tigre phonology is too rudimentary to propose a plausible formulation of the extended rule.[14]

Since the rules in (39), supplemented by the rule in the paragraph above, account for all schwas in Tigre words, schwas have been omitted in the transcriptions of Tigre words below. This makes it possible to state the various reduplication and metathesis processes of Tigre in their most perspicuous form, especially since schwa insertion applies to the outputs of the reduplication and metathesis processes discussed below.

13.4.2 Tigre Reduplications

Setting aside the semantic/morphological functions of the different verb forms in which they figure, Tigre stems are of three basic types, which, following Rose (and Raz 1983), I designate as A, B, C. As illustrated in (41a), type A is a pure triconsonantal stem. Types B and C are also triconsonantal, but they are subject to special readjustment rules. As shown in (41b), in type B stems the penultimate consonant is doubled, and in type C (see (41c)) a long /a:/ is infixed before the penultimate stem consonant. This long /a:/ is a suffix in the morphology, but is infixed into the stem by metathesis. This long /a:/ is distinct from the 3sg suffix, which, as noted, has been systematically omitted in the examples cited here.

(41)

a.	ktb	‘write’
	grf	‘whip’
	dgm	‘tell, relate’
	sbr	‘break’
b.	mssl	‘resemble’
	grrm	‘be beautiful’
	mzzn	‘weigh’
	9ddm	‘invite’
	mzz-	‘give responsibility’

c.	sa:kr	‘praise’
	sa:rH	‘send away’
	ma:sl	‘be diplomatic’
	ka:tb	‘write repetitively’
	ma:sl	‘give many examples’

I propose to account for these three types of stems by positing the purely consonantal stem as underlying, with syllabification being supplied by the rules in (39). The stem appears in its underlying shape in forms of class A, but is subject to the readjustment **(p.343)** rules in (42) in forms of class B and C. In (42a,b) I have stated the effects of the readjustment rules first, and below the statement I have given the formal rules inserting the appropriate junctures. Directly underneath each set of rules I have illustrated their effects with an actual Tigre word.

(42)

a. Reduplicate the penultimate stem consonant.
Insert a [juncture before and a] juncture after the penultimate consonant of the stem.
msl ⟩⟩⟩ m[s]l ⟩⟩⟩ mssl ‘resemble, be an example of ’
b. Metathesize the last two consonants of stem with the /a:/ suffix.
Insert [juncture before the penultimate stem consonant.
Insert] juncture after the /a:/ suffix.
Insert⟩ juncture after the last stem consonant. Insert ⟨ juncture before the /a:/ suffix.
msl ⟩⟩⟩ m[sl⟩-⟨a:] ⟩⟩⟩ ma:sl ‘give many examples of ’

This brings us to the so-called frequentative aspect, which in Tigre, “consistently expresses diminutive action” (Rose 2003, 112). This verbal aspect is signaled by a suffix /a:/, which, though homophonous with the “intensive” /a:/ suffix, is distinct from the latter, in that it triggers both reduplication of the penultimate consonants and metathesis (of the /a:/) with the directly preceding two-consonant sequence.

I have illustrated this in (43). (43a) shows the base verb /dngs/ meaning ‘to be scared’. The “intensive” variant of this verb undergoes only metathesis and surfaces as /dna:gs/ (see (43b)). The “frequentative” shown in (43c) undergoes both reduplication of the penultimate consonant and metathesis.

(43)

a.	dngs	‘become scared’	
b.	dna:gs	‘become very scared’	Intensive
c.	dnga:gs	‘become slightly scared’	Frequentative

We obtain the intensive form /dna:gs/ (43b) from the intermediate representation /dn[gs⟩⟨-a:]/, where /a:/ is the exponent of the intensive morpheme. Formally this form is generated by the readjustment rule (42b), which metathesizes the /a:/ with the last two stem consonants. The same metathesis operation is involved in the frequentative in (43c), but the form is subject in addition to rule (42a), which results in the reduplication of the penultimate stem consonant. Applying the two readjustment rules in (42) to the underlying string /dngs-a:/, we obtain the sequence

dn[[g]s⟩⟨-a:]

where the pair of square brackets generated by (42a) is internal to the pair of square brackets generated by (42b). This violates the prohibition (16) since the second square-bracket juncture is of the same direction as the first square-bracket juncture **(p.344)** and intervenes between it and the internal right square-bracket juncture. Since no empirical consequences of this violation are known, it is assumed here that when two identical junctures abut, one of the two abutters is deleted by the notational conventions in (44), and its (undeleted) mate is printed in bold type.

(44)

a. A [[B] C] D ⟩⟩⟩ A [B]C] D
b. X [Y [Z]] W ⟩⟩⟩ X [Y[Z] W

This bit of tidying up the notations has two effects. First, it eliminates the violation of prohibition (16). Second, the output strings in (44) include an unpaired square-bracket juncture, printed in boldface in (44), and to this point no suggestion has been made as to how this “unreadable” juncture is to be eliminated from the representation. We will assume that like the rest of the “unreadable” junctures, the unpaired square-bracket juncture is eliminated by relinearization rules, which are given in (45), where the sequences of dots … stand for junctures that may appear in these positions.

(45)

a. x_1 [x_2] …x_3 … x_4]x_5 ⟩⟩⟩ x_1 − x_2 [x_2 … x_3 … x_4] − x_5
b. x_1 [x_2 … [x_3 x_4]x_5 ⟩⟩⟩ x_1 − [x_2 … x_3 x_4] − x_3 x_4 − x_5

The junctures in the output of the rules (45) are eliminated by the subsequent application of the relinearization rule (7) or (20).

As illustrated in (46), the first step in deriving the surface form of (43c) is the elimination of the boldface square bracket by the application of the relinearization rule (45a). The remaining junctures are eliminated in the next step by application of the relinearization rule (20).

(46)

a. dn[g]s⟩⟨-a:] ⟩⟩⟩ dn-g-[gs⟩⟨-a:]
b. dn-g-[gs⟩⟨-a:] ⟩⟩⟩ dn-g-a:-gs

The order in which the relinearization rules apply is crucial, for as shown in (47), if (20) is applied first, an uninterpretable string is generated.

(47)

(20)
dn[g]s>-<a:] >>> dn-a:-g]s ***

It is to be observed, moreover, that in the first step of the derivation in (46), the reduplicated consonant /g/ must be placed outside the left square bracket.

This technical detail is crucial, for as shown in (48), placement of /g/ inside the square-bracket juncture produces an incorrect result:

(48) dn[g]s⟩⟨-a:] ⟩⟩⟩ dn[g-gs⟩⟨-a:] ⟩⟩⟩ dn-a:-g-gs ***

I close this discussion of the Tigre facts with Rose's (2003, 113) interesting observation that Tigre has "the ability to form verbs with up to three reduplicative syllables," where "with each reduplication, the meaning is [further] attentuated." Rose illustrates this with the examples in (49).

(p.345) (49)

dgm	'tell, relate'
dga:gm	'tell stories occasionally'
dga:ga:gm	'tell stories very occasionally'
dga:ga:ga:gm	'tell stories infrequently'

The underlying string of the longest form in (49) and the derivation of its surface string are shown in (50) (Rose 2003, 124). The multiple affixation of the frequentative morpheme is specifically ruled out in the other Ethiopic languages (see Rose 2003, section 13.1). The parentheses in (50) delimit the different cyclic constituents of the word. The first step in each cycle is the insertion of reduplication junctures by a readjustment rule; the next two steps show the effects of the application of the relinearization rules (45a) and (16).

(50)

UR:	(((dgm-a:)-a:)-a:)
1st cycle:	(dgm-a:) ⟩⟩⟩ d[g]m⟩-⟨a:] ⟩⟩⟩ dg[gm⟩⟨-a:] ⟩⟩⟩ dga:gm
2nd cycle:	(dga:gm-a:) ⟩⟩⟩ dga:[g]m⟩-⟨a:] ⟩⟩⟩ dga:g[gm⟩-⟨a:] ⟩⟩⟩⟩ dga:ga:gm
3rd cycle:	(dga:ga:gm-a:) ⟩⟩⟩ dga:ga:[g]m⟩-⟨a:] ⟩⟩⟩⟩ dga:ga:g[gm⟩-⟨a:] ⟩⟩⟩⟩ dga:ga:ga:gm

The underlying representation (UR) in (50) indicates the morphological composition of the forms; each additional intensive /a:/ suffix is directly reflected in the meaning of the form. And each /a:/ suffix also triggers exactly the same readjustment rules— that is, augmented consonant reduplication and /a:/ infixation. However, the readjustments are not part of the underlying representation; they are rather steps in the derivation of the form, instituted on each cycle. I regard the naturalness of this analysis as a significant argument in favor of the account presented here.

13.5 Augmented Reduplication in Mokilese

Additional support for the relinearization rules in (45) is provided by the interesting fact that double reduplication of a string W results in a sequence of three rather than of four W's. As shown in (51), this follows automatically if the strings in question are relinearized by the rules in (44) and (45).

(51)

a. [[W]]U ⟩⟩⟩ [W]]U ⟩⟩⟩ W [W] U ⟩⟩⟩ W W W U
b. X [[Y]] ⟩⟩⟩ X [[Y] ⟩⟩⟩ X[Y] Y⟩⟩⟩ XY YY

Actual examples of this kind of triplication are provided by the Mokilese progressive reduplication discussed by Blevins 1996.

(52)

a.	pɔdok/pɔdpɔdok	‘plant/ing’	[pɔd]ok
b.	kasɔ /kaskasɔ	‘throw/ing’	[kas]ɔ
c…	andip/andandip	‘spit/ting’	[and]ip
d..	sɔɔrɔk/sɔɔsɔɔrɔk	‘tear/ing’	[sɔɔrɔk
e..	caak/caacaacaak	‘bend/ing’	[caa]]k

(p.346) Examples (52a–d) show that in forming the progressive aspect the first three segments of a verb stem are reduplicated, and, as shown in the right-hand column of (52), this is notated by enclosing the first three segments of the string in (paired) square-bracket junctures.

Example (52e) differs from the rest in that the root here is monosyllabic. As Blevins (1996, note 1) points out, monosyllables “must undergo triplication in the progressive.” In terms of the theory developed here, progressive forms of monosyllabic roots are subject to the insertion of an additional pair of square brackets. Because of the convention (44) and the relinearization rules (45), this results in triplication, as shown in (53).

(53) [[caa]]k ⟩⟩⟩ [caa]]k ⟩⟩⟩ caa[caa]k ⟩⟩⟩ caa-caa-caak

The Mokilese example thus shows that given the formalism developed here, triplication rather than quadruplication is the output of doubly reduplicated sequences. The fact that formalism and observed behavior go so neatly together constitutes further evidence in support of the theory developed here.

13.6 Reduplication in Sanskrit

The most intricate examples of reduplication that I am aware of are those of the Sanskrit conjugation.[15] As I attempt to show below, all Sanskrit reduplications, like those of the Tigre frequentative (see section 13.4), involve simultaneously both partial reduplication (represented here with unpaired angle-bracket junctures) and augmented reduplication (represented here with an unpaired square bracket in boldface).

13.6.1 Preliminaries and Obstruent Modifications in Reduplication

The possibility of the reduplicating junctures],[appearing inside other junctures, in particular inside an⟩ juncture, has the consequence that simple reduplication of the type ABABC can be derived in two ways, as shown in (54).

(54)

(7)
a. [AB]C >>> ABAB-C

(44) (45) (20)
b. [[A]>BC] >>> [A]>B]C >>> A[A>B]C >>> A-BAB-C

At first glance, the fact that the theory provides two distinct ways of accounting for a given output sequence might appear to reflect a shortcoming. However, the facts of Sanskrit reduplication, to which I now turn, indicate that this is an incorrect conclu **(p.347)** sion and, that in order to do justice to these facts, the formally simpler alternative based on the underlying representation [AB]C must be replaced by the formally more complex [A]⟩B]C, even in those cases where the simpler account might seem adequate.

MacDonnell (1916, 122) writes: “Five verbal formations take reduplication: the present stem of the third conjugational class, the perfect (with the pluperfect), one kind of aorist, the desiderative, and the intensive. Each of these has certain peculiarities which must be treated separately.” The five reduplications are illustrated in (55) below with examples from Whitney 1885. (Below, the digraph C!—where C stands for consonant—represents a retroflex C.)

(55)

a. *tap* ‘heat’: perf. *tata:pa*; aor 3. *a-ti:tapat*; int. *ta:tapyate*; desid. *titapsa*;
b. $b^{h}i$*:*‘fear’: pres. $bib^{h}yati$; perf. $bib^{h}a$*:ya*; aor 3. *bi:*$b^{h}ayat$; int. $baib^{h}i$*:*; desid. $bib^{h}i$*:s!a*
c. *kam* ‘love’: perf. *cakame*; aor 3. *a-cakamata*; int. *cañkam*; desid. *cikamis!a*
d. $stamb^{h}$ ‘prop’: perf. $tastamb^{h}a$; aor 3. *a-*$tastamb^{h}at$; int. *tasta:*b^{h}*-* ; desid. *tis!* $tamb^{h}is$*!a-*
e. *ks!aip* ‘throw’: perf. *ciks!aipa*; aor 3. *ciks!ipat*; int. *caiks!ip*; desid. *ciks!ipsa*

In all five kinds of reduplication the initial stem obstruent(s) are subject to the same set of modifications. These modifications illustrated in the examples (55b–e) are deaspiration (55b), palatalization (k ⟩⟩⟩ c) (55c,e), and obstruent cluster simplification (55d,e). These consonantal modifications are the subject of this section. Two of the five kinds of reduplication are discussed in sections 13.6.2 and 13.6.3.

Although these three processes are totally distinct, all three affect the initial obstruent(s) of a reduplicated form. This environment is difficult to characterize, given the means available to phonological rules. Forms such as *ka:kud* ‘palate’ and *gagan!a* ‘sky’ show that one of the three processes, palatalization, does not take place in all cases where a word-initial onset is followed by an identical onset in the next syllable. At the very least, the rule of palatalization must therefore be limited to reduplicated forms.

The notation introduced here provides a simple solution to this difficulty. As noted above, the underlying representation [A]⟩B] is relinearized in two separate steps. As shown in (56), the first step (rule (45)) generates the sequence A[A⟩B] (augmented reduplication), and the second step (rule (20)) turns it into ABAB (partial reduplication). This is shown in (56).

(56) [A]⟩B] ⟩⟩⟩⟩ A [A⟩B] ⟩⟩⟩ A - BAB

The output of the first step in the derivation (56) allows us to refer to the obstruents affected by the three modifications as the segments directly preceding the [juncture. Since the segments following this juncture are guaranteed to be identical with those **(p.348)** that precede it, there is no need to mention this identity in the rule; it is sufficient to refer to the fact that the segments subject to change are followed by the [juncture.

In (57) I have shown the effects of the readjustment rule for the five verbs in (55), followed by the first step of the relinearization process (rule (45)).

(57)

tap ⟩⟩⟩ [t]⟩a]p ⟩⟩⟩ t [t⟩a]p	Perf. *tata:pa*
b^hi ⟩⟩⟩ [b^h]⟩i] ⟩⟩⟩ b^h [b^h⟩i]	Perf. *bib*^{h} *aida*
kam ⟩⟩⟩ [k]⟩a]m ⟩⟩⟩ k [k⟩a]m	Perf. *cakame*
stamb^h ⟩⟩⟩ [st]⟩a]mb^h ⟩⟩⟩ st[st⟩a]mb^h	Perf. *tastamb*^{h} *a*
ks!aip ⟩⟩⟩ [ks!]⟩ai]p ⟩⟩⟩ ks! [ks!⟩ai]p	Perf. *ciks!epa*

It is the obstruents directly preceding the [juncture that are subject to deaspiration, palatalization, and/or obstruent cluster simplification. Correct outputs are obtained by assuming that all three of these rules are ordered after the relinearization rule (45) and before the relinearization rule (20).

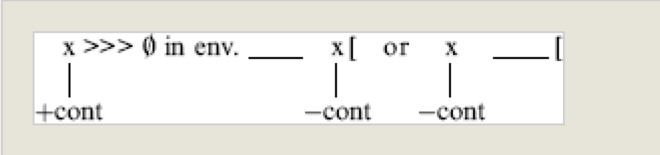
The three obstruent modification processes are not the only argument supporting the proposition that reduplication in Sanskrit needs to be of the complex form [A]⟩B], rather than of the less cumbersome form [AB]. As shown in sections 13.6.2 and 13.6.3, in a number of additional cases the complex intermediate representation is required in order to obtain the correct segment sequences in the reduplicated forms.

I conclude this section with a brief discussion of the three processes that affect initial obstruents in reduplication. The first of these, deaspiration, is a reflex of Grassmann's law. Deaspiration in Sanskrit could be formulated as a process applying to an obstruent when followed by an aspirated segment in the next syllable, and this formulation would obviate the need to stipulate that the latter segment is identical with the one undergoing deaspiration. The alternative proposed above, however, is no more complicated, and it takes advantage of the fact that its environment is identical with that of the other two obstruent modifications, for which an alternative similar to that available for deaspiration is not available.

Palatalization turns the dorsal obstruents [k,g] into coronal affricates [c, j]. Historically palatalization was triggered by a following [–back] vowel. As pointed out by Steriade 1988, the palatalization encountered in reduplicated forms frequently occurs before [+back] vowels, where the historical process could not ever have applied. A typical example of this kind is the root /kup/ 'be angry' whose perfect is /cu-kaupa/; aorist /a-cu:kupat/; intensive /caukup-/; desiderative /cukupis!a-/. The only (correct) environment for palatalization in Sanskrit is therefore before the [juncture.

Like palatalization, the third modification, obstruent cluster simplification, also takes place in the environment before the [juncture. In this environment a sequence of two obstruents like /st sk sp/ or /ks!/ loses the obstruent that is [+cont]. As a result **(p.349)** /s/ is lost in /st sk sp/, and /s!/ in /ks!/. Cluster simplification thus affects the [+continuant] segment regardless of its position. The rule is stated in (58).

(58)



13.6.2 Perfect Reduplication

As remarked in section 13.6.1, Sanskrit has reduplication in five morphologically distinct contexts. Because of limitations of space, only the perfect and the intensive reduplications are discussed here.

As above, it is assumed here that every reduplication process is the consequence of a readjustment rule inserting reduplication junctures into the timing slot sequence of the word. These junctures are subsequently eliminated by the relinearization rules (20) and (45).

The most important factor governing juncture insertion in Sanskrit is the syllable structure of the sequence; the distinction between timing slots belonging to the onset and to the rime of the stem syllable, in particular, is of basic importance here. Sanskrit has only three vowels in underlying representations: [–high] /a/ and [+high] /i,u/. The vowel /a/ is always rime-initial, but its location in a syllable is not predictable: “*a* … occur[s] root-initially (in *ais, auc*), root-medially (in *yaj, vac*), after two segments (in *vraçc*) or just after one (*vardh*)” (Steriade 1988, 94).

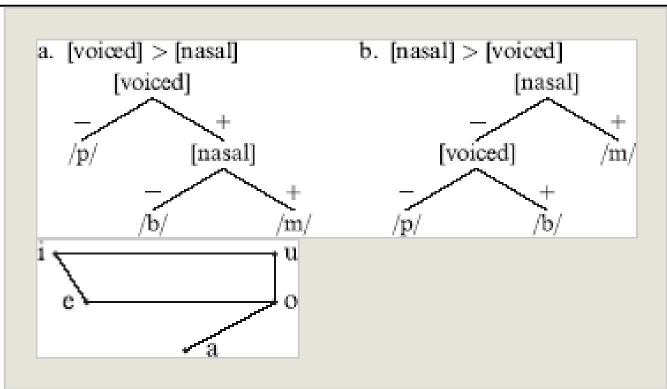
In the perfect, junctures are inserted by the readjustment rules (59).

(59)

a. Insert a [juncture before the initial timing slot of the root.
b. Insert a matching] juncture after the rightmost timing slot in the rime that is linked to a [− cons] segment.
c. Insert the ⟩ juncture in the env.__ x] (i.e., before the timing slot marked in step (b)).
d. Insert an (additional)] juncture in the env.___ [x (i.e., after the timing slot marked in step (a), provided the segment is in the onset of the syllable). If the root begins with a sequence of two obstruents, insert the] juncture in env. [xx__ (i.e., after the second obstruent).

The effects of (59) are illustrated below with the root *snih* ‘be sticky’, whose full-grade form is *snaih* and whose perfect is *sis!neha (= sis!naiha)*. (All forms below are from Whitney 1885 or Steriade 1988.) In (60a) I have shown the junctures inserted by (59); (60b) shows the changes wrought by the relinearization rule (45); and (60c), those of the second relinearization rule (rule (20)).[16]

(60)



(p.350) In (61) I have given the derivation of the perfect form of a number of additional verbs.

(61)

a. ks!aip ‘throw’ [ks!]a⟩i]p-a ⟩⟩⟩ ks!-[ks!a⟩i]pa ⟩⟩⟩ c-[ks!a⟩i]pa ⟩⟩⟩ c-iks!ai-pa ⟩⟩⟩ *ciks!epa*
ks!am ‘endure’ [ks!]⟩a]m-e ⟩⟩⟩ ks!-[ks!⟩a]m-e ⟩⟩⟩ c-[ks!⟩a]m-e ⟩⟩⟩ *c-aks!a-m-e*

In (61a) rule (59b) inserts a] juncture after the /a/, the rightmost [–cons] segment in the rime. In roots beginning with two obstruents, the boldface] juncture is inserted after the second obstruent (59d). The cluster is simplified and the /k/ palatalized to /c/ before the [juncture (see the discussion in section 13.6.1).

b. suar ‘sound’ [s]u⟩a]r-a ⟩⟩⟩ s-[su⟩a]ra ⟩⟩⟩ s-asuar-a ⟩⟩⟩⟩ *sasva:ra**

(61b) shows that in view of (59b) the right] juncture may not follow the rime liquid /r/, but, as shown in (60) and (61a), it follows a [cons] glide, which is part of the syllable rime. This form also shows that the ⟩ juncture is inserted before the slot preceding the right] juncture (cf. (59c)).

c. sarj ‘send forth’ [s]⟩a]rj-a ⟩⟩⟩⟩ s [s⟩a]rja ⟩⟩⟩ *s-asa-rj*
d. pat ‘fly, fall’ [p]⟩a]t-a ⟩⟩⟩ p[p⟩a]ta ⟩⟩⟩ *p-apa-ta*

In (61c,d) the ⟩ juncture is placed one timing slot before the second] juncture, as required by (59c).

e. iat ‘stretch’ [i]⟩a]t-a ⟩⟩⟩ i [i⟩a]t-a ⟩⟩⟩ i-aia-ta ⟩⟩⟩ *yayata*

In (61e) the] juncture is placed to the immediate right of /i/ as required by (59d), in spite of the fact that the initial segment is [cons], for /i/ is the onset of the syllable. This does not happen when the root begins with the [–high] /a/, because /a/ is always part of the rime and can never be part of the onset (cf. (59d)).

f. ai ‘go’ [a⟩i]-a ⟩⟩⟩ iai-a ⟩⟩⟩ **yaya *iyaya*
g. auc ‘pleased’ [a⟩u]c-a ⟩⟩⟩ uau-c-a ⟩⟩⟩ **woca *uwoca*

Since the roots in (61f,g) begin with a [–high] vowel, rule (59d) cannot apply to them. The other three rules of (59) should apply normally. This, however, would generate the incorrect outputs **/yaya/ and **/woca/. The correct outputs are obtained by positing an additional rule Glide Insertion (following Steriade 1988, 93), which converts /i-a/ to /iy-a/ and /u-a/ to /uw-a/, as shown below.

(p.351) i-ai-a ⟩⟩⟩ iy-ai-a ⟩⟩⟩ *iyay-a*

u-auc-a ⟩⟩⟩ uw-auc-a ⟩⟩⟩ *uwoca*

Steriade’s rule of Glide Insertion is specifically limited to applying only before roots beginning with /a/. As shown below, Glide Insertion also applies exceptionally in other roots.

Exceptions to (59) are represented here by the examples in Steriade 1988, 122.

(62)

a. suap ‘sleep’ [s]⟩u]ap-a ⟩⟩⟩ s [s⟩u]ap-a ⟩⟩⟩ s-usu-ap-a ⟩⟩⟩⟩ *sus!vapa*

b. miaks! ‘glitter’ [m]⟩i]aks!-a ⟩⟩⟩ m [m⟩i]aks!a ⟩⟩⟩ m-imi-aks!-a ⟩⟩⟩ *mimyaks!a*

In (62a,b), unlike in (61b), the right] juncture is inserted not after the rightmost [cons] segment of the rime, but after the rightmost [cons] segment of the onset (cf. (59b)). The other three rules in (59) apply regularly.

In (62c,d) I have given the derivations of additional exceptional verb forms cited by Steriade (1988, 122). Unlike the forms in (62a,b), these begin with vowels, in fact, with [+high] vowels. I assume that, as in (62a,b), rule (59b) applies in these forms and inserts a] juncture to the right of the initial high vowel. The next rule—(59c)— cannot apply here meaningfully, since there is no timing slot to the left of the env.___x]. I assume that in such cases the ⟩ juncture is inserted to the right of the only timing slot preceding the] juncture inserted by rule (59b). The remaining rule (59d) completes the juncture insertion. The resulting rather heavily junctured forms are shown below as the input stage of the derivations.

c. uas ‘shine’: [u]⟩]as-a ⟩⟩⟩ u-[u⟩]as-a ⟩⟩⟩ u-u-as-a ⟩⟩⟩ u-w-as-a ⟩⟩⟩ *uvas-a*

d. iaj ‘offer’ [i]]⟩aj-a ⟩⟩⟩ i-[i⟩]aj-a ⟩⟩⟩ i-i-aj-a ⟩⟩⟩ i-y-aj-a ⟩⟩⟩ *iyaj-a*

In the first step of the two derivations shown in (62c,d), the relinearization rule applies and generates the output sequences. These, however, raise a question as to the proper application of the linearization rule (20). The proper treatment of a string of the form [A⟩] parallels that of [A⟩ B] where B=0. On this reasoning, since [A⟩B] is relinearized as BAB, if B=0, then BAB = A. The forms /u-[u⟩]as-a/ and /i-[i⟩]aj-a/ are therefore turned into /u-u-as-a/ and /i-i-aj-a/, which are subject to Glide formation (Steriade 1988, 93). The derivations (62c,d) are thus minimally different from those of /iat/ ‘stretch’ in (61e), just like those in (62a,b) are minimally different from the regular /suar/‘sound’ in (61b).

The derivations in (62) approach the limits of the notational system developed here. That these derivations terminate in the correct output sequences was somewhat surprising to me, in spite of the fact that any other outcome would have revealed a fundamental inadequacy in the proposed theory. The fact that no such inadequacy has been discovered must therefore be taken as evidence in support of the theory presented here.

(p.352) 13.6.3 The Intensive

The readjustment rules for the Sanskrit intensive are given in (63). They obviously are very similar to those of the perfect (59), but the differences are not to be overlooked.

(63) *Intensive*

a. Insert a [juncture before the initial timing slot of the root.

b. Insert a matching] juncture after the rightmost timing slot in the rime that is linked to a [+son] segment (i.e., a liquid or a nasal).

c. Insert ⟩ juncture at the end of the syllable onset of the verb root.
d. Insert a] juncture in the env. [x___ (i.e., after the timing slot marked in step (a), provided the segment linked to x is not [–high] /a/). If the root begins with a sequence of two obstruents, insert the] juncture in env. [xx___(i.e., after the second obstruent).

The first difference between the rules in (63) and those in (59) is that in the perfect (59), the reduplicated material of the rime excludes liquids or nasals, whereas in the intensive these are included (cf. (63b)). A root such as /kam/ 'love' reduplicates as /ka-kama/ ⟩⟩⟩ *cakama** in the perfect, but as /kamkam-/ ⟩⟩⟩ *cañkam-* in the intensive. As (64) shows, the difference is due to the different insertions of the right] junctures, by (59b) and (63b) respectively.

(64) [k]⟩a]m ⟩⟩⟩ k [k⟩a]m ⟩⟩⟩ c[k⟩a]m ⟩⟩⟩ *c-aka-m* Perfect
[k]⟩am] ⟩⟩⟩ k [k⟩am] ⟩⟩⟩ c[k⟩am] ⟩⟩⟩⟩ *c-amkam* Intensive

A second difference concerns (63c). This rule differs from its perfect counterpart (59c) in that in the perfect the ⟩ juncture is inserted directly before the last reduplicated rime slot, whereas in the intensive the ⟩ juncture is inserted after the last onset slot. This is illustrated in (65) with the forms of the root /tuais/ 'be stirred up'.

(65) [t]ua⟩i]s ⟩⟩⟩ t [tua⟩i]s ⟩⟩⟩ t-itvai-s-a ⟩⟩⟩ *titvesa* Perfect
[t]u⟩ai]s ⟩⟩⟩ t [tu⟩ai]s ⟩⟩⟩ t-aitvai-s ⟩⟩⟩ *tetves** Intensive

The intensive form of roots that end with a short vowel followed by an obstruent requires further comment. As (66) shows, the rules developed to this point generate systematically incorrect output forms.

(66) grab^h 'grab' [g]r⟩a]b^h-a ⟩⟩⟩ g [gr⟩a]b^h-a ⟩⟩⟩ j [gr⟩a]b^h-a ⟩⟩⟩ *j-agra-b^h-a* *** correct form *ja:grab^h a*
pac 'cook' [p]⟩a]c-yate ⟩⟩⟩ p [p⟩a]c-yate ⟩⟩⟩ *p-apa-c-yate* *** correct form *pa:pacyate*
tij 'be sharp' [t]⟩i]j-te ⟩⟩⟩ [[t]⟩i]k-te ⟩⟩⟩ t [t⟩i]k-te ⟩⟩⟩ *t-iti-k-te* *** correct form *tetikte* from taitikte
bud^h 'know, wake' [b]⟩u]d^h-i:ti ⟩⟩⟩ b [b⟩u]d^h-i:ti ⟩⟩⟩ *b-ubu-d^h-i:ti* *** correct form *bobud^{h}i:ti* from baubud^{h}i:ti

(p.353) The difference between the correct forms and those generated by the rules developed so far concerns the short root vowel. In the correct forms we find in place of a short vowel, either long /a:/ (if the root vowel is short /a/) or the diphthongs /ai/ or / au/, which surface as /e/ or /o/ respectively, if the root vowel is short /i/ or /u/ respectively. We therefore obtain the correct outputs by a readjustment rule that inserts /a/, which applies after the first step in the linearization process (the same environment where palatalization, deaspiration, and cluster simplification apply) and inserts the vowel /a/ before the [juncture (see (67a)). This rule applies to intensive forms of roots that end with a short vowel followed by an obstruent. Its effects are shown in (67b).

(67)
a. Insert /a/ in env. -son [

b. bud^h ‘know, wake’ [b]⟩u]d^h-i:ti ⟩⟩⟩ b [b⟩u]d^h-i:ti ⟩⟩⟩ ba [b⟩u]d^h-i:ti ⟩⟩⟩ ba-ubu-d^h-i:ti ⟩⟩⟩ *bobud^{h}i:ti*

MacDonnell (1916, 202) describes the fourth (and final) difference between intensive and perfective reduplications as follows: “Over twenty roots with final or penultimate nasal, r or u: interpose an i: (or i if the vowel would be long by position) between the reduplicated syllable and the root; e.g., … han *slay*: ghan-i:-ghan; krand *cry out*: kan-i-krand and kan-i-krad (from /kan-i-krnd/ mh), skand *leap*: kan-i-skand and can-i-skand.”

I assume that these twenty roots are subject to a special readjustment rule in addition to those of (63), which is stated in (68). This rule is ordered directly after (63), but before any of the rules of the phonology.

(68) In intensive forms of the roots listed below, insert /⟨i:/ before the right] juncture.
/gam, g^{h}an, krand, skand, b^{h}ar, uart, nau …/

I have illustrated the effect of this rule in (69).

(69) [sk]⟩an]d ⟩⟩⟩ [sk]⟩an⟨i:]d ⟩⟩⟩ sk [sk⟩an⟨i:]d ⟩⟩⟩⟩ k [sk⟩an⟨i:]d ⟩⟩⟩ opt ⟩⟩⟩ c [sk⟩an⟨i:]d ⟩⟩⟩ c-ani:skan-d ⟩⟩⟩ *canis!kad*

The shortening of the long /i:/ is due to a general rule of Sanskrit phonology that applies in closed syllables and that is ordered after all relinearization rules.

Steriade observes that most of the intensive forms in (68) are also exceptions to palatalization, and attempts to account for both by noting that in the relinearized form the consonant failing to be palatalized is two syllables removed from its trigger. This account is, of course, not available here since I have argued that palatalization affects obstruents before the [juncture (see section 13.6.1). Since on both accounts the insertion of the /i:/ extension affects only a small list of twenty or so roots, it does not seem that the small gain in generality achieved by Steriade’s alternative **(p.354)** makes up for the loss resulting from the need to express palatalization by a rule that depends on the appearance of an identical obstruent later in the string.

13.7 Conclusions

Above I have attempted to present in detail the transformations in the linear order of segments that are observed in different types of reduplication. My main findings are:

First, there are (exactly) three kinds of reduplication: simple reduplication (copying), partial reduplication, and augmented reduplication.

Second, metathesis is a special case of partial reduplication (see section 13.3), which interacts in surprising—yet predictable—ways with other kinds of reduplication (see sections 13.4 through 13.6).

Third, the Greek augment /e/ is a prefix that undergoes partial reduplication not only with certain consonant-initial stems (as shown by Steriade 1982) but also with certain vowel-initial stems (as shown in section 13.2.1). This result has further—as yet unexplored—consequences for the treatment of the augment in other Indo-European languages, especially in Gothic.

Fourth, augmented reduplication is a distinct type of phonological operation with varying effects in different languages explored above for Tigre (section 13.4), Mokilese (section 13.5), and Sanskrit (section 13.6).

Fifth, all three kinds of reduplication are triggered by special extralinear concatenators that are inserted by readjustment rules.

Sixth, the widely varying transformations in segment sequences that have been observed in reduplications in different languages are all due to the application of the three relinearization rules (7), (20), and (45). The first of the three relinearizations— that is, (7)—reflects the transformation resulting from simple copying of a substring; the latter two rules, (20) and (45), express more complex transformations, where the copied sequences are modified at their edges, either by subtracting a terminal subsequence (20) from, or by adding such a subsequence (45) to, a reduplicated substring. Further complexities found in the data are consequences of the fact that a given form may be subject simultaneously to two or even all three of the relinearizations. What is lacking at this point is a proper grasp of the computational power implicit in the relinearization operations.

Seventh, the accounts above of facts from the phonology of different languages crucially involve derivations with numerous intermediate representations. Such derivations are specifically excluded in the different versions of Optimality Theory (OT) that of this writing (August 2005) are the predominant approaches in phonology. This study therefore constitutes a direct challenge to OT phonology to offer viable alternative accounts for the facts discussed above. Unless and until such alternative accounts are advanced, the data and the analyses in this study stand as blatant counterexamples that invalidate all versions of OT.

Notes

As noted in the text this study developed under the direct influence of Raimy 2000 and Frampton 2004. I am especially indebted to John Frampton for our many discussions, without which this chapter would not have been written. I am grateful to Julie Sussman, Jerry Sussman, and Donca Steriade, as well as to two anonymous reviewers for numerous corrections and improvements in the text and argumentation of this chapter. Any remaining inadequacies are my sole responsibility.

(1.) In Wilbur 1973 attention was drawn to the fact that in reduplication there are instances of both overapplication and underapplication of particular phonological rules. These exceptional applications of rules were serious counterexamples to every phonological theory. One of the important discoveries of Raimy's study was that all cases of overapplication and underapplication affect segments that are multiply linked like x_1 and x_3 in (4). This discovery provided Raimy with the basis for an extension of the theory of rule application that properly solves all problems connected with over- and underapplication of phonological rules (see Raimy 2000, section 2.2.1). Since this result crucially depends on the existence of segments with multiply linked concatenators, it must be considered additional support (additional to the reduplication facts discussed in this chapter) for Raimy's concatenator notation. As explained below, the aspects of Raimy's notation that are crucial to reduplication, the subject of this chapter, are expressed here formally by a set of junctures.

(2.) Readjustment rules are not the only source of reduplication in languages. It has been shown that Manam has words with reduplicated syllables in underlying representations. For some discussion, see Fitzpatrick 2004.

(3.) I assume that (7) is a rule, rather than a convention, because it is ordered with respect to other rules. (For discussion, see section 13.6.1.)

(4.) In (26b) the symbol (V) stands for a vowel that may optionally occur in this position; see discussion below.

(5.) Note that the pluperfect (= past + perfect) /e-lelu-k-a/ derives from an underlying representation where the past prefix /e/ precedes the perfect prefix, which is also /e/, but which in addition triggers reduplication (i.e., /e-[e⟩ -l] u-k-a/). The simple aorist (past) is /e-lu-a/, with the e augment, but without partial reduplication.

(6.) It may be noted here that the well-known English example of partial reduplication *table-shmable* is, like that of Kolami (see (29)), an instance of suffixation, as suggested by Raimy 2000, 78. For additional discussion, see section 13.7.

(7.) The attested cases of noncontiguous metathesis involve metatheses of consecutive consonants (skipping intervening vowels), or of consecutive syllable onsets, or of consecutive syllable rimes—that is, metatheses of elements that are contiguous on special projections of the base string. For additional discussion, see Halle 2001.

(8.) An example of metathesis quite similar to that of Slavic is cited by Hume from the Dravidian language Kuvi (Hume's example (23), 225), which metathesizes vowel-sonorant rime sequences.

(9.) In Harris and Halle 2005, we discuss examples from Spanish where the plural imperative suffix /-n/ undergoes either metathesis or (partial) reduplication.

(10.) I thank an anonymous reviewers of this chapter for suggesting the analysis of the Kain-gang data in this section.

(11.) /y/ stands for a [+high, +back round] vowel.

(12.) The glides /v/ and /j/ are deleted before consonants by a rule of the phonology of Kain-gang. /tam/ ⟩⟩⟩ /ty-g-tam/ from /[tam]⟩ ⟨g]/ 'cover' in (35g) is not an instance of deletion, but of nasal assimilation. This process turns /m+g/ into a dorsal nasal, which is represented as /g/ in Wiesemann's transcription. (See Steriade 1988.)

(13.) This parenthesis is distinguished typographically from the parentheses inserted by rule (b) by being printed in bold type.

(14.) I thank Andrew Nevins for drawing my attention to the forms in (40b).

(15.) The following discussion of the Sanskrit reduplication is heavily indebted to Steriade 1988. Although my theory of reduplication and the accounts I offer of particular reduplication processes in Sanskrit differ from those of Steriade, the treatment of the complex body of data that I offer below would not have been possible without Steriade's study.

(16.) The retroflex coronals are the result of the so-called *ruki* rule of Sanskrit, and the mid-vowels e and o are surface realizations of the diphthongs ai and au, respectively.

References

Bibliography references:

Blevins, Juliette. 1996. Mokilese reduplication. *Linguistic Inquiry* 27:523–530.

Bräuer, Herbert. 1961. *Slawische Sprachwissenschaft*. Berlin: de Gruyter.

Broselow, Ellen, and John McCarthy. 1983. A theory of internal reduplication. *Linguistic Review* 3:25–98.

Fitzpatrick, Justin. 2004. The representation and linearization of nonlinear precedence. Unpublished ms., MIT.

Fitzpatrick, Justin, and Andrew Nevins. 2004. Phonological occurrences: Relations and copying. http://ling.auf.net/lingBuzz/00051.

Frampton, John. 2004. Distributed Reduplication. Northeastern University.

Goldsmith, John. 1976. *Autosegmental Phonology*. Doctoral dissertation, MIT. New York: Garland Press, 1979.

Halle, Morris. 2001. Infixation vs. Onset Metathesis in Tagalog, Chamorro, and Toba Batak. In Michael Kenstowicz, ed., *Ken Hale: A Life in Language*, 153–168. Cambridge, Mass.: MIT Press.

Halle, Morris, and William J. Idsardi. 2000. Stress and length in Hixkaryana. *Linguistic Review* 17:199–218.

Harris, James W., and Morris Halle. 2005. Unexpected plural inflections in Spanish: Reduplication and Metathesis. *Linguistic Inquiry* 36:195–222.

Hume, Elizabeth. 2004. The indeterminacy/attestation model of metathesis. *Language* 80:203–237.

Idsardi, William. 1992. The Computation of Prosody. Doctoral dissertation, MIT.

Idsardi, William. 2004. Calculating metrical structure. In Raimy, E. and C. Cairns, eds. Forthcoming. *Contemporary Views on Architecture and Representation in Phonological Theory*. Cambridge, Mass.: MIT Press.

(p.357) MacDonnell, Arthur. 1916. *A Vedic Grammar for Students*. Reprint New Delhi: Motilal Banarsidass, 1993.

Marantz, Alec. 1982. Re reduplication. *Linguistic Inquiry* 13:435–482.

McCarthy, John, and Alan Prince. 1986. Prosodic morphology. Unpublished ms., University of Massachusetts.

McCarthy, John, and Alan Prince. 1995. Faithfulness and reduplicative identity. In Jill Beckman, L. Dickey, and S. Urbanczyk, eds., *UMASS Occasional Papers* 18:249–384.

Purnell, Thomas C. 1997. Principles and Parameters of Phonological Rules: Evidence from Tone Languages. Doctoral dissertation, University of Delaware, Newark.

Raimy, Eric. 2000. *The Morphology and Phonology of Reduplication*. Berlin: Mouton de Gruyter.

Raz, Shlomo. 1983. *Tigre Grammar and Texts*. Malibu: Undena Publications.

Rose, Sharon. 2003. Triple Take: Tigre and the case of internal reduplication. *San Diego Linguistics Papers* 1:109–128 (UCSD).

Sihler, Andrew. 1995. *New Comparative Grammar of Greek and Latin*. Oxford: Oxford University Press.

Steriade, Donca. 1982. Greek Prosodies and the Nature of Syllabification. Doctoral dissertation, MIT.

Steriade, Donca. 1988. Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology* 5:71–155.

Whitney, William D. 1885. *The Roots, Verb-Forms and Primary Derivatives of the Sanskrit Language*. Reprint New York American Oriental Society, 1988.

Whitney, William D. 1889. *Sanskrit Grammar*. Reprint Cambridge, Mass.: Harvard University Press, 1941.

Wiesemann, Ursula. 1972. *Die phonologische und grammatische Struktur der Kaingang Sprache*. The Hague: Mouton.

Wilbur, Ronnie. 1973. The Phonology of Reduplication. Doctoral dissertation, University of Illinois, Urbana.

Notes:

(1.) In Wilbur 1973 attention was drawn to the fact that in reduplication there are instances of both overapplication and underapplication of particular phonological rules. These exceptional applications of rules were serious counterexamples to every phonological theory. One of the important discoveries of Raimy's study was that all cases of overapplication and underapplication affect segments that are multiply linked like x_1 and x_3 in (4). This discovery provided Raimy with the basis for an extension of the theory of rule application that properly solves all problems connected with over- and underapplication of phonological rules (see Raimy 2000, section 2.2.1). Since this result crucially depends on the existence of segments with multiply linked concatenators, it must be considered additional support (additional to the reduplication facts discussed in this chapter) for Raimy's concatenator notation. As explained below, the aspects of Raimy's notation that are crucial to reduplication, the subject of this chapter, are expressed here formally by a set of junctures.

(2.) Readjustment rules are not the only source of reduplication in languages. It has been shown that Manam has words with reduplicated syllables in underlying representations. For some discussion, see Fitzpatrick 2004.

(3.) I assume that (7) is a rule, rather than a convention, because it is ordered with respect to other rules. (For discussion, see section 13.6.1.)

(4.) In (26b) the symbol (V) stands for a vowel that may optionally occur in this position; see discussion below.

(5.) Note that the pluperfect (= past + perfect) /e-lelu-k-a/ derives from an underlying representation where the past prefix /e/ precedes the perfect prefix, which is also /e/, but which in addition triggers reduplication (i.e., /e-[e⟩ -l] u-k-a/). The simple aorist (past) is /e-lu-a/, with the e augment, but without partial reduplication.

(6.) It may be noted here that the well-known English example of partial reduplication *table-shmable* is, like that of Kolami (see (29)), an instance of suffixation, as suggested by Raimy 2000, 78. For additional discussion, see section 13.7.

(7.) The attested cases of noncontiguous metathesis involve metatheses of consecutive consonants (skipping intervening vowels), or of consecutive syllable onsets, or of consecutive syllable rimes—that is, metatheses of elements that are contiguous on special projections of the base string. For additional discussion, see Halle 2001.

(8.) An example of metathesis quite similar to that of Slavic is cited by Hume from the Dravidian language Kuvi (Hume's example (23), 225), which metathesizes vowel-sonorant rime sequences.

(9.) In Harris and Halle 2005, we discuss examples from Spanish where the plural imperative suffix /-n/ undergoes either metathesis or (partial) reduplication.

(10.) I thank an anonymous reviewers of this chapter for suggesting the analysis of the Kaingang data in this section.

(11.) /y/ stands for a [+high, +back round] vowel.

(12.) The glides /v/ and /j/ are deleted before consonants by a rule of the phonology of Kaingang. /tam/ ⟩⟩⟩ /ty-g-tam/ from /[tam]⟩ ⟨g]/ 'cover' in (35g) is not an instance of deletion, but of nasal assimilation. This process turns /m+g/ into a dorsal nasal, which is represented as /g/ in Wiesemann's transcription. (See Steriade 1988.)

(13.) This parenthesis is distinguished typographically from the parentheses inserted by rule (b) by being printed in bold type.

(14.) I thank Andrew Nevins for drawing my attention to the forms in (40b).

(15.) To specify the mutations induced by these various particles, one should write *goN*, *gurL*, *aN*, *arL* …

(15.) The following discussion of the Sanskrit reduplication is heavily indebted to Steriade 1988. Although my theory of reduplication and the accounts I offer of particular reduplication processes in Sanskrit differ from those of Steriade, the treatment of the complex body of data that I offer below would not have been possible without Steriade's study.

(16.) The retroflex coronals are the result of the so-called *ruki* rule of Sanskrit, and the mid-vowels e and o are surface realizations of the diphthongs ai and au, respectively.