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Chapter 1

Introduction and Overview

Copying is ubiquitous in morphophonology. Every time a lexical item enters a computation, its exponent must be copied from the lexicon to the active workspace. It would be remarkable if morphophonology reserved its copying capability for copying from the lexicon. Indeed, it does not. Many languages use copying as a way to mark word inflection, similar in essence to the way that English phonology uses its vowel-lowering capability to modify *sing* to *sang* as a way to mark past tense. In Mokilese, for example, the verb root *wadek* 'read' inflected for progressive aspect is *wadwadek*. In Manam, the adjectival form of the verb *salaga* 'be warm' is *salagalaga*.

One obvious question is how the portion of the base that is doubled is chosen. A less obvious question is the nature of the copying process. Wilbur (1973) demonstrated that phonological rules sometimes apply in unexpected ways in reduplicated forms. Mester (1986) made significant progress in showing how these apparent anomalies could result from the exceptional autosegmental structures involved in doubling a portion of the base, but this line of inquiry was cut short. In the early 1980s, work in reduplication was providing rich evidence for the important role of prosody in various morphological processes (McCarthy and Prince 1986). With respect to reduplication, this work was directed at the question of what was copied and provided important insights. Unfortunately, the project of understanding the autosegmental structure of the representations involved in copying was never integrated with the project of understanding the various roles that prosody can play in morphology. A close analysis of the copying process was largely abandoned in favor of prosodic analysis. In my view, this was a mistake. Prosody does play a crucial role in many reduplication processes, and it is impossible to fully understand the phenomenon of reduplication without understanding the ways prosody can affect structure building.

But the effect of prosody is to shape the construction of autosegmental representations. Without understanding the unusual autosegmental representations that are built in carrying out reduplication, it is impossible to understand how phonology computes reduplicated forms.

My hope is that this book can show how to continue the development of the analysis of copying that was cut short by the development of Prosodic Morphology in a way that allows the insights of Prosodic Morpholoty to be incorporated into the theory. Ultimately, of course, the value of the analysis of phonological phenomena is determined by the light shed on basic questions of structure and the algorithms that modify these structures in the course of phonological processing. As we will see, reduplication offers important evidence about the nature of autosegmental representations. In particular, the phenomenon of reduplication gives evidence that the No Crossing Constraint of autosegmental phonology is an interface condition, not something inherent in the structure of autosegmental representations.

In place of a traditional introduction, this chapter will sketch out the main features of the theory that will be developed in detail in chapters 2–6, so that the reader will have some idea of where the project is heading and what the underlying assumptions are. This chapter is therefore mainly an overview. My hope is that starting from an overview will allow the reader to better appreciate the point of view and the relevance of the various components of the theory that are developed in the upcoming chapters. All of the examples and claims made in the overview will be revisited in later chapters, which will provide details, argumentation, and references to prior work.

The presence of an inflectional morpheme in underlying word structure is often expressed by the concatenation of a prefix or suffix characteristic of the morpheme. This mode of morpheme realization, *concatenative morphology*, is often fairly transparent, in that the surface word can be broken up into pieces that correspond to pieces of the underlying syntax. But there is another important mode of morpheme realization. Some inflectional morphemes are realized not by concatenation of a prefix or suffix, but by a transformation of the stem in a fashion characteristic of the morpheme. This is *nonconcatenative morphology*. German, for example, uses noun root umlaut to realize a plural morpheme (*Apfel/Äpfel* ‘apple/apples’) in some contexts.

Many languages have morphemes whose realization involves doubling a portion of the stem. The presence of the morpheme in under-

lying word structure is inferred from the appearance at the surface of the reduplication pattern characteristic of the morpheme. Mangarayi (Merlan 1982), for instance, uses reduplication to mark pluralization.

(1)

Root	*Plural*	
gaḷugu	g-**aḷ**-aḷugu	'poor things'
waŋgij	w-**aŋg**-aŋgij	'children'
jimgam	j-**img**-imgam	'knowledgeable people'

The copying process is simple to characterize: "starting to the left of the first vowel, copy up to the left of the second vowel." The material produced by copying (boldface above), called the *reduplicant*, is adjacent to the original, often called the *base*. (Here and throughout this book, unless there is a statement to the contrary, hyphenation and/or boldface in reduplicated forms is intended only to help the reader understand the copying process, not to indicate phonological or morphological boundaries, which may or may not be present.)

The Mangarayi example is typical. Aside from a few cases in which roots have inherent reduplication, *reduplication is the surface manifestation of nonconcatenative inflectional morphology*. The issues that need to be addressed under this view of reduplication are the modification that the stem undergoes at the point of morpheme realization, and the transformations that this modified stem undergoes in generating a surface form. Ilocano uses what Hayes and Abad (1989) call "light reduplication" in conjunction with the prefix *ʔagin-* to build a form with the meaning 'to pretend to . . . '.

(2)

dáʔit	'to sew'	ʔagin-**da**-dáʔit	'to pretend to sew'
sáŋit	'to cry'	ʔagin-**sa**-sáŋit	'to pretend to cry'
trabáho	'to work'	ʔagin-**tra**-trabáho	'to pretend to work'

The prefix is concatenated and the portion of the stem from its left edge up to and including its first vowel is copied to the left. Realizing a morpheme by a combination of affix concatenation and stem transformation is not uncommon. In the *sell/sold* tense alternation in English, for example, the presence of the past-tense morpheme is manifested not only by concatenation of the suffix *-d*, but also by lowering the vowel of the root. In other tense alternations, *sing/sang* for instance, the presence of the past-tense morpheme has a purely nonconcatenative manifestation: only vowel modification occurs, with no prefix or suffix. This is analogous to Mangarayi pluralization (1) in which the stem is transformed, but no prefix or suffix is concatenated.

Copying is often assumed to be a unitary operation, but it can be decomposed into component suboperations. This decomposition is crucial to what follows, since much of the complexity of reduplicative phenomena will be shown to be the effect of phonological operations that intervene between the various components of copying. Three distinct steps in the copying operation are proposed here. The first step is the direct effect of morpheme realization. The next two steps take place in the phonology, as reactions to the initial modification of the stem by the morphology.

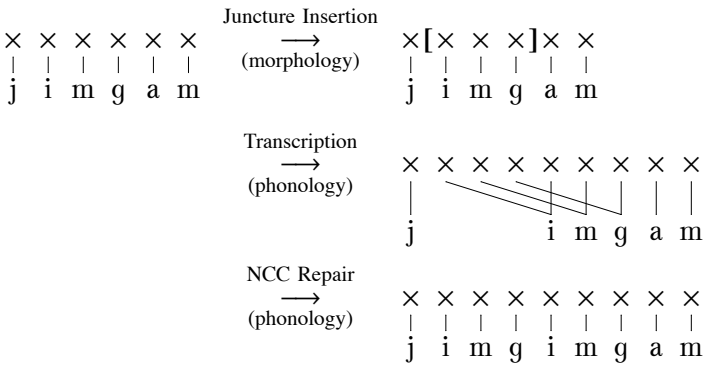
How is copying decomposed? The most remarkable example of a copying-like process in the biological world is the transcription of genes to RNA.[1] In the simplest case, a gene is a subsequence of a long DNA sequence. More complex cases involve multiple subsequences with intrusions that are truncated when transcription takes place. Transcription is a two-step process. First, a marker, called a "transcription factor," is attached to the DNA at the beginning of the gene to signal the position at which transcription should be initiated. In effect, a transcription factor is a "molecular diacritic." Second, transcription itself takes place starting at the marker. Marking by the attachment of a transcription factor to the DNA and transcribing marked DNA are independent mechanisms, carried out by different biological systems. I will attempt to establish in this book that reduplication, and copying generally, is organized in roughly the same way, as a multistage process. In place of the attachment of transcription factors to the DNA, junctures (called *t-junctures*, or *transcription junctures*) are inserted into the timing tier by the morphology. The transcription mechanism, which operates in the phonology, is triggered by these t-junctures to carry out transcription, just as the DNA transcription mechanism is triggered by transcription factors to carry out its biological copying. The t-junctures are interpreted as instructions that trigger and guide duplication and/or truncation.

The decomposition of copying into one stage in which junctures are inserted into a linear string and later one in which operations actually carry out the reproduction is familiar from another source: repetition blocks in music. Part of the standard repertoire of signs and symbols used in writing music scores are repeat marks: 𝄆 and 𝄇. They are instructions to be used in the translation of the score from an abstract representation to a concrete physical performance. There is a strong similarity between a music score and a phonological representation.

Goldsmith (1976), for example, describes an autosegmental representation as an "orchestral score." Both a music score and an autosegmental representation are abstract representations that can be, but need not be, translated into a physical performance.[2]

The initial operation of the full copying process is *Juncture Insertion*, which is the immediate consequence of morpheme realization. In the Mangarayi examples (1), for instance, the morphology inserts **[** to the left of the first vowel, and **]** to the left of the second vowel. Two further phonological operations complete the copying process, as shown in (3), using one of the examples in (1). These operations are the response of the phonology to the introduction of t-junctures into the representation. Since the theory distributes the responsibility for reduplication over multiple suboperations, it is called Distributed Reduplication (DR).

(3) *Distributed reduplication*



Transcription first copies the timing tier and its phonemic associations, removing the t-junctures. If it is assumed that t-junctures are uninterpretable at the interface with phonetics, transcription can be regarded as a repair operation. Transcription produces violations of the No Crossing Constraint (NCC). It is further assumed that the NCC is an interface condition (following Sagey 1988), so a repair operation of some kind must follow that produces representations that are acceptable at the phonology-phonetics interface. *NCC Repair* of some sort (*phoneme fission* in this case) must therefore follow Transcription.

Aside from unpackaging various components of the copying process into separate operations, there are two key innovations in the proposed architecture: (1) the delimiters of the base (**[** and **]**) are considered to be real phonological objects, which are therefore subject to manipulation by the phonology; and (2) there is a stage in the derivation in

which geminate structure links reduplicant and base phonemes. Because t-junctures can be manipulated by the phonology, a delimiter can be shifted to adjust the content of the base, for example. This will prove to be crucial in understanding how prosodic conditions can affect reduplication and allows some key insights of Prosodic Morphology (McCarthy and Prince 1986) to be incorporated into DR. Because Transcription produces a representation with multiple geminates, we expect that the well-known conditions on rule application to geminates will affect rules that apply after Transcription, but before NCC Repair. This will prove crucial in understanding what otherwise appear to be anomalous results of rule application to reduplicative forms (so-called *overapplication* and *underapplication*).

The overall architecture can be pictured as follows:

(4) Juncture Insertion ⟶ Transcription ⟶ NCC Repair

Rules can intervene here that adjust the prosodic shape of the projected reduplicant to a target prosodic condition.

Segmental rules that intervene here can be affected by conditions on applying rules to geminates.

There is a long tradition in studies of reduplication, beginning with Marantz's (1982) pioneering work, that views reduplication as essentially prefixal or suffixal. An underspecified affix is concatenated with the stem (or perhaps infixed into the stem) and rules of association in the phonology fill out the unspecified aspects of the affix using the raw material provided by the stem. So, for instance, the derivation of the Mokilese progressive form *wadwadek* would be

(5) wadek $\overset{\text{morphology}}{\longrightarrow}$ $\square_{\sigma}$-wadek $\overset{\text{phonology}}{\longrightarrow}$ $[\text{wad}]_{\sigma}$-wadek

The underspecified affix is called a *reduplicative template* or simply a template. In (5), the template is a syllable (specified to be bimoraic). Enough material is then associated in the phonology with the template to fill it with a bimoraic syllable. There is a large literature devoted to questions of how templates are specified and how association is carried out.

DR does not view the morphological operation that initiates the reduplication process as concatenative morphology. Although the effect of reduplication in examples like (5) is to produce a string that looks

like a prefix at the surface, its origin in the morphology is not prefixal. Its origin is Juncture Insertion. DR therefore views the morphology of reduplication as of the *sing/sang* variety, not of the *like/like-d* variety. DR follows Kitagawa 1987 and Raimy 2000a in this. Kitagawa rejects affixal accounts and proposes that "a morphological rule of reduplication *three-dimensionally copies* [my emphasis] the relevant CV skeleton and its association lines directly from the base."[3] Raimy proposes that the morphological operation leading to doubling at the surface is an alteration in the precedence relations between the timing slots in the stem.

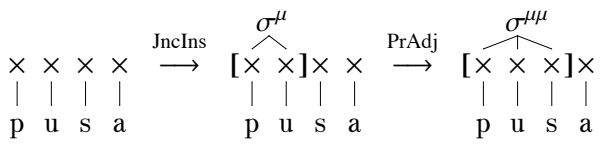
I turn now to consider the prosodic shape of the reduplicant. Ilocano plural reduplication, which was analyzed by Hayes and Abad (1989), illustrates the effect of target prosody.

(6)	*Root*	*Plural*	
	kaldíŋ	**kal**-kaldíŋ	'goats'
	púsa	**pus**-púsa	'cats'
	ǰyánitor	**ǰyan**-ǰyánitor	'janitors'

One might try to characterize the base as extending from the left edge of the stem to the first timing slot following the leftmost vowel. That is less than elegant, but does suffices for the examples in (6). Hayes and Abad demonstrate, however, that the copying process in Ilocano plural reduplication must be characterized in terms of the prosodic weight of the reduplicant: something like "starting at the left edge, copy enough material to form a heavy syllable." CVC syllables are bimoraic in Ilocano. Hayes and Abad's argument that the specification of the reduplicant as a heavy syllable shapes the reduplication process will be put off until chapter 6 since it relies on the analysis of various complexities and special cases that require some preparation. But I assume it here for the purposes of the overview.

DR analyzes (6) in the following way. Juncture insertion by the morphology is the same as in light reduplication; **[** is inserted at the left edge of the stem and **]** after the first vowel. But a Prosodic Adjustment operation applies before Transcription to adjust the base so that a bimoraic reduplicant is produced.

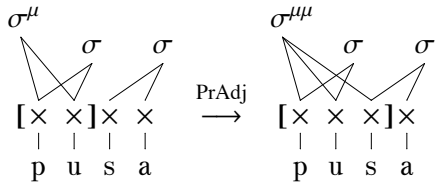
(7)



In this case, prosodic adjustment consists of shifting the]-juncture to the right. Transcription and NCC Repair follow, yielding *pus-pusa* as desired. Although the reduplicant does not exist until Transcription creates it, its projected makeup is known before Transcription applies and the computation can use this information.

The computation is autosegmental. The prosody of the projected reduplicant and the prosody of the stem are computed on different planes.

(8)



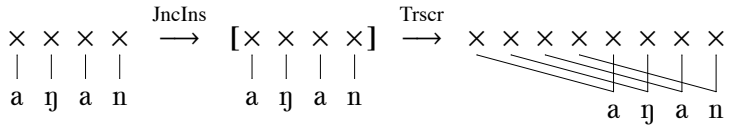
The moraic count of syllables on the stem tier is not shown because it is irrelevant to the computation. In fact, the syllable structure of the stem is irrelevant to the prosodic adjustment rule. The two tiers in (8) are shown only to illustrate how reduplicant prosody can be computed in parallel with stem prosody, not to indicate that prosodic adjustment in Ilocano plural reduplication depends on the stem syllable structure.

The representations (8) bear some similarity to the structures proposed in parafixal theories of reduplication (Clements 1985; Mester 1986; Uhrbach 1985). Parafix theory assumes that reduplication is template affixation, but introduces the idea that in addition to prefixation, suffixation, and infixation, there is a fourth category of affixation, parallel affixation, or parafixation.[4] The template is first filled out, then the parallel structure is linearized. DR builds the projected reduplicant not as a parallel structure, but as a substructure of the stem. The parallel computation is not parallel words, but two parallel prosodic analyses of the same material.

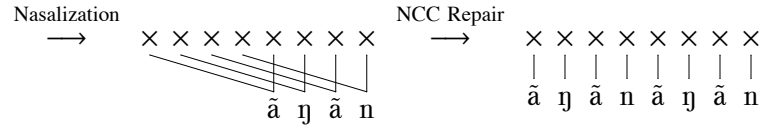
I can now illustrate the effect of geminates on the application of phonological rules that intervene between Transcription and NCC Repair. One of the best known examples in the study of reduplication is the interaction of nasalization and reduplication in Malay (Onn 1976). Malay uses total stem reduplication for both plural and intensive inflection (often with idiomatic meanings). The reduplicated form of *aŋãn* 'reverie' is *ãŋãnãŋãn* 'ambition'. Malay has a rule of rightward nasalization, that nasalizes vowels that follow nasals (under locality conditions which will be discussed later). The great interest in the example, which Onn highlighted, is the nasalization of the initial vowel

in the reduplicated form. The initial *a* does not follow a nasal in either the unreduplicated or reduplicated form. Naively, one might expect *aŋãnaŋãn* or *aŋãnãŋãn*, depending on the ordering of nasalization and reduplication. There does not appear to be any way for the initial vowel to nasalize.

The architecture in (4) clears up the mystery. The morphology inserts **[** at the left edge of the stem and **]** at the right edge. Transcription copies the timing slots and their associations.

(9) 

After Transcription, *nasalization applies before NCC Repair*.

(10) 

One of the timing slots associated with the initial *a* in the final representation in (9) immediately follows a timing slot linked to a nasal. The other timing slot linked to *a* does not. It is known from work on the application of rules to geminates that although the application of some rules to geminates requires *all* the timing slots associated with the geminate to satisfy the structural condition for rule application, other rules apply if *any* of the timing slots associated with the geminate satisfy the structural condition. Assuming that the Malay nasalization rule requires only one of the timing slots linked to *a* to follow a timing slot linked to a nasal, the derivation (10) results.

There would be a different outcome if nasalization required that all timing slots associated with a geminate vowel follow timing slots linked to nasals. If nasalization did not apply again later in the derivation, and intervened between Transcription and NCC Repair as in (9) and (10), then *aŋãnaŋãn* would result. Instead of a surprising nasalization of the initial vowel, there would be a surprising failure to nasalize a medial vowel. Wilbur (1973), in her influential study of anomalies in rule application to reduplicative forms, first called attention to effects of this kind, calling the two kinds of deviations from naive expectations rule *overapplication* and rule *underapplication*. Accounting for overapplication and underapplication has been a central problem for theories of reduplication. DR explains many instances of underapplication and

overapplication as effects of conditions on rule application to geminates. Other instances, as we will see, have their origin in operations that apply after Juncture Insertion, but before Transcription.

A closer look at the application of phonological operations on structures with crossing violations (called *crossed structures* in what follows as a descriptive convenience) will reveal some subtleties. Nasalization is generally thought to be a feature-spreading operation. Although the NCC is not a derivational constraint on Transcription, the NCC (or something like it) does appear to constrain feature spreading, as a derivational constraint. A thorough discussion of feature spreading in the structures produced by Transcription is therefore required. Chapter 2 undertakes this, examining the No Crossing Constraint, constraints on feature spreading, and the application of phonological rules in structures with "long-distance geminates." McCarthy's work on nonconcatenative Semitic morphology, McCarthy 1986 in particular, plays a central role. It will be shown that known constraints on feature spreading imply that feature spreading can take place in crossed structures only in very special environments, accounting for why attested instances of overapplication are rare.

This brief overview will close with a sketch of how some other aspects of Prosodic Morphology are adapted to DR. One of the accomplishments of Prosodic Morphology was to provide an answer to the puzzling absence of attested examples of *syllable copy reduplication*. Patterns 1 and 2 below are widely attested. But Pattern 3, in which the initial syllable is copied, is unattested.

(11)

Stem	*Pattern 1*	*Pattern 2*	**Pattern 3*
gin.dal	**gi**-gin.dal	**gin**-gin.dal	**gin**-gin.dal
gi.dal	**gi**-gi.dal	**gid**-gi.dal	**gi**-gi.dal
giː.dal	**gi**-giː.dal	**giː**-giː.dal	**giː**-giː.dal

Moravcsik (1978), in her important worldwide survey of the reduplication patterns known at that time, had concluded that prosodic constituency does not play a role in delineating the base, the material that is copied in reduplication. Later work uncovered reduplication patterns showing that this conclusion was too strong, but the failure to find instances of syllable copy reduplication showed that Moravcsik's conclusion did contain an important kernel of truth. If prosodic constituents of the base could be freely singled out for reduplication, syllable copy reduplication would be expected.

Marantz (1982) highlighted the example of plural reduplication in

Yidiny (Nash 1979, 1980) as a counterexample to Moravcsik's conclusion. It is exemplified in (12).

(12)

Stem	*Plural*	
gin.dal.ba	**gindal**-gin.dal.ba	'species of lizard'
mu.la.ri	**mula**-mu.la.ri	'initiated man'

Determining the substring of the stem that is copied (i.e., its first two syllables) requires reference to the prosodic structure of the stem, contradicting Moravcsik's claim that prosodic properties of the stem are not used in delimiting the base of reduplicative copying. Marantz provided an analysis of Yidiny plural reduplication by introducing the important idea of a prosodic template, but he was then unable to explain why syllable reduplication does not occur. He concluded that it "leaves us with a mystery."

Prosodic Morphology explained the absence of cases of syllable copy reduplication, coupled with attested cases of foot reduplication, in the following way. First, following Nash 1980 and Broselow and McCarthy 1983, Yidiny reduplication was analyzed not as partial reduplication of the full stem, but total reduplication of a prosodically delineated substem of the stem. Importantly, it was assumed that only "word-like" substems were possible. Prosodically, this implied foot-length substems, ruling out the specification of the initial syllable as a prosodic substem and explaining why total reduplication of a prosodic substem can produce Yidiny-type reduplication, but not syllable copy reduplication. Patterns 1 and 2 above were analyzed in terms of a prosodic template, partially following Marantz, but modifying his proposal for how the template was filled out by material from the stem. Marantz had assumed that syllables from the stem are used to fill out the foot template of the reduplicant. McCarthy and Prince assumed that the prosodic structure of the stem was invisible to the operation that filled out the template with stem material. Pattern 1 is then obtained by filling out a monomoraic syllable template and pattern 2 is obtained by filling out a bimoraic syllable template. The key to the Prosodic Morphology account is that prosodic shape is only relevant on the output side. Prosodic constituency on the input side, aside from the possible presence of a prosodic substem, is irrelevant to template satisfaction.

DR adapts these ideas. First, it accepts the idea that reduplication can be defined with respect to a prosodic subword of the stem. More narrowly, an initial or final foot of the stem can be designated as the domain to which Juncture Insertion applies. Second, it proposes that

the landmarks in the stem that can be used to define juncture insertion sites do not include prosodic constituent boundaries, but are restricted to notions like "before/after the leftmost/rightmost vowel" and "leftmost/rightmost edge." Third, it proposes that the projected reduplicant can be adjusted so that it has desired prosodic characteristics. This allows the idea of template satisfaction to be incorporated into DR without the introduction of underspecified affixes. This adjustment is carried out by a Prosodic Adjustment rule that applies before Transcription. Crucially, prosodic adjustment is only an *option* in DR. Many reduplicative processes (Mangarayi and Yidiny plural reduplication, and Ilocano light reduplication, for example) do not employ prosodic adjustment. Also crucially, Prosodic Adjustment can attend to low-level prosodic issues, such as well-formed syllable structure, not just issues of prosodic weight.

Most of what is to follow has already been previewed. Chapter 3 provides a full examination of the morphology that underlies DR, a version of Distributed Morphology. Chapter 4 develops the theory of truncated reduplication, in which the base is copied, subject to truncation in either the base or reduplicant. This is related to Steriade's (1988) idea that reduplication consists of total stem reduplication coupled with truncation. The interaction of copying and truncation is complex, with a rich array of possibilities. It will turn out that many instances of metathesis as well as infixation are best analyzed as varieties of truncated reduplication.

Chapter 5 discusses the range of variation in juncture insertion, with particular attention to showing why syllable copy reduplication is impossible. Chapter 6 develops the theory of prosodic adjustment. There is a detailed discussion of heavy-syllable prefixal reduplication in the related Austronesian languages Mokilese, Ponapean, Agta, and Ilocano. The range of variation in juncture insertion coupled with the range of variation in prosodic adjustment is examined and it is demonstrated that there is a good fit between the attested reduplication patterns and the predictions of DR.

Chapter 7, which is by far the longest chapter, is a series of case studies. Most of the languages with well-studied complex reduplicative processes are discussed in some detail: Asheninca Campa, Chaha, Kinande, Lushootseed, Ndebele, Sanskrit, and Washo. The test of a theory is not the excellent job it does on its "poster-child" language (to borrow Donca Steriade's colorful phrase), but its ability to make sense

of a phenomenon as the manifestation of a computational ability that is put to use in different ways in different languages. The purpose of chapter 7 is to show that reduplicative phenomena in a wide variety of languages can be analyzed in detail on the basis of the proposals in chapters 2–6.

Appendix B is a critique of Raimy 2000a. What I have called Distributed Reduplication is based on ideas of McCarthy and Steriade, mentioned above, as well as on the important insight of Odden and Odden 1985 that reduplication can be a multistage process.[5] The only idea that DR shares with Raimy 2000a is the idea that the initial step in reduplication is nonconcatenative modification of the stem, but its implementation of this idea is much closer to Kitagawa 1987 than to Raimy. Nevertheless, Raimy's return to core structural questions was the direct inspiration for the development of DR. His analysis therefore deserves special attention. Indirectly, the appendix serves to justify the different approach taken by DR.