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Studies in African Linguistics is published three times a year. Occasional supplements are published at irregular intervals and are available to current subscribers at reduced rates.

Contributions to the journal should be sent to: The Editor, *Studies in African Linguistics*, Department of Linguistics, Memorial Hall 322, Indiana University, Bloomington, IN 47405. Contributors please refer to "Guidelines for Contributors" inside the back cover.

Correspondence concerning subscriptions or other business should be sent to: Managing Editor, *Studies in African Linguistics*, African Studies Center, University of California, Los Angeles, CA 90024-1543. Subscription rates are the following:

Individuals	$25.00 per year
Institutions:	$50.00 per year
Single issue:	$10.00
Supplements:	variable price depending on supplement

(Add $10.00 per year for overseas Air Mail subscriptions)

Make checks payable to **The Regents of the University of California**

Volume 23, Number 2 • 1992 - 1994

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ISSN 00390-3533

Studies in African Linguistics

Volume 23, Number 2 1992-1994
[Published Winter 1995]

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Volume 23, Number 2, 1992-1994

TONE SANDHI AND VOWEL DELETION IN MARGI

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Within the theoretical framework of nonlinear phonology, this paper proposes an account of tone sandhi and vowel deletion in Margi, a Chadic language spoken in Northern Nigeria. The database is Hoffman's *Grammar of the Margi Language*. Language-specific tonal processes in Margi are shown to originate in tone trapping, i.e., the impossibility for a tone to anchor to a skeletal slot by a universal mechanism. The paper identifies the circumstances leading to tone trapping (e.g., Vowel Elision) and formalizes the various tone-rescue processes available both word-internally and across words. Whereas trapped high tones are always saved (either taking over low-tone vowel positions or giving rise to contour tones), trapped low tones may remain trapped throughout a derivation and thus receive no phonetic realization (by universal convention).

1. Introduction*

This paper investigates contour tones and a series of related issues in Margi, a Chadic language of Northern Nigeria described in Hoffmann [1963]. In viewing Margi's rising tones as "a combination of a low with a high tone" (§33), Hoffmann prefigured nonlinear phonology's interpretation of contour tones as the derived clustering of two level tones on a single tone-bearing unit.[1] Here, I seek to make precise, both descriptively and formally, the set of phonological and morphological circumstances leading to such LH clusterings in Margi. I extend the range of data considered in previous nonlinear studies dealing with Margi's

* Thanks to Russell Schuh and an anonymous reviewer for their useful comments.

[1] For further theoretical and typological developments regarding the representation of contour tones as either "clusters" or "units", see Yip [1989].

rising tones [Williams 1976; Dell and Vergnaud 1984; Pulleyblank 1986], and I resolve the differences in analysis among them. I also address the question of the status of Margi's falling tones, concluding that they too can, by and large, be regarded as derived clusters, but under special "expressive" conditions. In connection with an elucidation of Margi's contour tones, I provide an account of the cases where tone sandhi results in the occurrence of level, rather than contour, tones. Finally, I examine the non-tonal phenomena which feed tone sandhi by stranding tones, namely the vowel deletion processes of Apocope, Syncope, and Elision.

Contour tones in Margi generally result from tone "trapping", i.e., the impossibility for a tone to anchor to a skeletal slot by a universal mechanism.[2] The identification of a trapped tone in Margi follows automatically from three basic theoretical premises. First, I assume with Pulleyblank [1986:96] that universal Association Conventions (UAC) operate strictly in a one-to-one relation between free elements on separate tiers such as the tonal and the skeletal tiers, and, therefore, that one-to-many and many-to-one tonal associations are created by language-specific rules. Second, I also adopt the view widely accepted since Goldsmith [1976] (e.g., Pulleyblank [1986: 11-12, 197, 206]) that UAC apply whenever they can, in particular whenever a free tone and a free anchor are available for each other.[3] Finally, combining results in Pulleyblank [1986] and Yip [1988], I assume that the directionality of the universal mapping is parameterized and that for tones in Margi the left-to-right option has been selected by the grammar. Given these theoretical premises, tone trapping can be generally defined as occurring in any sequence where, after automatic application of the UAC, a tone remains floating. In Margi, as we shall see, tone trapping comes about in two basic ways, which can be labeled "lexical insufficiency" and "derivational deprivation". In the first case, lexical entries do not provide a sufficient number of tone-bearing elements to satisfy each tone for attachment on a one-to-one basis. In the second case, a tone may become stranded because its tone-bearing element has been either deleted or else taken over by another tone.

It is important to mention at the outset a circumstance where tone trapping does not arise, even though a tone has lost its mooring to a tone-bearing element. This situation occurs when a single tone is linked to several tone-bearing elements. In such a configuration, the elimination of a tone's association line to a tone-bearing element obviously fails to strand the tone, since it remains attached to one or more tone-bearing elements. As we shall see, the representation of "adjacent" tone-bearing elements carrying identical tones as the multiple attachment of a

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2 The term "trapping" is borrowed from Prince [1987: 497], who uses it to refer to the case where the mapping algorithm operating between the melodic and skeletal tiers leaves members of either tier unassociated.

3 This property is subject to superseding conditions such as the Elsewhere Condition and the Relinking Condition (see Pulleyblank [1986: 94; 114-6]).

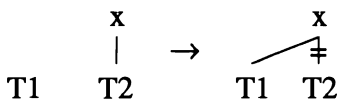
single tone to several tone-bearing elements allows an elegant account of otherwise puzzling restrictions on the formation of rising tones in Margi. Configurations in which a tone is multiply linked in Margi result from the lexical observance of the Obligatory Contour Principle (OCP) and the existence of a language-specific word-internal rule of Tone-Spreading which spreads an anchored tone rightward to free tone-bearing elements [Pulleyblank 1986: 71-4, 89-91, 195-7, 198-201, 210-2].

When tone trapping occurs, two options are, in theory, available to resolve the entrapment. They are schematized in (1) (where the first tone T1 is assumed to be the trapped tone for illustrative purposes only).

(1) Options Outcomes

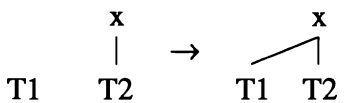
A. Language-specific association:

i. with delinking:



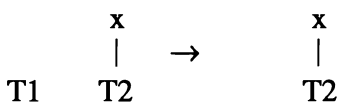
delinked tone T2 is trapped if singly linked, but not if multiply linked

ii. without delinking:



creation of a contour tone

B. Universal Convention:



trapped tone not realized phonetically

(A) By a language-specific rule, a trapped tone can become associated to a tone-bearing element; this new tonal association may or may not involve the delinking of the tone already borne by the tone-bearing element. (A.i) With delinking, another trapped tone will be created if the delinked tone was linked to a single skeletal position; if the delinked tone was multiply linked, its occurrence on the skeletal position from which it was delinked will simply leave no trace in the string. (A.ii) Without delinking, the new tonal association will give rise to a contour tone. (B) In the absence of applicable language-specific rules, the automatic alternative for a trapped tone is lack of phonetic realization, since it is not integrated into the overall prosodic structure. As we shall see, Margi presents the interesting characteristic of attesting the various types of options and outcomes

just outlined. Thus, I will argue that its phonology regarding trapped tones comprises three rules involving delinking—L-Association, H-Association, and H-Attachment—and two rules creating contour tones—Rising-Tone Formation and Falling-Tone Formation. In addition, I will show that, because of rule constraints on the directionality of tonal association and on domain of application, trapped tones (specifically low tones) cannot always be rescued; this is when trapped tones receive no phonetic realization (by universal convention).[4]

The detailed study of tone sandhi in Margi cannot be undertaken without examining closely the various processes which leave tones stranded through the deletion of vowels, specifically Vowel Apocope, Vowel Syncope, and Vowel Elision. The resolution (through Vowel Elision) of vowel sequences arising from suffixation is a particularly interesting process. As we shall see, the situation in Margi appears paradoxical at first, as segmental and tonal evidence point in different directions as to which of the two vowel positions should be assumed to have been eliminated. I will ultimately abide by the tonal evidence, which argues for the elimination of the first position. The conflict presented by some of the segmental evidence (which would seem to favor the elimination of the second position) will be resolved by bringing together aspects of Maddieson's [1987] reanalysis of Hoffmann's characterization of the Margi phonological system, Underspecification Theory (e.g., Archangeli [1988], Pulleyblank [1988]), and the availability of trapped vowel melodies for relinking.

Relevant aspects of Margi morphology brought into the picture in this paper include reduplication and types of interface between morphemes ("stem/suffix", "prefix/stem", and "word/word"). An account of Margi reduplication, with a special focus on the behavior of tones in reduplication, is proposed within the framework of Steriade's [1988] theory of reduplication. The non-uniform resolution of tone and vowel sequences at different morphological boundaries provides the basis for the identification of domains in the phonology of Margi within the broad framework of Lexical Phonology (e.g., Kiparsky [1982], Halle and Vergnaud [1987]).

All Margi data cited in this paper are taken from Hoffmann [1963], the basic source of information for other published studies on the phonology of the language. The paragraph numbers given throughout are for easy reference to the information in Hoffmann's book. From a theoretical standpoint, Pulleyblank's [1986] work on tonology in general and aspects of Margi tonology in particular deserves special mention for shaping this study.

The overall organization of the paper is as follows. After a brief background section on Margi surface tones (Section 2), the next two sections—one on monosyllabic rising verbs (Section 3), the other on Vowel Apocope (Section 4)—

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[4] Another possibility, exhibited by languages such as Tiv or Dschang, is for the trapping of a low tone to have a downstepping effect on a following tone (see Pulleyblank [1986: Chapter 2]). This option is apparently not available in Margi.

motivate the existence of a process of Rising-Tone Formation linking a trapped high tone to a low-tone vowel on its left and rule out the existence of a parallel rule of Falling-Tone Formation. Section 5, on Vowel Syncope, introduces a process of L-Association that feeds Rising-Tone Formation by linking a trapped low tone to a high-tone vowel on its right and concurrently delinking the high tone. In addition, this section broaches the issue of ordering relations between tonal associations and vowel deletion processes, and argues on both theoretical and descriptive grounds against the analyses in Williams [1976] and Dell and Vergnaud [1984] which postpone all tonal associations until after the vowel deletion processes. Sections 6-7 also deal with tone trapping and the creation of rising tones, but in connection with Reduplication and Vowel Elision, respectively. Section 6 offers an account of total and partial reduplication through the interaction of Full Copy, Template Satisfaction, and independently occurring tonal and segmental phenomena. Section 7 on Vowel Elision provides additional motivation for L-Association, as well as for a similar rule of H-Association. It attempts too to pinpoint the exact nature of "Vowel Elision", arguing that its surface effects result from vowel position deletion, followed by the linking and delinking of vowel melodies and tones, as opposed to vowel position fusion, followed by vowel melody coalescence and tonal delinking. In sum, Sections 3-7 are articulated around an inventory of the five basic sets of circumstances under which rising tones may surface in Margi (monosyllabic verb stems, Vowel Apocope, Vowel Syncope, Reduplication, and Vowel Elision). Section 8 deals with falling tones; it identifies the specific circumstances under which falling tones occur in Margi, and motivates a rule of Falling-Tone Formation to derive most instances. Finally, Section 9 recapitulates the basic characteristics of the language-specific rules offered in the paper to account for Margi's phenomena of vowel deletion and tone sandhi.

2. Background on Margi tones

There are four surface tones in Margi (§33): two level tones (a low tone and a high tone) and two contour tones (a rising tone and a falling tone). The level tones and the rising tone are commonplace, but falling tones are "extremely rare". My survey of Hoffmann's grammar identified about a dozen occurrences of falling tones, with an apparent predilection for what might be called "expressive items", such as the suffix *êi* of emphatic vocative forms (§95), the sentence emphasizer *wâ*, and a handful of interjections and greetings (§460). Elsewhere, I found a falling tone in two nouns (*ghâghá* 'ibis' and *pâm* 'pound sterling'; §34) and in a construction combining the word *kàshá* 'be quick!' with a vowel-initial verb (e.g., the low-tone verb stem *inda* 'to sit'). In this case, the final vowel of the word *kàshá* is elided, and its high tone combines with the low tone of the following vowel to create a falling tone (e.g., *kàsh îndà*! 'quick, sit (down)!'; cf. *kàshá wì*! 'quick, run!'; §272). As we shall see, in broad contrast to

rising tones, Margi does not ordinarily seize the chance to create falling tones when opportunity knocks. The formation of a falling tone in phrases like *kàsh îndà*! will be related to the "expressiveness" of the construction (an emphatic imperative) (see Section 8).

3. Rising tones and monosyllabic verb stems

As shown in Pulleyblank [1986: 195-7], the lexical entries of verb stems in Margi can be inherently toneless (Hoffmann's "changing verbs"; §210), or they can be specified with one of three unlinked tonal melodies: L ("low-tone verbs"), H ("high-tone verbs"), and LH ("rising-tone verbs"). When a rising-tone verb stem is monosyllabic and occurs as such on the surface (for example in the imperative singular or the infinitive; §263, 291), a rising tone is created on the verb's single vowel (e.g., *fĭ* 'to swell', *vəl* 'to jump'). The process of Rising-Tone Formation in (2) is, thus, required. The set of figures in (3) illustrates the derivation of verb forms of this type.[5]

(2) Rising-Tone Formation:

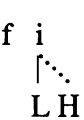
(3) a.

Lexical Representation

b.

UAC

c.



Rising-Tone Formation (Rule 2)

After the operation of the UAC anchoring the low tone in (3b), the high tone is trapped and links to the low-tone vowel on its left by application of the language-specific rule of Rising-Tone Formation. This case typifies the condition of "lexical insufficiency" under which a tone is trapped because the lexical entry does not provide enough tone-bearing elements for each of its tones to become

[5] For the sake of typographical simplicity, phonological representations are given with merged segmental and skeletal tiers when more elaborate displays showing both are unnecessary.

anchored by the UAC. The cases of tone-trapping examined in the remainder of this paper are due to "derivational deprivation", that is, the elimination of the association line of a singly attached tone in the course of a derivation, either by a vowel deletion process or by a tonal rule involving delinking.

4. Vowel Apocope

For many morphemes in Margi a distinction is observed between their "final" and "non-final" forms. In Hoffmann's words, "[t]he final form is used at the end, i.e. when the word takes the last place in a sentence or word-group ... The non-final form is used when the word is followed by a suffix or by another word in close connection ... The difference may be a difference of the final vowel or a difference of its tone" (§37). A number of suffixes ending in high vowels (e.g., the nominal definite suffix and several verbal suffixes) may thus lose their final vowel when the words of which they are part are non-final. In a few other morphemes, the loss of the final vowel may occur regardless of the word's position in the sentence; for example, the plural imperative suffix may appear with or without its final vowel at the pause. I subsume these cases of final vowel deletion under the rubric of "Vowel Apocope". Through this process of Vowel Apocope, tones may become trapped. In this section I investigate the various outcomes for tones that have lost their tone-bearing elements under Vowel Apocope.

Some of the suffixes susceptible to Vowel Apocope are listed in (4); they are grouped according to tonal and segmental properties relevant for the subsequent discussion.

(4)	I. Full forms	II. Reduced Forms	Approximate description of suffix function
a.	*-amə̀*	*-am̀*	plural imperative verbal suffix (§263)
b.	*-árì*	*-ár*	nominal definite suffix (§71)
	-ərì	*-ər*	past tense verbal suffix (§321)
c.	*-ə́rí*	*-ə́r*	partitive verbal suffix (§230)
	-ŋgə́rí	*-ŋgə́r*	additive verbal suffix (§228)
d.	*-ari*	*-ar*	diminutive verbal suffix (§215)
	-əri	*-ər*	applicative verbal suffix (§230)

Lexically, the suffix in (4a) has an initial toneless vowel, while its final vowel is prelinked to a low tone [Pulleyblank 1986: 90]. The toneless vowel typically acquires a surface tone from the preceding stem through Tone-Spreading, as in *fə́lámə̀* 'dance!' (from the high-tone stem *fəl*), or by application of the UAC, as in *və̀lámə̀* 'jump!' (from the rising-tone stem *vəl*). For our purposes, the interesting aspect of this suffix in these examples is that when the final low-tone vowel

undergoes Vowel Apocope, the preceding nasal consonant becomes syllabic and receives the stranded low tone (§32) (cf. *fɔ́lámǹ*, *vəlámǹ*). As the alternation between the demonstrative morpheme *ŋɔ́* 'this' and its reduced form *ŋ́* shows (e.g., *nàndà ŋɔ́ ~ nàndà ŋ́* 'it is they'; §137-8), a stranded high tone similarly survives the deletion of its supporting vowel. This type of transfer of a stranded tone onto a nasal consonant occurs not only word-finally, as in the examples just given, but also word-medially (e.g., *ànɔ́ɗà ~ àńɗà* 'for me') and word-initially (e.g., *ɔ́mpì ~ ḿpì* 'life') (§32) (see Section 5 below on Vowel Syncope). The analysis I propose is that in such cases of vowel deletion in a position adjacent to a nasal consonant, the nasal consonant becomes the nucleus of the syllable, and the UAC automatically link the free tone to the new available nucleus. In certain cases, the transfer of a deleted vowel's tone to an adjacent nasal consonant may actually be the outcome of Tone-Spreading, rather than the outcome of the UAC. For example, in the plural imperative *sàmə̀/sàmǹ* 'drink!' (from the lexically toneless stem *sa*) (§263, 322), the low tone on the *a* comes from the application of L-Default (a late rule assigning a low tone to vowels that have remained toneless; see Pulleyblank [1986: 125, 198-9], and Section 7.6. below). Assuming that a single low tone ends up multiply attached to the vowels in *samə* (because of the OCP), the deletion of the final *ə* by Vowel Apocope will not strand a tone. The nasal consonant *m*, which fulfills the role of the nucleus in the syllable that has lost its vowel, must therefore receive its low tone by Tone-Spreading.

Set (4b) includes two suffixes: *ari*, which has a lexical HL tonal melody whose level tones ordinarily surface distributed over its two vowels, as in *kùmárì* 'the meat' (from *kùm* 'meat') (§72), and *ɔri*, which is lexically analogous to the suffix in (4a) in having a toneless first vowel and a prelinked low tone on its final vowel (§321). For the latter suffix, the verb stems relevant to our purposes are those whose lexical tonal melodies end in a high tone (i.e., high-tone and rising-tone verb stems). With such verb stems, the toneless first vowel of the suffix receives a surface high tone through Tone-Spreading, as in *nì àfɔ́lɔ́rì* 'I danced' (from the high-tone stem *fɔl*), or through the UAC, as in *nì ávəlɔ́rì* 'I jumped' (from the rising-tone stem *vəl*). The initial *a* in both examples is a prefix carrying the opposite tone from the one in the next syllable (see Pulleyblank [1986: 205-7], and Section 7.6. below) (§313, 321-3). The interesting aspect of the two suffixes in (4b) is that in their apocopated forms, the final low tone is lost together with the vowel: it appears neither in the reduced form of the word, nor in the following word (cf. *kùmár* 'the meat', *àfɔ́lɔ́r yɔ́* 'I danced', *ávəlɔ́r yɔ́* 'I jumped'). The same phenomenon can be observed in the non-final form *àbár* for *àbárì* 'how', as in *àbár tlə̀r?* 'how is the work?' and *àbár kyî?* 'how is the compound?' (§154). This tone loss stands in stark contrast to the preceding case (cf. the discussion about 4a), and with other suffixal cases to be examined next (cf. the discussion below about 4c), where tone preservation holds under Vowel Apocope. I propose the following explanation for the loss of the trapped tone with the suffixes in (4b). The consonant that ends up in word-final position after the

application of Vowel Apocope is a nasal in the suffix in (4a), but a liquid in the suffixes in (4b). I assume that, as opposed to nasal consonants, liquids in Margi are not licensed as syllable nuclei and, therefore, cannot bear tones. This restriction on liquids leaves in principle only two survival possibilities for the low tone trapped as a result of Vowel Apocope in forms with the suffixes in (4b): (i) Association to the preceding vowel, which already bears a tone (a high tone), and thus creation of a falling tone. Since this multiple tonal attachment does not in fact occur, I conclude that the grammar of Margi does *not* include a rule of Falling-Tone Formation such as (5), parallel to Rising-Tone Formation (Rule 2).

(5)


(ii) The second possibility for rescuing a low tone trapped by Vowel Apocope would be to link it to the first tone-bearing element in the next word. The examples given above show that this type of association does not happen either. I conclude that the grammar of Margi does *not* include a rule associating a trapped low tone rightward *across words*.[6] Since no universal association convention or language-specific rule integrates into prosodic structure the word-final trapped low tones of the suffixes in (4b), they remain stranded and fail to be realized phonetically.

The suffixes in (4c) have a lexical high tone melody which ordinarily spreads onto their two vowels when these are present phonetically, as in *ŋálárí* 'to bite' (from the toneless stem *ŋal* + the high-tone suffix *ərí*) (§233) and *ndàlŋgárí* 'to throw on top' (from the low-tone stem *ndal* + the high-tone suffix *ŋgərí*) (§228). In examples such as these, the multiple attachment of the suffixal high tone means that Vowel Apocope will not create tone trapping; therefore, nothing special happens to the tonal patterns in the non-final forms (cf. *ŋálár*, *ndàlŋgár*). This situation is always true with the consonant-initial suffix *ŋgárí*. The interesting cases arise with the vowel-initial suffix *árí* when it combines with vowel-final monosyllabic verb stems. As two vowels become adjacent, Vowel Elision takes place (see Section 7 below) and contributes to the formation of bisyllabic forms such as *tlárí* 'to cut part of' (from the lexically toneless stem *tlə*) and *ŋgyìrí* 'to make fire' (from the low-tone stem *ŋgyi*) (§233). In the first example, because the high tone is multiply attached, the application of Vowel Apocope again does not trap it, and so nothing special happens (cf. *tlár*). But in the second example,

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6 We shall see in Sections 5 and 7.5-7.6. that there is in Margi a rightward *word-internal* process of low-tone association (L-Association [Rule 13/60]). For independent evidence that subject clitics like *yə* 'I' in, e.g., *àfəlàr yə* 'I danced' and *ávèlár yə* 'I jumped' retain "some degree of word status", see Pulleyblank [1986: 208-12].

the high tone *is* trapped by the application of Vowel Apocope, and as the surface form *ŋgyĭr* shows, it reattaches to the preceding low-tone vowel to yield a rising tone: Rising-Tone Formation (Rule 2) has applied.

Set (4d) contains lexically toneless verbal suffixes which acquire their surface tones by Tone-Spreading from lexically toned stems, as in *ɓárí* 'to help' (from the high-tone stem *ɓə* + the suffix *arí*) and *ɗəmərì* 'to pick part of' (from the low-tone stem *ɗəm* + the suffix *ərí*) (§215, 232). With lexically toneless verb stems, the addition of these suffixes leads to underlying representations that are also toneless, and which acquire their surface tones either through L-Default or through Tone-Spreading. For instance, given the toneless stem *hə* and the toneless suffix *ərí*, the low tones in the infinitive *hərì* 'to take' are derived through L-Default (§232) and the high tones in the present tense *àhórí* (§316) are derived through the UAC and Tone-Spreading from the extratonal high-tone prefix *a* (the surface low tone on the prefix results from L-Default; see Pulleyblank [1986: 205-7], and Section 7.6. below). We see from these examples that with high-tone, low-tone, and toneless verb stems, the tone on the final vowel of the suffixes will generally be the same as the tone on the preceding vowel, and, therefore, that Vowel Apocope will not trap a tone and cause any special tonal adjustment in non-final forms (cf. *ɓár*, *ɗəmər*, *àhór*). For our purposes, the potentially interesting cases involve rising-tone monosyllabic vowel-final verb stems, because in such instances the addition of the toneless vowel-initial suffixes *arí* and *ərí* will ultimately result, through tonal association and Vowel Elision, in bisyllabic forms with a low tone on the first vowel and a high tone on the final vowel (see Section 7.5. below). With this final vowel deleting by Vowel Apocope, the situation is again set for tone trapping and the creation of a rising tone through the application of Rule (2). Hoffmann does not provide any verb stem with the appropriate properties in his list dealing with toneless *arí* (§215), but two relevant stems exhibit in their combination with *ərí* the expected formation of a rising tone when Vowel Apocope has applied (§234): *ghə̌r* 'to deceive; to catch' (from the rising-tone verb stem *ghə*) and *ghyĭr* 'to steal' (from the rising-tone verb stem *ghyí*).[7]

The creation of rising tones in apocopated forms shows that Rising-Tone Formation (Rule 2) is sensitive to the effects of Vowel Apocope. Since Vowel Apocope may depend for its application on whether a word is final or non-final within a phonological group, it must apply post-lexically. Rising-Tone Formation

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[7] As Hoffmann himself mentions, such forms could actually be derived from high-tone *ərí* suffixation rather than toneless *ərí* suffixation, but this ambiguity only affects whether these examples should be classified under our discussions of (4b) or (4c), not the substance of what they show with respect to Rising-Tone Formation.

Hoffmann transcribes the corresponding non-apocopated forms as *ghórí* and *ghyírí* instead of the expected *ghərí* and *ghyìrí*. I assume that the tone patterns given by Hoffmann in these two non-apocopated forms are incorrect (compare, also in §234, the expected paradigms *nǰí* 'to thicken (soup); (soup) to become thick; to pass (urine)'/ *nǰírí*, *nǰìrə́* 'to thicken (soup)' and *və̌l* 'to jump; to fly' / *vələrí*, *vələr* 'to jump on to').

must, therefore, apply post-lexically as well. This finding agrees with Pulleyblank's conclusion [1986: 80, 221-3], based on independent arguments, that Rising-Tone Formation is a post-lexical rule.[8]

Summary of Section 4 results:

(i) The behavior of trapped tones in apocopated forms in Margi leads to the conclusion that whereas there exists in this language a process creating rising tones through the attachment of a trapped high tone to a vowel on its left already bearing a low tone (Rule 2), there is no parallel rule (see 5) which would create falling tones.

(ii) This result strongly supports Pulleyblank's hypothesis [1986: 79-80] that multiple linkings of tones to a single tone-bearing element are not automatic. Not only must they be language-specific, as demonstrated by Pulleyblank, but they must also be tone-specific within a given language, as shown here with Margi.

(iii) Low tones stranded by Vowel Apocope survive in Margi only if the preceding consonant is a nasal consonant; they survive by linking to the syllabic version of the nasal consonant through the UAC. They otherwise do not get realized phonetically, thereby indicating that there is no language-specific rule in Margi attaching a trapped low tone leftward within words or rightward across words.

(iv) Finally, it has been shown that Rising-Tone Formation applies post-lexically, since it takes into account the effects of Vowel Apocope, a post-lexical rule sensitive to whether words are final or not in a phonological group.

5. Vowel Syncope

Vowel Syncope, the interconsonantal deletion of a vowel, is an optional process of Margi frequently affecting the vowels [ə, i, u] (§39). Vowel Syncope is illustrated in (6) below. In these examples, Vowel Syncope does not create trapped tones, since the tone on the deleted vowels is otherwise linked to a preserved vowel.

(6)	*ə́ntsə̀kà*	~ *ə́ntskà*	'stone'
	Mìcìkə́rà	~ *Mìckə́rà*	name of a village
	àtsúkú	~ *àtskú*	'it is becoming' (from the verb stem *tsúkú* 'to fit, to become')

In another type of case, mentioned in passing in Section 4 above, a nasal consonant adjacent to the syncopated vowel becomes syllabic as a result of the syncope, and ends up carrying the tone of the deleted vowel, as shown in (7a)

[8] Pulleyblank's arguments for viewing Rising-Tone Formation as post-lexical are based on simplicity and Lexical Phonology's Principle of Structure Preservation.

(§32). This phenomenon extends to words beginning in a sequence of ə + nasal consonant, as shown in (7b) (§32).

(7) a. *ànə́ɗà* ~ *àn̋ɗá* 'for me'

b. *ə́mpàdlə* ~ *m̋pàdlə* 'beer'
ə́mpì ~ *m̋pì* 'life'
ə́mtàl ~ *m̋tàl* 'lizard'
ə́ntəm ~ *n̋təm* 'pot'
ə́ntskà ~ *n̋tskà* 'stone'
ə́ncàlà ~ *n̋càlà* 'calabash'
ə́ŋkyàgə ~ *ŋ̋kyàgə* 'blacksmith'

In these examples, Vowel Syncope strands a high tone, which the UAC automatically link to the syllabic nasal consonant (Such derivations were proposed earlier in relation to the application of Vowel Apocope after a nasal consonant; see Section 4).

Neither in (6) nor in (7) does Vowel Syncope result in tone trapping. However, in one example given elsewhere by Hoffmann (§186-7), conditions *are* fulfilled for tone trapping to occur: the vowel subject to Vowel Syncope carries a low tone and occurs between syllables bearing high tones. At least in theory, the resulting trapped low tone could link to the left (to create a falling tone) or to the right (to create a rising tone). As shown in (8), the attachment occurs to the right.

(8) *tətəkú* ~ *tətkŭ* 'single'

The fact that a falling tone is not created on the left side of the word is not surprising given our conclusion in Section 4 that there is no rule of Falling-Tone Formation in Margi attaching a low tone to a vowel on its left already bearing a high tone. However, the formation of the rising-tone on the right side of the word, as depicted in the derivation in (9) below, cannot, strictly speaking, obtain through the application of the rule so far posited for the creation of rising tones (Rule 2), since Rule (2) links a trapped high tone to a preceding vowel already linked to a low tone (9d shows the linking of a trapped low tone to a following vowel already linked to a high tone).

(9) a. t ə t ə k u Underlying Representation

H L H

b. t ə t ə k u UAC

H L H

c. t ə t k u Vowel Syncope

H L H

d. t ə t k u Rising-Tone Formation

H L H

One conceivable approach to this problem would be to assume that Vowel Syncope is ordered before tonal associations. The derivation of *tə́tkŭ* could then make use of Rule (2), as shown in (10).

(10) a. t ə t ə k u Underlying Representation

H L H

b. t ə t k u Vowel Syncope

H L H

c. t ə t k u UAC

H L H

d. t ə t k u Rising-Tone Formation (Rule 2)

H L H

Williams [1976: 466-7] and Dell and Vergnaud [1984: 8-9] similarly assumed that other vowel deletion processes of Margi, such as Vowel Apocope (see Section 4 above) and Vowel Elision (see Section 7 below), take place before all tonal associations. On theoretical as well as descriptive grounds, however, this type of

analysis does not seem appropriate. First, there are two serious theoretical disadvantages inherent to it: (i) the ordering of vowel deletion processes before tonal associations has to be stipulated (an undesirable complication of the grammar), and (ii) this extrinsic ordering goes against the strong hypothesis that UAC apply whenever they can, i.e., in the case of tonal associations, whenever a free tone can find a free anchor [Pulleyblank 1986: 11-2, 197, 206]. Secondly, the ordering of vowel deletion processes such as Vowel Apocope and Vowel Syncope before any of the tonal associations governed by the UAC seems descriptively incorrect. Pulleyblank [1986: 71-4] has convincingly demonstrated that the UAC and Tone-Spreading apply cyclically in Margi. Since Vowel Apocope is a post-lexical rule (see Section 4), one must conclude that it cannot precede all tonal associations. A similar conclusion is applicable to Vowel Syncope. There are two indicators pointing to the post-lexical character of Vowel Syncope: (i) as most of the examples in (6)-(8) above indicate, Vowel Syncope applies in non-derived environments, and (ii) Vowel Syncope occurs in syntactic phrases such as the two genitive constructions illustrated in (11).

(11) *wù + r + ə́sə̀nì > wúr sə̀nì* 'the tree Khaya senegalensis' (§40, 90)
màl + ə̀sə̀nì > mál sə̀nì 'the oil of Khaya senegalensis' (§40, 86)

As was the case with Vowel Apocope, if Vowel Syncope is post-lexical, then it cannot precede all tonal associations, since the UAC and Tone-Spreading apply cyclically in Margi.[9]

In order to maintain the type of ordering relations depicted in (9), rather than (10), Rising-Tone Formation could be viewed as a directionally neutral process, as stated in (12).

(12) Rising-Tone Formation (bidirectional): In an LH sequence with one tone trapped and the other anchored, link the trapped tone to the vowel bearing the other tone.

Rule (12) would directly provide for derivation (9). Alternatively, the rule of L-Association given in (13) could be posited.

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[9] With respect to the examples in (11), note that the high tone trapped by Vowel Syncope replaces the low tone on the preceding vowel, instead of forming a rising tone with it (**wŭr sə̀nì*) or a falling tone with the following low tone in the same morpheme (**wùr sə̂nì*). This indicates that the domain of Rising-Tone Formation does not extend beyond the word (compare 8 above), and that falling tones are presumably not created within morphemes (compare the "emphatic imperative" *kàsh ìndà* in Section 2 above). The issue of tone sandhi across words and the status of falling tones will be taken up in more detail in Sections 7.7. and 8, respectively.

(13) L-Association:

L-Association links a trapped low tone to a vowel on its right bearing a high tone, and delinks the high tone in addition. Since we know from Section 4 on Vowel Apocope that a low tone trapped on the right edge of a word does not become associated with the next word's initial tone-bearing element, the domain of L-Association must be restricted to words. The application of this rule, followed by that of Rule (2), the first version of Rising-Tone Formation, will provide for the derivation of *tə́tkŭ* from *tə́tə̀kú*, as shown in (14) below. Note that given the post-lexical placement of Vowel Syncope suggested above, L-Association must be post-lexical too, since it is fed by Vowel Syncope.

(14) a. t ə t ə k u — Underlying Representation

H L H

b. t ə t ə k u — UAC

H L H

c. t ə t k u — Vowel Syncope

H L H

d. t ə t k u — L-Association (Rule 13)

H L H

e. t ə t k u — Rising-Tone Formation (Rule 2)

H L H

I opt to account for the tonal alternation between *tə́tə̀kú* and *tə́tkŭ* with the combination of Rules (13) and (2), and I reject the postulation of Rule (12). The reason for this choice is that, as we shall see in Sections 7.5-7.6 (see in particular derivations 59, 62, and 75 below), there is independent motivation for Rule (13), with its high-tone delinking, so that *tə́tkŭ* can be derived by the joint operations of Rules (13) and (2), without recourse to Rule (12).

I have not found in Hoffmann's grammar examples where Vowel Syncope results in a high tone trapped between two low tones *word-internally*. However, as I shall argue in Section 7.5, Vowel Elision may lead to the formation of such configurations (see derivation 64 below); in these cases, the trapped high tone combines with the preceding low tone to form a rising tone. It is only natural to predict that, should the same tonal configuration come about through Vowel Syncope, a rising tone would also be formed.[10]

Summary of Section 5 results:

(i) Vowel Syncope may create trapped low tones word-medially and lead to the formation of rising tones, but not falling tones. The lack of formation of falling tones under such circumstances is in keeping with the results of Section 4 on Vowel Apocope, where it was established that there is no word-internal process of Falling-Tone Formation in Margi parallel to Rising-Tone Formation (Rule 2). The desired outcome (a rising tone) is obtained by postulating, in conjunction with Rule (2), a post-lexical rule of L-Association (Rule 13), whose domain is the word and which links a trapped low tone rightward, delinking at the same time the high tone carried by the new anchor.

(ii) The option generalizing Rising-Tone Formation to include both the linking of a trapped high tone to a preceding low-tone vowel (Rule 2) and the linking of a trapped low tone to a following high-tone vowel, was discarded on grounds of simplicity.

(iii) Another alternative, which relies on the stipulation that vowel deletion processes such as Vowel Syncope are ordered before tonal associations, was rejected on both theoretical and descriptive grounds. Such an alternative would force the abandonment of the strong hypothesis that UAC apply whenever they can; in addition, it seems incompatible with independent evidence on rule placement in Margi phonology.

6. Reduplication

Reduplication in Margi involves both the segmental and the tonal tiers, thus offering the potential for interactions with tonal association procedures and for tone trapping. For purposes of discussion, I assume Steriade's [1988] theory of reduplication, which views reduplication as a morphological operation involving full copy of the base; any required adjustments beyond Full Copy are independently existing operations of stem modification, such as stem truncation, which is

[10] By contrast, an analysis relying on the extrinsic ordering of Vowel Syncope (or Vowel Elision) before tonal associations (cf. Williams [1976: 466-7]; Dell and Vergnaud [1984: 8-9]) would predict a rightward shift of the high tone. It may be of some significance that phrasal cases of Vowel Syncope (see 11 above) do exhibit a leftward, rather than rightward, shift of the high tone whose vowel is syncopated (see Section 7.7. below for a formal treatment of these cases).

achieved through various mechanisms of Template Satisfaction. The behavior of tones in reduplication is briefly considered by Steriade [1988: 147] with data from Kela (a Bantu language from Zaire). We shall see here that the Margi tonal data are compatible with her theory of Full Copy, although Margi appears to differ from Kela in not preserving the tones of syllables eliminated by Template Satisfaction. I shall also argue that, contra Halle and Vergnaud's model of phonology [1987: 78], Reduplication in Margi must follow certain phonological processes, in particular that Full Copy must be able to take into account the effects of Vowel Elision and that Template Satisfaction must come after the UAC governing the linking of tones.

Reduplication in Margi is a fairly widespread process which can be observed in particular in nouns (§67), adjectives (§100-1), numerals (§196), and verbs (§251-4). It appears to be especially productive with verbs (Hoffmann states in §251 that "almost any verb seems to have a latent capability of being reduplicated"). Reduplication can be total (the whole word is reduplicated) or partial (the word-initial consonantal onset and the following vowel are reduplicated).[11] The basic mechanisms of Steriade's theory of reduplication which are relevant to Margi are as follows:

(i) Full Copy: "Reduplication always begins by making a complete copy of the base" (78); this principle will account directly for cases of total reduplication.

(ii) Partial reduplication in Margi will be accounted for by Full Copy, supplemented by procedures of Template Satisfaction licensing a light syllable at the leftmost edge of the left constituent.

With nouns and adjectives, reduplication indicates plurality or a quality of the sort denoted by the simple form.

(15)	Base		Reduplicated form	
	pə́rdá	'sinew, tendon'	*pə́rdápə́rdá*	'a sinewy piece of meat'
	làsə̀	'moisture, dampness'	*làsə̀làsə̀*	'moist, damp'
	də̀gàl	'great'	*də̀gàldə̀gàl, də̀də̀gàl*	'great (pl.)'
	tsàpù	'good, proper'	*tsàtsàpù*	'good, proper (pl.)'

With numerals, the reduplication of cardinal numbers serves to derive distributive forms.

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[11] According to Hoffmann (§30), what may look in his transcriptions like word-initial consonant clusters are actually "compound consonants", that is, in Sagey's [1986] terminology, "multiply-articulated" or "complex" consonants. Maddieson [1987] disagrees with this view, at least regarding labio-coronals, but this particular issue has no bearing on the topic at hand.

(16)	Base		Reduplicated form	
	pátlɔ́	'one'	*pápátlɔ́*	'one each'
	fòdə̀	'four'	*fòfòdə̀*	'four each'
	dúbú	'one thousand'	*dúbúdúbú*	'one thousand each'

With verbs, reduplication usually conveys "iterative, intensive, or extensive action"; it may also "point to the plurality of the subject ... or of the object ..." (§252).

(17)	Verb base		Reduplicated form	
	pìdà	'to spend the night'	*pìdàpìdà*	'to spend the whole night'
	fíkú	'to whistle'	*fífíkú*	'to whistle much'

Verb stem reduplication also serves to form adjectives.

(18)	Verb base		Reduplicated adjective	
	kùŋgùrà	'to blister'	*kùŋgùràkùŋgùrà*	'covered with blisters'
	tsɔ́lá	'to whet, sharpen'	*tsɔ́látsɔ́lá*	'sharp'
	ghàl	'to grow old, age'	*ghàlghàl, ghàghàl*	'old'
	gwàdə̀	'to mix'	*gwàgwàdə̀*	'mixed'
	mwàl	'to become sour'	*mwàmwàl*	'sour, acid'

All the examples of reduplication given so far in (14)-(18) involve stems with either a low-tone or a high-tone lexical melody. The reduplicated portions correspondingly appear on the surface with a low or a high tone, so that one could indifferently assume that tonal associations precede reduplication or that reduplication precedes tonal associations. With lexically toneless verb stems, reduplicated verb forms retain the "changing-tone" pattern of the simple forms and acquire surface tones in the same way (i.e., from toned affixes through the UAC and Tone-Spreading, or else through L-Default).

Verbal adjectives derived by reduplication from lexically toneless verb stems are invariably low-tone on the surface, and I assume that the low tones on these derived adjectives are obtained through L-Default.

(19)	Verb base		Reduplicated adjective	
	ɗuwa	(stem for 'to hide')	*ɗùwàɗùwà*	'hidden'
	ŋal	(stem for 'to bite')	*ŋàlŋàl, ŋàŋàl*	'bitten'
	ləɓasi	(stem for 'to catch [fish] by hand')	*lələɓàsì*	'[fish] caught by hand'

For our purposes, the more interesting cases of reduplication are those where a base has a lexical tonal melody with alternating tones, because of the potential for tone trapping when a single syllable ends up reduplicated (either through the total reduplication of a monosyllabic stem or through the partial reduplication of a polysyllabic stem). Hoffmann provides a number of relevant examples with the formation of adjectives from verb stems (§253). All of these examples involve *monosyllabic* verb stems of the shape "onset + vowel", for which total reduplication and partial reduplication are indistinguishable. As the list in (20) shows, the complete LH melody (i.e., a rising tone) occurs on both constituents of the reduplicated forms.

(20)	LH verb stem		Reduplicated adjective	
	bdlə̌	'to forge'	*bdlə̌bdlə̌*	'forged'
	fĩ	'to swell'	*fĩfĩ*	'swollen'
	ghyĭ	'to steal'	*ghyĭghyĭ*	'stolen'
	mbə̌	'to get better; to be saved, healed'	*mbə̌mbə̌*	'better; saved, healed'
	mbŭ	'to hide'	*mbŭmbŭ*	'hidden'
	mtsə̌	'to sprout'	*mtsə̌mtsə̌*	'sprouted'
	njĭ	'[soup] to become thick'	*njĭnjĭ*	'[soup] thick'

These data could be derived by assuming (i) that in line with Halle and Vergnaud's [1987: 78] model of phonology, the morphological process of reduplication occurs before phonological operations, and (ii) that each of the two constituents in a reduplicated form is a cyclic domain. The derivation of *fĩfĩ* given in (21) illustrates this analysis.

(21) a. [f i] Lexical representation of verb stem

L H

b. [f i] [f i] Reduplication (Full Copy)

L H L H

c. [f i] [f i] UAC (within each domain)

L H L H

d. [f i f i] Rising-Tone Formation (Rule 2)

L H L H

In this derivation, the intermediate representations (21b-c) show the importance of viewing each constituent of the reduplicated form as a separate phonological domain for the purpose of tonal associations. If there were only one domain, then the UAC would incorrectly distribute the tones as **fifí* (with the last two tones L and H of the total tonal melody irremediably stranded and phonetically unrealized). Step (21d) shows the post-lexical operation of Rising-Tone Formation (Rule 2), with the two trapped high tones linking to the low-tone vowels on their left.

One problem with the analysis illustrated in (21) is that there are cases indicating that reduplication in Margi is sensitive to the operation of phonological rules, in particular Vowel Elision. Thus, while it is generally true of Margi that reduplication does not involve derivational suffixes (i.e., only stems are reduplicated), the situation is actually different when a vowel-final monosyllabic verb stem combines with a vowel-initial monosyllabic derivational suffix. Vowel Elision then creates another monosyllabic verb form (see Section 7.5. below), and it is this suffixed form which is reduplicated, rather than the original verb stem. For instance, beginning with the lexically toneless verb stem *nta*, the concatenation of the high-tone suffix *ia* and the application of Vowel Elision yield *ntía* 'to split; to incise' (§220), and Reduplication produces *ntíantía* 'to make several incisions' rather than **ntantía* (§251).[12]

If a phonological process such as Vowel Elision must precede Reduplication, the UAC will be able to create tonal associations before Reduplication takes place,

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[12] See Odden and Odden 1985 for similar phenomena in Kíhehe, as well as Marantz [1987] and Aronoff [1988] for further discussion on the issue.

since these conventions are assumed to apply whenever they can in the phonology (see Section 1 above). The derivation of the reduplicated forms in (20) must then be as illustrated in (22) below, rather than as in (21).

Given that Reduplication is lexical and Rising-Tone Formation post-lexical, (22) shows that Reduplication must involve the copying of floating tones as well as the copying of the skeleton and its segmental and tonal attachments. This type of copying is allowed, and in fact required, by Steriade's model of reduplication, since it takes reduplication to involve the *complete* copying of the base. Any model restricted to copying only the skeleton and associated materials would in this case incorrectly leave behind the trapped high tone of (22b).

(22) a. [f i] Lexical representation of verb stem

LH

b. [f i] UAC

LH

c. [f i] [f i] Reduplication (Full Copy)

LH LH

d. [f i f i] Rising-Tone Formation (Rule 2)

LH LH

I now turn to partial reduplication on bisyllabic verb stems with a lexical LH tonal melody. Strictly speaking, Hoffmann does not provide such cases, but he does mention one instance which can be so interpreted, namely the verb *ŋàŋàdə́* 'to shake' (§251). This verb indeed looks like a reduplicated form, but according to Hoffmann, it has no attested corresponding base. One can, however, easily reconstruct it as the rising-tone verb stem *ŋədə̌*. This case is important because, if representative, it would clearly show (independently of the preceding argument regarding the application of Full Copy after the UAC) that Template Satisfaction must follow the tonal associations due to the UAC. As illustrated in (23) below, if Template Satisfaction preceded the UAC, the reduction to one syllable of the first constituent in the reduplicated form would eventually result in a trapped high

tone which Rising-Tone Formation would operate on to yield the incorrect **ŋǎŋàdə́*.[13]

(23) a. [ŋ ə ɗ ə] Lexical representation of verb stem

L H

b. [ŋ ə ɗ ə][ŋ ə ɗ ə] Reduplication (Full Copy)

L H L H

c. [ŋ ə][ŋ ə ɗ ə] Template Satisfaction

L H L H

d. [ŋ ə][ŋ ə ɗ ə] UAC
(within each domain)

L H L H

e. [ŋ ə ŋ ə ɗ ə] Rising-Tone Formation (Rule (2)

L H L H

f. *[ŋǎŋàdə́] Output

The derivation in (24) shows how the correct form is derived by having Template Satisfaction follow the UAC.[14]

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[13] Derivation (23) again assumes that each of the two constituents in the reduplicated form is a cyclic domain. If they were not separate cyclic domains, then a different but equally incorrect output would emerge, namely **ŋàŋə́də̌*.

[14] In this particular derivation, the application of the morphological operation of Reduplication (Full Copy) *after* the phonological operation of the UAC is not necessary to obtain the correct output, but it comes about automatically if, as argued above, Vowel Elision must precede Reduplication (cf. *nta+ía* > *ntíantía*, **ntantía*) and the UAC apply whenever they can in the phonology (see Section 1).

(24) a. [ŋ ə ɗ ə] Lexical representation of verb stem

L H

b. [ŋ ə ɗ ə] UAC

L H

c. [ŋ ə ɗ ə][ŋ ə ɗ ə] Reduplication (Full Copy)

L H L H

d. [ŋ ə][ŋ ə ɗ ə] Template Satisfaction

L L H

e. [ŋəŋəɗə́] Output

The crucial difference between (23) and (24), then, is the ordering of the UAC and Template Satisfaction. Because Template Satisfaction comes first in (23), the preservation of the first light syllable in the leftmost constituent cannot serve to eliminate any of the tonal melody, since it has not yet been integrated into prosodic structure. By contrast, in (24), the tonal melody is first integrated into prosodic structure by the UAC, so that when Template Satisfaction comes along, any and all material which is not part of the first light syllable, including tonal information, can be appropriately discarded.[15]

With the formation of reduplicated plural adjectives and distributive numerals from stems with tonally alternating melodies, examples such as those in (25a-b) (§100, 186, 196) follow straightforwardly the type of "tonal transfer" observed above in the reduplication of verb stems, i.e., the surface tonal properties of a vowel are preserved under reduplication.[16]

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15 The situation reported for Kela by Steriade [1988: 147] is different in that tones are preserved under Template Satisfaction and associate leftward with the remaining syllable to form contour tones (cf. *sùkú* → *sùkú-sùkú* → *sŭsùkú*). This behavior could be accounted for by assuming that, contrary to the situation in Margi, Reduplication in Kela (i.e., Full Copy + Template Satisfaction) precedes phonological operations; the problem is that other Kela examples seem to show that a phonological process of vowel contraction intervenes between Full Copy and Template Satisfaction, preempting the latter (cf. *èsé* → *èsé-èsé* → *èsêsé* / **ĕsé*).

16 "Tonal transfer" is used analogically to "syllabic transfer" [Steriade 1988]. The only problem in accounting for the reduplicated forms in (25) is the vowel change in the partially reduplicated adjective *ɗə́ɗúmì*. This vowel change might be due to the fact that the [u] in the stem is an

...continued on next page

(25) a.

Adjective base		Reduplicated form (plural)
ɗúmì	'bad, ugly'	*ɗúmìɗúmì, ɗəɗúmì*
lákə	'weak'	*lákəlákə*
míɗàgə	'fresh'	*míɗàgəmíɗàgə*

b.

Numeral base		Reduplicated form (distributive)
mákər	'three'	*mákərmákər, mámákər*
məɗəfə	'seven'	*məɗəfəməɗəfə, məməɗəfə*
mətlkùmì	'twenty'	*mətlkùmìmətlkùmì*
ghàrə	'one hundred'	*ghàrəghàrə*

The cases listed in (26) (§100-1) display interesting surface properties which can be shown to follow independently of reduplication.

(26)

	Base		Reduplicated form	
a.	*mənágə*	'good'	*mənág(ə)mənágə*	'good (pl.)'
b.	*əzàgə*	'Isge'	*əzàgəzàgə*	'à la Isge'
	əntàbə	'rubber'	*əntàbəntàbə*	'rubber-like, sticky'

The apparent difficulty with (26a) concerns the high tone on the optionally syncopated vowel in the reduplicated form. On the basis of the simple stem, one would expect a low tone on this vowel. However, as other uses of the word *mənágə* reveal (§102-3), the final vowel of this adjective carries a low tone only when the word occurs finally in a sentence; otherwise, i.e., in its non-final form, it carries a high tone. This is illustrated in (27) (where I have ignored the vowel quality changes due to the same non-final/final contextual opposition).

(27) a. *tásá mənágə́ kə* 'this good dish' (literally: "dish good this")
b. *tásá gəndà mənágə* 'his dish is good' (literally: "dish his good")

Since the first constituent in the reduplicated plural form of 'good' is obviously not final, finding a high tone on its last vowel—the third vowel in the word *mənágəmənágə*—is consistent with the data in (27a). To go beyond this correlation and actually explain the tonal alternation for this adjective, I extend to it Pulleyblank's account of Margi's "polarity items" such as the present prefix *a* and

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underlying /ə/ (cf. Maddieson [1987]) whose surface quality is ultimately conditioned by the following labial [m]. For additional discussion on the broader issue of Margi's underlying vowel system, see Maddieson [1987] and Sections 7.2.-7.4. below.

a number of subject and object clitics (see Pulleyblank [1986: 198-212] and Section 7.6. below). Thus, I assume that the adjective for 'good' has the lexical representation given in (28a).

(28) a. m ə n a g ə
[+ex]
H

b. m ə n a g ə
[+ex]
H

c. m ə n a g ə + ...]
H

d. m ə n a g ə]
H L

This word is exceptional in that its final vowel is marked as "extratonal" ([+ex]). The marking means that the vowel is "invisible" for purposes of tone assignment, at least as long as it is on the edge of a tonal domain (Peripherality Condition). The lexical application of the UAC and of Tone-Spreading will therefore yield the intermediate representation in (28b). In reduplication and other circumstances where the form in (28b) is ultimately brought together with a following item into a larger constituent, the extratonal vowel is no longer final; the extratonality marking is consequently lost, and the toneless vowel receives a high tone through Tone-Spreading (see 28c). By contrast, when the adjective is sentence-final, the extratonality persists until the phonetic level, where "by a universal convention, extratonality is lost", since "*all* tone-bearing units must be assigned a tone value" [Pulleyblank 1986: 206]. Tone-Spreading being no longer applicable at this late stage, the toneless vowel receives a low tone by default (see 28d).

In the reduplicated adjectives in (26b), it is Vowel Elision which causes special effects. Consider the representations in (29) below. Ignoring the nature of the consonants, the two base stems of (26b) have the same lexical canonical representation (29a), which turns into (29b) by application of the UAC and Tone-Spreading. Reduplication (Full Copy) yields (29c). Vowel Elision is then applicable and basically deletes the first vowel in the sequence (see Sections 7.3-7.4. below for details); given the multiple attachment of the low tone, tone trapping does not occur, and the correct surface tonal pattern is obtained directly (see 29d).

(29) a. ə C ə C ə

H L

b. ə C ə C ə

H L

c. ə C ə C ə + ə C ə C ə

H L H L

d. ə C ə C + ə C ə C ə

H L H L

The two instances in (30) (§67, 186, 196) are analogous to those of (26b) analyzed in (29), except that tone trapping takes place as a consequence of Vowel Elision, because the tone assigned to the vowel subject to Vowel Elision is not multiply linked.

(30)	Base		Reduplicated form	
a.	*ə́mhyà*	'a small clay-dish'	*mhyímhyà*	'something like a clay-dish'
b.	*ə́mdlə̀*	'nine'	*ə́mdlə́mdlə̀*	'nine each'

I provide in (31) the derivation of the reduplicated forms up to the stage of Full Copy.

(31) a. ə m hy a ə m dl ə Lexical Representation

H L H L

b. ə m hy a ə m dl ə UAC

H L H L

c. ə m hy a + ə m hy a ə m dl ə + ə m dl ə Reduplication (Full Copy)

H L H L H L H L

Both *mhyímhyà* and *ə́mdlə́mdlə̀* exhibit vowel sandhi and tone sandhi at the interface between their two constituents (cf. 31c). In the first word, the vowel sequence /*a*+ə/ results in [i], while in the second word, the vowel sequence /ə+ə/ uncomplicatingly turns into a simple [ə]. In both words, the tonal sequence LH

reduces to a high tone, rather than forming a rising tone.[17] I examine first the case of /*a*+*ə*/ → [i] and then the tonal reduction LH → H.

Granted the melody deletion of /*a*/ in front of /*ə*/ in (31c), the quality of the resulting surface vowel [i] is in fact expected, because [i] is an allophone of non-final /*ə*/ after palatals (§18) (*hy* stands for the voiceless palatal fricative [ç]; cf. *hyə̀* 'to tear' / *hyìhyə̀* 'torn'; §20). The puzzle is that /*a*/ should lose out to /*ə*/ in the first place, since /*ə*/ normally yields to /*a*/ in Vowel Elision, regardless of the order of the two vowels (§38; see Sections 7.2.2. and 7.7. below); only one other "unusual" example where /*a*+*ə*/ → [ə] is noted by Hoffmann (§232).[18] More regularly, though, the melody /*a*/ *is* lost before another vowel at the prefix/(verb) stem interface (/*a*+*i*/ → [i] and /*a*+*u*/ → [u]; see Sections 7.6. and 8 below); the loss of /*a*/ before /*ə*/ in *mhyímhyà* might be related to this phenomenon.

At any rate, in both reduplicated forms in (31c), Vowel Elision will create a trapped tone in the medial LH sequence, from which one could expect the formation of a rising tone. But instead, the low tone loses out to the high tone. As we shall see in Section 7 below, while it is true that a trapped tone in a LH sequence often results in the formation of a rising tone at a stem/suffix interface, a high tone ordinarily wins out across words. This phenomenon was already observed with respect to the application of Vowel Syncope in the genitive phrases given in (11) above (see note 9). The constituents within a reduplicated word thus continue to exhibit word-like behavior with respect to tone sandhi.

With respect to vowel deletion and tone sandhi, the interface between the two constituents of a reduplicated form is thus more akin to the prefix/stem and word/word interfaces than to the stem/suffix interface. This type of interface distinction is not uncommon across languages; for example, in French, glide formation typically occurs between stem and suffix, but not between prefix and stem, between the members of compounds, or between words [Tranel 1987: 118-9].

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[17] *mhyímhyà* also loses its initial vowel and accompanying high tone. The loss of the initial vowel can be attributed to the post-lexical rule of Vowel Syncope (see Section 5 above and the examples in 7b). *mhyímhyà* differs, however, from the examples in (7b) in not exhibiting on its initial nasal the high tone stranded by the deletion of the vowel. If Hoffmann's transcription is correct, this may indicate that the nasal consonant is not syllabic in this word, perhaps because it is followed by a fricative rather than a stop (all of Hoffmann's examples with an initial toned syllabic consonant exhibit a stop after the nasal). The absence of tone reassignment to the nasal consonant would then follow from the non-syllabicity of the nasal consonant (cf. Sections 4-5 above), and the surface loss of the trapped high tone would result from the lack of a suitable vowel position that could make it visible (the next vowel position is occupied by a high tone).

[18] Compare for instance the regular cases *nyànì* 'to fill' (from the low-tone verb stem *nyə* + the toneless derivational suffix *anì*) and *hwàrì* 'to boil, to cook' (from the low-tone verb stem *hwa* + the toneless derivational suffix *ərì*) versus the "unusual" case *jìgə̀rì* 'to pile up (stones, firewood); to put together (things for a load)' (from the low-tone verb stem *jiga* + the toneless derivational suffix *ərì*) (§213, 232).

Summary of Section 6 results:

(i) Reduplication in Margi involves both segmental and tonal tiers. Tone transfer is observed under Reduplication. The tonal differences occasionally observed between the base and the constituents of a reduplicated form occur as the consequences of independent phenomena such as extratonality and vowel deletion.

(ii) Reduplication not only provides inputs for Vowel Elision, but also takes into account the effects of Vowel Elision. Reduplication cannot, therefore, belong to a separate morphological component that would precede all phonological rules. It also follows that Vowel Elision must apply in the lexicon. Since Vowel Elision additionally applies at the interface between words, it must be post-lexical as well. (See Section 7 below for a fuller discussion of Vowel Elision.)

(iii) On grounds of descriptive adequacy, Reduplication (both Full Copy and Template Satisfaction) must be preceded by an application of the UAC linking tones. Given that the application of at least one phonological rule (Vowel Elision) must precede Reduplication, the appropriate interaction between universal tonal associations and Reduplication follows from the hypothesis that the UAC apply whenever they can in the phonology.

(iv) Finally, while the formation of rising tones is possible within each constituent of a reduplicated form, it is blocked at their interface, where a high tone wins over at the expense of a low tone. This blockage can also be observed across words (see Section 7.7. below for further discussion on this question).

7. Vowel Elision

7.1. Vowel Elision and tone sandhi: Introduction. In the preceding sections, four different situations have been identified in which rising tones can be created. Rising tones can form on monosyllabic verb stems, when lexical entries do not provide enough tone-bearing elements for the available tones (Section 3); this type of "lexical insufficiency" also leads to rising tones within constituents in reduplicated forms (Section 6). Rising tones can form as well when a tone becomes derivationally trapped because a process of vowel deletion such as Vowel Apocope (Section 4) or Vowel Syncope (Section 5) removes a crucial tone-bearing element ("derivational deprivation"). In this section, the focus is on situations of derivational deprivation caused by Vowel Elision: when vowels sequences occur through morphological concatenation, a vowel position is lost on the skeletal tier, and the creation of rising tones results in a number of cases, particularly in suffixation.

I list in (32) the three suffixes which I have identified in Hoffmann's grammar as providing appropriate conditions for the formation of rising tones under Vowel Elision.

(32)	Segmental melody	Tonal melody	Description
a.	*ari*	HL	definite suffix (§71-9)
b.	*ia* (i.e., ^{j}a)	H	verbal derivational suffix (§220-3)
c.	*wa* (i.e., ^{w}a)	H	verbal derivational suffix (§240-1)

I follow Maddieson [1987: 339-341] in analyzing the two suffixes in (32b-c) as being underlyingly composed of a floating palatalizing/labializing component (respectively), followed by a skeletal slot for the vowel melody /a/. All three suffixes can thus be said to begin skeletally with a vowel, and to have an initial high tone. I provide in (33) instances where rising tones are created as a result of the suffixation of these morphemes (§73-8, 122, 220, 240).

(33) a. *árì*-suffixation

fà	*fărì*	'farm'	
hyà	*hyărì*	'dog'	
ŋwà	*ŋwărì*	'face'	
hyì	*hyărì*	'leg'	
ʔíʔì	*ʔíʔyărì*	'country'	
tì	*tĭarì*	'mourning'	
hù	*hwărì*	'grave'	
ʔúʔù	*ʔúʔwărì*	'fire'	
wù	*wărì*	'tree, wood'	
cédè	*cédĕrì*	'money'	
pénè	*pènĕrì*	'halfpenny'	
àdíkò	*àdíkwărì*	'kerchief'	
áŋkò	*áŋkwărì*	'handcuff'	
-ágə	*-ágărì*	'your...(sg)'	as in *ùʔwágărì* (from *ùʔwà* 'breast')
-ámà	*-ámărì*	'our...(dual)'	as in *ùʔwámărì*
-áʔyà	*-áʔyărì*	'our...'	as in *ùʔwáʔyărì*
-ányì	*-ányărì*	'your...(pl)'	as in *ùʔwányărì*
-ándà	*-ándărì*	'their...'	as in ùʔwándărì

b. *ía*-suffixation

ghà	*ghĭa*	'to shoot; to shoot (game)'
ŋgyə	*ŋgyĭa*	'to burn; to burn (pottery, bricks)'

c. *wá*-suffixation

ghà	*ghwă*	'to pass, to stretch forth; to reach inside'
ntsə	*ntswă*	'to pass (string) through'
tlà	*tlwă*	'to cut (with knife); to cut in two (with knife)'

These examples illustrate the expected basic condition for the formation of rising tones under Vowel Elision: the first vowel V1 carries a low tone and the second vowel V2 a high tone. This condition is formalized in (34).

(34) Basic condition for the formation of rising tones under Vowel Elision:

V1	V2	(segmental melody; root nodes)
|	|	
x	x	(skeletal tier)
|	|	
L	H	(tonal melody; tonal tier)

Descriptively, however, Condition (34) is not restrictive enough, as the formation of a rising tone fails to take place in two broad categories of cases meeting this condition. The restrictions describing these cases are given in (35).

(35) Constraints on Condition (34):
a. Neither the low tone nor the high tone must be multiply linked.
b. The low tone and the high tone must not belong to different words.

The examples in (36) (§73-8, 220, 240) and (37) (§233) below illustrate Constraint (35a). The set of examples in (36) shows that even the suffixes in (32) do not always lead to the formation of rising tones when the stem ends in a low-tone vowel, and that in (37) that the addition of the high-tone verbal suffix *əri* to a stem ending in a low-tone vowel never produces a rising tone. In (36), it is the low tone of the stems that is initially associated with more than one stem vowel; in (37a), it is the high tone of the suffix that is initially associated with more than one suffixal vowel; and in (37b), both the low tone of the stems and the high tone of the suffix are initially associated with more than one vowel. In Section 7.6. below, we shall see that in constructions involving the prefix /a/ with lexically toneless vowel-initial verb stems, a low tone similarly fails to combine into a rising tone with a following multiply attached high tone.

(36) a. *árí*-suffixation

màlà	*màlárì*	'woman'
ù?wà	*ù?wárì*	'breast'
màhyìdì	*màhyìdĭarì*	'women'
làgù	*làgwárì*	'way, road'
bìkə̀	*bìkárì*	'sin'
məlmə̀	*məlmárì*	'village'

b. *ía*-suffixation

dùgù	*dùgwía*	'to find'
dzàʔù	*dzàʔwía*	'to pound'
ghàɗə	*ghàɗía*	'to close'
ghərzə	*ghərzía*	'to move'
kùtə	*kùtía*	'to see'
ndəɓə	*ndəɓía*	'to beat'
skùɗə	*skùɗía*	'to push'
tsáʔù	*tsàʔwía*	'to incise'
tsùŋgù	*tsùŋgwía*	'to collect'

c. *wá*-suffixation

ɓàtsə	*ɓàtswá*	'to break'
skùɗə	*skùɗwá*	'to push'
tsəɗə	*tsəɗwá*	'to scoop out'

(37) *ərí*-suffixation

a.

là	*làrí*	'to dig'
ŋgyì	*ŋgyìrí*	'to burn'
tlà	*tlàrí*	'to cut'

b.

ɓàtsə	*ɓàtsərí*	'to break'
mərghyì	*mərghyírí*	'to pinch'
mtàɗə	*mtàɗərí*	'to lick'
mùrdə	*mùrdərí*	'to scratch'
ŋàdlə	*ŋàdlərí*	'to grind coarsely'
pàdlə	*pàdlərí*	'to pound'
tsàvə	*tsàvərí*	'to stab'
tsùŋgù	*tsùŋgúrí*	'to collect'
wùtə	*wùtərí*	'to take much (soup) with little mush'
zàtə	*zàtərí*	'to cut'

In Hoffmann's grammar, I have found only four examples, all with the definite suffix *árì* (§74-6, 78), which stand as exceptions to the generalization regarding multiple tonal attachment. They are listed in (38); (38a) includes two cases where a rising tone fails to appear when expected, while (38b) includes two cases where a rising tone appears unexpectedly; these four exceptional instances will be discussed in Section 7.5. below.

(38) a. *sə̀* *sárì* 'thing'
míríʔù *míríʔwárì* 'porridge'

b. *vìʔì* *vìʔyárì* 'night'
gòdò *gòdǒrì* 'a Hausa cloth'

The examples in (39)-(41) below illustrate Constraint (35b) above. As we have seen already in Section 6, Vowel Elision leads to the elimination of the low tone in favor of the high tone across constituents in reduplicated forms (see 39); the same is true across words (see 40); and the genitive high-tone morpheme *a*, used mainly with body parts, behaves alike, making the low tone of a preceding word-final vowel yield to it (see 41) (§87, 120).

(39) Across constituents in reduplication:
ə́mhyà 'a small clay-dish' > *mhyímhyà* 'something like a clay-dish'
ə́mdlə̀ 'nine' > *ə́mdlə́mdlə̀* 'nine each'

(40) Across words:
ə́mckà ə́skwàr > *ə́mcká skwàr* 'soup pot'
sà ə́ntàbà > *sá ntàbà* 'to smoke tobacco'

(41) With the high-tone genitive morpheme *a* ("possessed + *á* + possessor"):
ŋwà + á + bzə́r > *ŋwá bzə́r* 'the boy's face'
mnyà + á + màlà > *mnyá màlà* 'the woman's mouth'
ʔyà + á + màmpə́lə́ŋù > *ʔyá màmpə́lə́ŋù* 'the hyena's thigh'
lì + á + Mádə̀ > *lía Mádə̀* 'Madu's lip'
tsì + á + wù > *tsía wù* 'branch' (= "hand of tree")
hyì + á + Tlàmà > *hyá Tlàmà* 'Tlama's leg'

The data in (41) are particularly interesting because the same stems produce rising tones in combination with the definite suffix *árì*, as illustrated in (42) (from 33a above).

(42) *ŋwà* *ŋwárì* 'face'
hyì *hyárì* 'leg'

The contrast (41) versus (42) indicates that there must be a constructional difference at the root of the two kinds of tonal sandhi behavior. I suggest a suffixal type of construction in the case of the definite morpheme *árì* (leading to a word-internal sandhi of the type observed with the verbal suffixes) and a syntactic construction in the case of the genitive morpheme *á* (leading to a word-external sandhi of the type observed between independent words) (See Sections 7.5. and 7.7. below for further discussion).

An exception to the behavior characteristic of word-external sandhi occurs with the word *wù* 'tree', which yields a rising tone not only when it appears with the definite morpheme *árì* (*wù/wǎrì*; §75), but also when it enters into a syntactic construction with a predicate beginning in a high-tone vowel (*wù + ákàŋgàdə́ > wǎkàŋgàdə́* 'the tree shakes'; §38). To account for the latter, I tentatively suggest that for some reason (perhaps linked to monosyllabicity), the word for 'tree' can cliticize onto the next word, thus becoming a member of the domain within which Rising-Tone Formation normally operates. Cliticization is probably required as well for what I have called, following Hoffmann's terminology, the definite "suffix" *árì*. This terminology seemed adequate for most of the examples provided so far, which were basically of the form "noun + *árì*". However, Hoffmann observes (§79, 108, 122) that *árì* actually attaches outside "noun + adjective" constructions, and as in fact already illustrated in (33a) with the word for 'breast', after possessive endings. It may, therefore, be more accurate to assume that the definite morpheme *árì* is syntactically an N' specifier, and that it becomes cliticized onto the last syntactic constituent in N' for phonological purposes (see also the discussion of 66a below).

In this section I have descriptively delineated the cases where the formation of rising tones occurs under Vowel Elision and where level tones are preserved. Before a formal account of tone sandhi under Vowel Elision can be provided, it is necessary to determine the exact nature of what I have termed "Vowel Elision". Vowel Elision involves certain melodic adjustments regarding vowel quality. Thus, as already mentioned in Section 6, one of the most striking and frequent melodic adjustments takes place when the vowel /ə/ becomes adjacent to the vowel /a/: /ə/ generally loses out to /a/, regardless of the order of the two melodies; how can this yielding property of /ə/ be captured? Vowel Elision also involves the loss of a vowel position on the skeleton tier, since it does not result in long vowels; how is this reduction to be implemented formally: through Vowel Position Fusion or through Vowel Position Deletion? If the latter, which of the two positions deletes? The resolution of such questions depends in part on the analysis of Margi's vowel system.

7.2. The vowels of Margi

7.2.1. Surface and phonemic inventories. Hoffmann's description of Margi's surface vowels (§18) yields the surface inventory shown in (43) (I ignore the three diphthongs *ai*, *au*, and *ia* mentioned in §19).

(43)

i	y	ɯ	u
ɪ		ə	ʊ
ɛ	œ		ɔ
æ	a	ɑ	ɒ

Hoffmann derives this complex phonetic array from the six phonemes represented in (44). Note that Hoffmann writes /ɛ/ and /ɔ/ as *e* and *o*, respectively, a practice followed throughout in this paper; Hoffmann's ə corresponds to IPA /ɨ/ (Russell Schuh, personal communication).

(44)

i	ə	u
e		o
	ɑ	

Maddieson [1987] further reduces the phonemic inventory to two elements: the low vowel /a/ and the non-low vowel /ə/. This reduction comes on two fronts. First, Maddieson [1987: 328] decides to ignore the mid vowels /e/ and /o/, because of their "marginal status" as vowels occurring "*only* in a few recent loanwords" (emphasis added). Hoffmann actually states (§18) that these vowels are "*mostly* found in foreign words" (emphasis added). Second, Maddieson views the high vowels [i] and [u] as surface realizations of /ə/ conditioned by the preceding consonant: palatalized consonants trigger [i], labialized consonants [u]. Plain consonants yield a following [ə]. This approach allows a parallel treatment of allophonic distribution for the low and non-low vowels. According to Maddieson, it also places Margi more in line with other Chadic languages, which typically have reduced vowel inventories, but fairly complex sets of plain, palatalized, and labialized consonants. In this paper, I will basically adopt Hoffmann's more conservative stance and include the high vowels /i/ and /u/ and the mid vowels /e/ and /o/ in the set of phonemes to be recognized in Margi. I do agree with Maddieson in viewing *most* occurrences of [i] and [u] as surface realizations of /ə/, but I remain uncertain that *all* occurrences of [i] and [u] can be legitimately derived from /ə/. As to the mid vowels, they do occur phonetically and simply cannot be ignored phonologically.

7.2.2. Margi vowels and Underspecification. In terms of the theory of Radical Underspecification (e.g., Archangeli [1988]), the underlying system given in (45) can be postulated for Margi, where /ə/ is completely unspecified.

(45)

	i	e	ə	a	o	u
high		-		-	-	
back	-	-				
round					+	+

With this radically underspecified system, the unspecifed values of the features are filled in by means of the redundancy rules in (46).

(46) a. [ ] → [+high]
b. [ ] → [+back]
c. [ ] → [-round]

The interest of Radical Underspecification here is in providing an explanation for the already noted fact that in a sequence of two vowels, Margi /ə/ generally loses out to the other vowel, whether it comes in first or second position. For instance, when the derivational (lexically toneless) suffixes *ani* or *ari* (e.g., *ntàl/ntàlànì* 'to look') are added to verb stems ending in /ə/, it is the initial suffixal vowel which surfaces at the expense of the final stem vowel (§213, 215) (see 47a); but when *ərí* (as a high-tone derivational suffix or as a lexically toneless derivational suffix; e.g., *ɗəm/ɗəmərì* 'to pick') is added to verb stems ending in /a/, it is the stem vowel which surfaces at the expense of the initial suffixal vowel (§232-4) (see 47b).

(47) a. /ə + a/ → a

hə̌	*hàní*	'to grow up'
mbə̌	*mbàní*	'to get better'
nyə	*nyànì*	'to fill'
ɓə́	*ɓárí*	'to help'
mɗìɗə́	*mɗìɗárí*	'to blow (e.g., flute)'
tsə̀dzə̀	*tsə̀dzàrì*	'to shake'

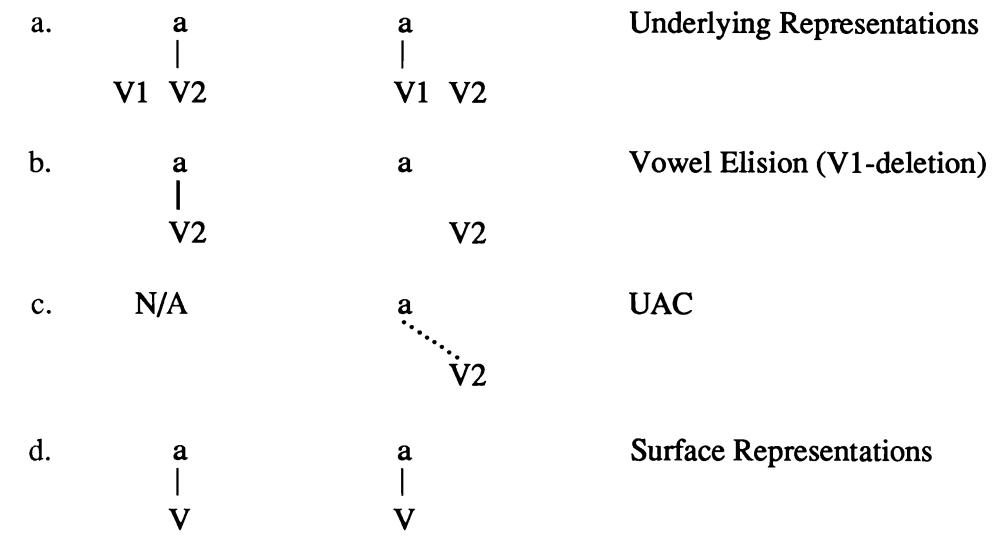
b. /a + ə/ → a

ghà	*ghàrì*	'to put on (clothes)'
tá	*tárí*	'to cook'
ùzà	*ùzàrì*	'to hoe'

Under the assumption that /ə/ is unspecified, the loss of a vowel position in a sequence of two on the skeletal tier will necessarily result in the survival of the (partially) specified vowel melody at the expense of the unspecified vowel melody, regardless of how the vowel position loss is formally implemented and regardless of the order of the vowel melodies. The examples in (48) show how these results obtain, with the first vowel position (V1) assumed to delete; (48A) provides a derivation with the underlying melodic sequence /ə+a/ (as in the examples of 47a), (48B) with /a+ə/ (as in the examples of 47b).[19]

[19] See Pulleyblank [1988: 242-3] for a similar account of the properties of Yoruba /i/ under Vowel Deletion.

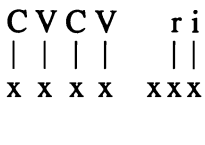
(48) A. /ə + a/ → a B. /a + ə/ → a



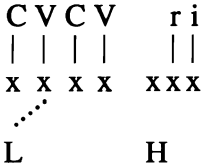
7.3. Vowel Elision: Tonal evidence in favor of V1-deletion. The results in (48) would have equally obtained if the second vowel position (V2) had been assumed to be lost, or if the two vowel positions had been assumed to fuse. On theoretical grounds Vowel Position Deletion is, a priori, preferable to Vowel Position Fusion because deletion is an elementary phonological operation, whereas fusion is a complex one, decomposable in principle into deletion and linking (another elementary phonological operation). In this section, I argue that tone sandhi in Margi supports the theoretical argument by contributing language-internal evidence in favor of Vowel Position Deletion. Regarding the issue that arises within the Vowel Position Deletion approach (V1-deletion vs. V2-deletion), the tonal evidence is similarly decisive (in favor of V1-deletion). The next section takes up the apparent resolution of certain vowel melody sequences in terms of V2-deletion and shows these data to be compatible with V1-deletion (Section 7.4.).

Consider the cases where the high-tone bisyllabic derivational suffix *əri* (§232) is attached to low-tone polysyllabic vowel-final verb stems. The application of the UAC and of Tone-Spreading results in the multiple attachment of both the low tone of the stem and the high tone of the suffix, as illustrated canonically in (49).

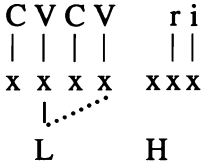
(49) a. Underlying Representation



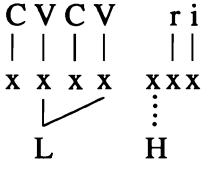
b. UAC (on stem cycle)



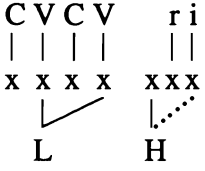
c. Tone-Spreading (on stem cycle)



d. UAC (on stem + suffix cycle)



e. Tone-Spreading (on stem + suffix cycle)

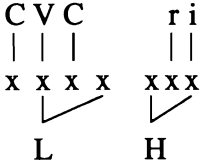


In conformity with Constraint (35a) on Condition (34), no rising tone surfaces under Vowel Elision in such instances. A few examples are given in (50), repeated for convenience from (37b).

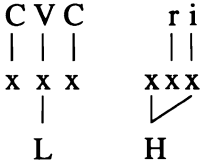
(50)

mtàdə	*mtàdərí*	'to lick'
mùrdə	*mùrdərí*	'to scratch'
ŋàdlə	*ŋàdlərí*	'to grind coarsely'
pàdlə	*pàdlərí*	'to pound'
tsàvə	*tsàvərí*	'to stab'
wùtə	*wùtərí*	'to take much (soup) with little mush'
zàtə	*zàtərí*	'to cut'

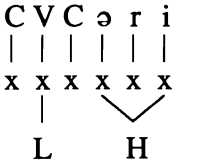
The important tonal fact to notice about these data is that at the interface between stem and suffix, it is the high tone of the suffix which takes over, not the low tone of the stem. This fact can be easily explained if Vowel Elision is assumed to be V1-deletion, as shown in (51), which continues the canonical derivation started in (49), with both vowels at the stem/suffix interface initially unspecified since both are /ə/ in the examples of (50).

(51) a. 

(= 49e)

b. 

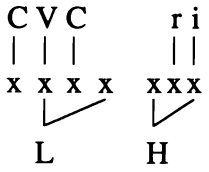
Vowel Elision (V1-deletion)

c. 

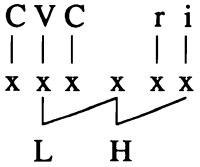
Surface Representation

The figure in (51a) shows the multiple attachments of both the low tone (of the stem) and the high tone (of the suffix). In (51b), Vowel Elision as V1-deletion has operated, in effect "eliminating" a low tone, as desired. If Vowel Elision were V2-deletion, a high tone would be "eliminated", incorrectly yielding outputs of the shape *[CV̀Cə́rí]. The figure in (51c) is the canonical surface representation with the empty vowel slot specified as [ə].

Data such as (50) also argue against Vowel Position Fusion. The derivation in (52) below reprises derivation (51) with Vowel Position Fusion taking place instead of Vowel Position Deletion.

(52) a. 

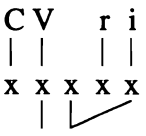
(= 49e)

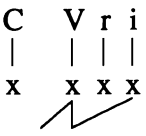
b. 

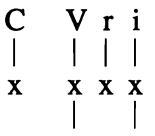
Vowel Position Fusion

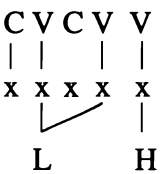
The problem with (52b) is that the fused vowel position now has a rising tone which needs to be reduced to a high tone, and there is no independent motivation for the required delinking of the low tone rather than the high tone. Derivations (59) and (65) in Section 7.5. below show that Vowel Position Fusion would also yield the canonical outputs with rising tones given under (ii) in (53A-B); these rising tones would be required to be reduced to level tones, a low tone in (53A) and a high tone in (53B), as shown under (iii) (Tonal association lines are shown exhaustively in 53).

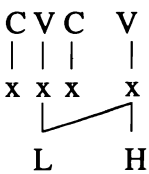
(53) (i) Input (ii) Output of Fusion (iii) Phonetic output

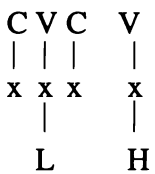
A. 





B. 





In other words, the delinking of a high tone which is part of a rising tone is required for (53A), i.e., when the high tone is multiply linked, and the delinking of a low tone is required for (53B), i.e., when the low tone is multiply linked. The difficulty in (52b) is that both the low tone and the high tone are multiply linked. To obtain the appropriate delinking in (52b), the low-tone delinking rule would have to be extrinsically ordered before the high-tone delinking rule. This undesirable ordering stipulation could be avoided by viewing the two delinking

rules as a unitary process erasing from left to right any association line that contributes to both a rising tone and a multiply-linked tone (the directionality condition ensures that the low tone rather than the high tone is affected in 52b). However, this formulation simply observes that rising tones and multiply-linked tones do not mix in Margi, without providing any explanation as to why their combination is disfavored. Less stipulatory formulations are conceivable, but none is entirely satisfactory.

The following formulation would provide an explanation from the standpoint of constraining the occurrence of multiply-linked tones: Erase the association lines of multiply-linked tones from left to right as long as no vowel position is left toneless. The basic idea here is that multiply-linked tones are eliminated in Margi, unless they serve the purpose of providing a tone for otherwise toneless vowels. The problem with this account is that its output condition essentially duplicates the raison d'être of any tonal process in the language linking a tone to a toneless vowel (i.e., the UAC, Tone-Spreading, and L-Default). In addition, emphatic imperatives provide a counterexample by having a low tone which is both part of a falling tone and multiply attached (see the derivation in (80) in Section 8 below).

The idea that the occurrence of rising tones is disfavored in Margi yields another conceivable formulation: Erase the association lines of rising tones from left to right as long as no tone is trapped on the left. The function of this process is to eliminate rising tones in favor of level tones, unless their presence is required to preserve a tone. Although the connection made here between rising tones and tone preservation is on the right track, its formal implementation as an output condition on the reduction of rising tones to level tones is problematic, because rules linking trapped tones are required independently of the effects of Vowel Elision viewed as Vowel Position Fusion (see Sections 3-5 above).

Perhaps the most general formulation would be one based on the economy of use of association lines: Erase superfluous tonal associations lines from left to right ("superfluous" describing lines whose absence does not create toneless vowels or trapped tones). In its sweeping generality, however, this formulation combines the problems inherent to the preceding alternatives.

In sum, Vowel Position Fusion does not appear to offer a satisfactory formal account of the conditions under which rising tones reduce to level tones under Vowel Elision. It can only provide explanations that reiterate independently needed portions of Margi phonology and parts of Universal Grammar. The fundamental problem is that Vowel Position Fusion systematically creates rising tones which must then be selectively reduced to level tones. One gets a better handle on tone sandhi if the phenomenon is viewed from the reverse perspective: Under what conditions are rising tones created? It is clear that rising tones are formed at the stem/suffix interface only when a tone would otherwise be lost as a result of Vowel Elision. As we shall see in detail in Section 7.5. below, this phenomenon of tone preservation is exactly what V1-deletion allows to capture.

Thus, with input like that in (51a) and in (53(i)B), no tone is trapped through the application of V1-deletion, so nothing special need occur tonally, and level tones are the result (with the surface appearance of the loss of a low tone). With input like that in (53(i)A), V1-deletion does create the potential for the loss of a low tone through trapping, and this is when a tonal process (L-Association—see Rule 13) comes into play to rescue the endangered tone by making it take over the next (high-tone) vowel position; nothing further need happen, however, as no tone is now trapped, and again level tones are the result (with the surface appearance of the loss of a high tone). It is only when L-Association itself creates a trapped high tone that a rising tone is formed (through Rising-Tone Formation—see Rule 2) in order to save the trapped high tone (no tone loss on the surface).[20]

To summarize, on both theoretical and descriptive grounds Vowel Position Deletion appears superior to Vowel Position Fusion. In addition, the tonal evidence clearly argues in favor of V1-deletion over V2-deletion.

7.4. Vowel Elision and vowel melody loss. I now turn to the vowel melody data which could be considered as evidence for V2-deletion, namely, cases where under Vowel Elision the V1-melody exhibits stability at the expense of the V2-melody. My aim is to show that these data are actually compatible with V1-deletion.

I briefly consider first the case of vowel sequences involving stem-final [i] or [u] and the initial /ə/ of the derivational verbal suffixes in *əri*. As the examples in (54) show (§232-3), the stem-final vowels [i] and [u] give all appearances of being stable (Stems given without tones are lexically toneless).

(54) a.	Verb stem non-final form	Suffixation of toneless *əri*	
	hyì	*hyìrì*	'to tear'
	ʔi	*ʔìrì*	'to do'
	ushi	*ùshìrì*	'to stir, to mix'
	mbù	*mbùrì*	'to sew'
b.	Verb stem non-final form	Suffixation of high-tone *əri*	
	mərghyì	*mərghyírí*	'to pinch'
	ŋgyì	*ŋgyìrí*	'to burn'
	tsùŋgù	*tsúŋgúrí*	'to collect'
	gu	*gúrí*	'to look for, to seek'

[20] The absence in Margi of suffixes with an initial low-tone vowel prevents testing the fate of a stem's high tone under Vowel Elision at the stem/suffix interface. But see Section 7.6. below for a relevant configuration at the prefix/verb stem interface.

The hypothesis that /ə/ is unspecified accounts for these data without recourse to V2-deletion (see 48B above), but I would like to show that regardless of the status of /ə/ they are in fact compatible with V1-deletion. In the analysis of such stems, I follow Maddieson [1987] in considering that their final vowels are underlyingly /ə/, and that their surface quality [i] or [u] is derived by "Vowel Coloring" from the secondary articulation (palatalization or labialization) of the preceding consonant. The simplified derivations in (55) illustrate how, under this view, V1-deletion can handle the data in (54) (I ignore tones in these derivations).

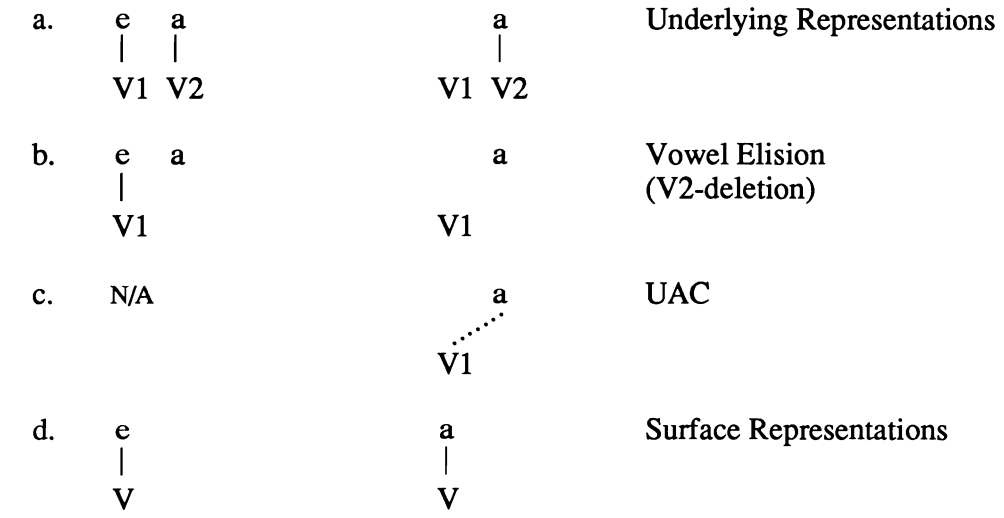
(55)	*ŋgyi*	*ŋgyiri*		*gu*	*guri*		
	ŋg^{y}ə	ŋg^{y}ə	+ əri	g^{w}ə	g^{w}ə	+ əri	Underlying Representations
	N/A	ŋg^{y}	+ əri	N/A	g^{w}	+ əri	Vowel Elision (V1-deletion)
	ŋg^{y}i	ŋg^{y}	+ iri	g^{w}u	g^{w}	+ uri	Vowel Coloring

A priori sturdier evidence favoring V2-deletion comes from the resolution of vowel sequences not involving /ə/, in particular the apparent stability of the stem-final vowels /e/ and /o/ at the expense of the initial vowel /a/ in the definite morpheme *árì*. Examples are given in (56) (§77-8).

(56)	a.	*kyékyé*	*kyékyérì*	'bicycle'
		shéré	*shérérì*	'court'
		cédè	*cédĕrì*	'money'
		pénè	*pénĕrì*	'halfpenny'
	b.	*gòdò*	*gòdŏrì*	'a Hausa cloth'
		sóró	*sórórì*	'rectangular mud-house'
		tóró	*tórórì*	'threepence'

With V2-deletion, relevant sample derivations would proceed as depicted in (57): (57A) serves to illustrate the case of vowel sequences not involving unspecified /ə/ (i.e., both vowel melodies are partially specified) and (57B) shows how unspecified /ə/ would fail to survive despite being the first vowel in a sequence.

(57) A. /e + a/ → /e/ B. /ə + a/ → /a/



After the application of V2-deletion (see 57b), there is no skeletal slot available for the stranded melody /a/ in (57A), and it can be assumed to receive no phonetic realization. By contrast, in (57B), a skeletal slot *is* available for the stranded melody /a/, and the UAC automatically establish the link between the two (see 57c).

The data in (56) can, however, be reconciled with V1-deletion by assuming that V1-deletion is followed by a process of Vowel Melody Association linking to the V2-position the vowel melody left stranded by V1-deletion. Given radical underspecification (see 45 above), the combinations of /e+a/ and /o+a/ under a single vowel position (by Vowel Melody Association) will yield /e/ and /o/, respectively, through Feature Coalescence, as shown in (58).[21]

[21] The stems susceptible to derivation (58) which I found in Hoffmann contain two identical mid vowels (see 56 above). In order for the analysis of Vowel Elision as V1-deletion to work, these identical vowels must not be vowel positions linked to a single vowel melody, for if they were, this vowel melody would fail to be stranded by V1-deletion, Vowel Melody Association could not apply, and the suffixal vowel would be preserved instead of the stem vowel. I therefore assume that Margi is not a language with planar segregation between vowels and consonants [McCarthy 1989].

(58) A. /e + a/ → e B. /o + a/ → o

a. [-hi,-bk] [-hi] [-hi,+rd] [-hi] Underlying Representations
V1 V2 V1 V2

b. [-hi,-bk] [-hi] [-hi,+rd] [-hi] Vowel Elision (V1-deletion)
V2 V2

c. [-hi,-bk] [-hi] [-hi,+rd] [-hi] Vowel Melody Association
V2 V2

d. [-hi,-bk] (= e) [-hi,+rd] (= o) Feature Coalescence
V V

Similar approaches are available in Dependency Phonology (e.g., Anderson, Ewen, and Staun [1985]), Particle Phonology (e.g., Schane [1984]), and Charm and Government Theory (e.g., Kaye, Lowenstamm, and Vergnaud [1985]). The basic idea shared by these theories is that /e/ and /o/ are complex vowels, each resulting from the combination of two basic elements: thus, /a+i/ → /e/ and /a+u/ → /o/. When /e/ (i.e., /a+i/) and /o/ (i.e., /a+u/) in turn combine with /a/, the vowel qualities /e/ and /o/ will remain intact, at least if the concatenation of *another* element /a/ is not taken to contribute any additional timber adjustment.[22]

An alternative to Feature Coalescence is to assume that Vowel Melody Association triggers delinking. Under this view, the attachments of /e/ and /o/ in (58c) above will strand the following /a/'s, thus immediately yielding the appearance of the V1-melody, even with V1-deletion. Since the stranded /a/'s are followed by consonants and no planar segregation is assumed between vowels and consonants in Margi (see note 21), they will be irremediably trapped, and they will consequently fail to be realized phonetically.

In order to decide between the two types of approaches, morphological concatenations involving vowel sequences such as /a+e/ and /a+o/ are required. The coalescence approach would predict the outcomes to be /e/ and /o/, respectively, whereas the delinking approach would predict /a/ in both cases. Relevant data are scant. I found only one relevant form, namely the emphatic vocative *Tlámâi*, obtained by concatenation of the person's name *Tlàmà* and the emphatic vocative

22 This is actually contrary to Schane's Particle Phonology, where successive additions of the particle /a/ are taken to increase vowel aperture.

ending *êi* (cf. *Hámànêi*, from *Hámàn* + *êi*; §95). If representative, this example would argue in favor of the delinking approach, since it shows that the first vowel melody /*a*/ has displaced the second vowel melody /*e*/.[23] It could also be taken to militate against Vowel Position Fusion, since this approach might be expected to rely on feature coalescence rather than delinking to derive the correct vowel melodies. In subsequent derivations, I will assume that Vowel Melody Association triggers delinking and, therefore, that Feature Coalescence is not required.[24]

7.5. Tone sandhi under Vowel Elision at the stem/suffix interface. My goal in this section is to show that the rules of L-Association and Rising-Tone Formation introduced in different contexts earlier also account for tone sandhi under Vowel Elision at the stem/suffix interface. Given these two tonal processes, the central explanatory principle behind the preservation of level tones versus the creation of rising tones is the distinction between multiply-linked and singly-linked level tones.

The canonical derivation in (51) above has already shown how and which level tones are preserved when a polysyllabic low-tone verb stem is combined with a high-tone bisyllabic derivational suffix like *əri*: Because the low tone is multiply-linked to the stem vowels, V1-deletion directly results in the "elimination" of a low tone, so that intermediate /Cx̀Cx̀ + x́rx́/ (x = vowel position) yields [Cx̀Cx́rx́], without the formation of a rising tone (e.g., *wùtə̀/wùtə́rí*; see 37b).

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[23] *Gámíêi* (from *Gàmì* + *êi*) seems to indicate that the vocative morpheme does not always cliticize to the preceding noun (compare *Fàlêi*, from *Fàlí* +*êi*) (§95).

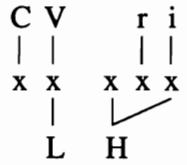
The occurrence of *ôu* instead of *êi* in cases like *Mádə̀/Mádôu* and *Mjìgə́mtə̀/Mjìgə́mtôu* (§95) can be attributed to Vowel Coloring from an underlying secondary articulation (labialization) on the preceding consonant (cf. Maddieson [1987]; see also Section 7.2.1. and derivation 55 above). Additional evidence for this secondary articulation can be adduced from the fact that the non-final form of *Mádə̀* ends in [u] rather than [ə] (cf. *Mádú wá*! 'hey, Madu!') (§18, 95).

Note that in *Mádôu* and *Mjìgə́mtôu*, the loss of a low tone under Vowel Elision (cf. *Mádə̀*, *Mjìgə́mtə̀*) is only apparent, as this low tone is not inherent to the stem, but due to L-Default (cf. the tonal alternation in *Mádə̀/Mádú wá*!, which suggests that this noun has a high tonal melody and an extratonal final vowel; see Section 6 above for the treatment of the parallel tonal alternation in *mánágə̀/mánágə́mánágə̀*).

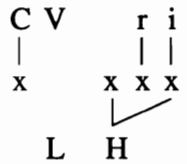
The apparent replacement of the low tone in *Tlàmà* and *Gàmì* with a high tone in the emphatic vocative (*Tlámâi*, *Gámíêi*) remains to be explained. It is possible that these stems are lexically toneless; they would get a low tone by L-Default when unsuffixed and they would inherit a high tone from the ending *êi* in the emphatic vocative (cf. also *Gámí wá*! 'hey, Gami!').

[24] The delinking approach may not be a possible alternative within Charm and Government Theory. Rather than an unspecified vowel, Margi /*ə*/ would likely be regarded as the identity element in this framework (cf. its surfacing as the tense cold vowel [ɯ] in final position; §18); a process of Vowel Melody Association including delinking would therefore incorrectly predict the survival of /*ə*/ when it occurs in V1-position. An approach combining Vowel Melody Association (without delinking) and Vowel Melody Coalescence would thus appear necessary within this particular theory.

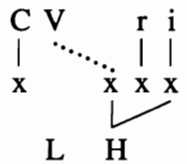
I consider now cases where the same high-tone suffix *ərí* combines with low-tone vowel-final verb stems that are monosyllabic rather than polysyllabic, as in *là/làrí* (see 37a). I propose for these cases the canonical derivation given in (59).

(59) a. 

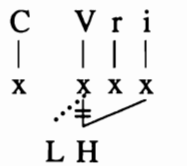
Output of UAC and Tone-Spreading

b. 

Vowel Elision (V1-deletion)

c. 

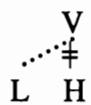
Vowel Melody Association

d. 

L-Association

(59a) is the intermediate representation created by the UAC and Tone-Spreading. (59b) shows the effect of V1-deletion, which creates a trapped low tone. (59c) reflects the application of Vowel Melody Association. Finally, (59d) depicts the association of the trapped low tone to the high-tone vowel on its right and the concurrent delinking of the high tone by means of L-Association, a rule introduced as (13) in Section 5 above, and repeated here in (60).

(60) L-Association: (= Rule 13)



The fact that no rising tone is formed in cases represented by derivation (59) receives a straightforward account under the assumption that L-Association delinks the high tone (see also derivations 62 and 75 below). The delinking of the

high tone does not create a trapped high tone (because of the multiple attachment of the high tone), and there is thus no reason for a rising tone to be formed. We shall see in derivation (63) below that rising tones do surface when L-Association applies in front of a singly-linked high tone, but the formation of such rising tones follows from the independently motivated existence of Rising-Tone Formation (Rule 2) (see Section 3 above). If L-Association did not delink the high tone, an additional rule would have to be introduced to delink the high tone of a rising tone just in case this high tone is multiply linked.

The delinking effect of L-Association in (59) might be taken to follow automatically from a *lexical* application of the rule. Assuming that rising tones do not occur lexically in Margi and are thus exclusively formed post-lexically by virtue of Lexical Phonology's Principle of Structure Preservation (Kiparsky [1982], Pulleyblank [1986: 221-3]),[25] the linking (in the lexical phonology) of the trapped low tone in (59d) could be viewed as automatically forcing the delinking of the high tone. However, as we shall see in Section 7.6. below, the effects of L-Association, including the delinking of the high tone, must obtain post-lexically. A rule of L-Association formulated as in (60) is, therefore, independently motivated. Furthermore, no untoward result will accrue in derivations like (59) if L-Association is restricted to the post-lexical component; in fact, according to Mohanan [1986: 46], such rule placement might correspond to the unmarked option in Universal Grammar.

Derivations similar to (59) are required for morpheme combinations like those illustrated in (61), which involve monosyllabic rising-tone verb stems with the toneless derivational suffix *ani* (§213).

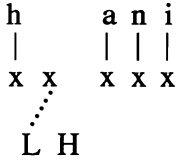
(61) *hə̌* *hàní* 'to grow up'—'to blow up with pride'
mbə̌ *mbàní* 'to get better, to be saved'—'to save, to cure, to heal'

The derivation of *hàní* in (62) exemplifies the need for the effects of L-Association. The steps in (62d-e) complete the partial derivation suggested by Pulleyblank [1986: 80] for this word.

---

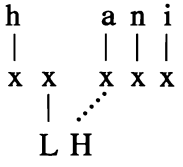
25 I found only one form in Hoffmann which seems to require the existence of a lexical rising tone: *dzə̌árə̀rì*, the definite form of the noun *dzə̌ər* 'leather loin-cloth of a woman', obtained by addition to the noun stem of the definite suffix *árì* (§72). The form *dzə̌árə̀rì* appears unusual in that the stem's rising tone is not "reduced" to a low tone in front of a high tone (*dzə̌árə̀rì* rather than **dzàrárì* is the form given by Hoffmann). In the verb morphology, when a monosyllabic rising-tone stem (e.g., *və̌l* 'to jump; to fly') takes a high-tone derivational suffix like *ba*, no rising tone occurs on the surface (*vəlbá* 'to jump over, across' / **və̌lbá*; §217); in other words, the contiguous H-tones of the stem and suffix conflate into one (cf. Pulleyblank's rule of Floating H-Deletion [1986: 206]; see 71 below). Rising tones seem extremely rare on noun stems: besides *dzə̌ər*, I was able to find just one other noun stem with a rising tone, namely *bghyĭr* ~ *ghyĭr* 'a (large) cricket' (§49); it did not appear in combination with the definite suffix *-árì*.

(62) a.



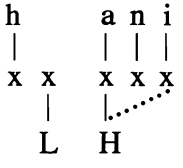
UAC
(on stem cycle)

b.



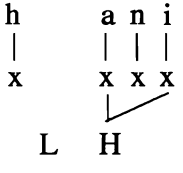
UAC
(on stem + suffix cycle)

c.



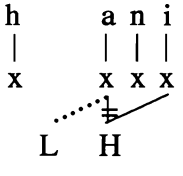
Tone-Spreading
(on stem + suffix cycle)

d.



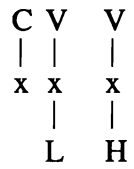
Vowel Elision (V1-deletion)
(on stem + suffix cycle)

e.

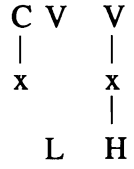


L-Association (Rule 60)

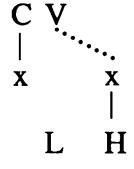
I turn next to a situation similar to that in (59), except that the delinked high tone is trapped and a rising tone is consequently formed, as in *fà/fǎrì*. Such cases were illustrated in (33) above, and I summarize their basic characteristics here: the stems are vowel-final and the suffixes are vowel-initial; the stems have a final low tone which is singly attached (either because the stems are monosyllabic or because a high tone precedes); the suffixes have an initial high tone which is also singly attached (either because the suffixes are monosyllabic or because a low tone follows). I propose for these cases the canonical derivation given in (63).

(63) a. 

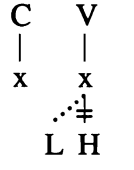
Output of UAC

b. 

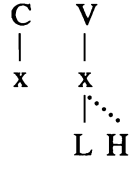
Vowel Elision (V1-deletion)

c. 

Result of Vowel Melody Association

d. 

L-Association (Rule 60)

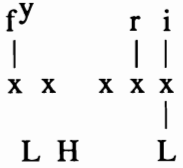
e. 

Rising-Tone Formation (Rule 2)

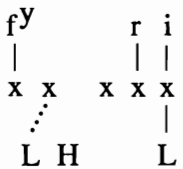
The bisyllabic phonological information encoded in (63a) is meant to indicate that neither the low tone nor the high tone is multiply attached. As a result, the low tone becomes trapped when Vowel Elision (V1-deletion) applies in (63b), and the high tone similarly becomes trapped when L-Association applies, linking the trapped low tone and delinking the high tone (see 63d). The application of Rising-Tone Formation (Rule 2) eventually relinks the high tone, creating the rising tone observed on the surface (see 63e). In connection with the high-tone delinking function attributed to L-Association, it is important to recall that Rule (2) is motivated independently of its reattaching high tones delinked by L-Association (see Section 3 above).

Another interesting situation where the application of L-Association traps a following high tone, ultimately leading to the formation of a rising tone, can be

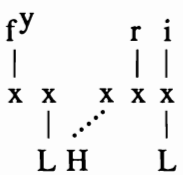
illustrated with the derivation of the past verb form *áfĩrì* 'it is swollen' (§327). *áfĩrì* concatenates the high-tone prefix *a* (§321), the rising-tone verb stem *fi* (§212), and the past suffix *ərì*, which has a lexically toneless initial vowel and a low tone lexically attached to its last vowel (§321). In the derivation proposed in (64) below, the segmental representation of the verb stem is taken to be */fʸə/*, in keeping with what was said earlier regarding the forms in (54). Since the presence of the high-tone prefix *a* is irrelevant to the processes leading to the formation of the rising tone on the stem, it has been omitted from consideration.[26]

(64) a. 

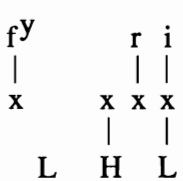
Underlying Representation

b. 

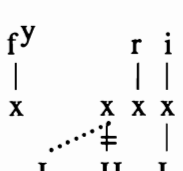
UAC
(on stem cycle)

c. 

UAC
(on stem + suffix cycle)

d. 

Vowel Elision (V1-deletion)
(on stem + suffix cycle)

e. 

L-Association (Rule 60)

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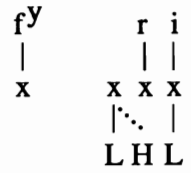
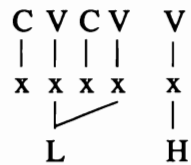
[26] On this prefix, see Pulleyblank [1986: 205-8] and Section 7.6. below.

f. 

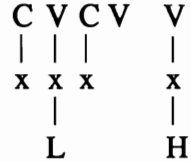
Rising-Tone Formation (Rule 2)

Derivation (64) is particularly interesting in that it involves an intermediate step with a trapped high tone between two anchored low tones (see 64e). This tonal configuration was sought earlier (see Section 5) in order to complement the example where Vowel Syncope yielded a trapped low tone between two anchored high tones and in effect produced a *rightward* shift of the trapped low tone. By contrast, as the phonetic output for the word *áfĩrì* indicates, a trapped high tone between two low tones is not shifted rightward; instead, as shown in (64f), Rising-Tone Formation (Rule 2) performs the required *leftward* linking. We can thus see that tones trapped inside words are associated in different directions depending on whether they are low or high; the generalization binding together these two opposite behaviors seems to be that the language normally allows the formation of rising tones, but not that of falling tones.[27] Derivation (64) is interesting for another reason: it shows that, contrary to Pulleyblank's suggestion [1986: 222], Rising-Tone Formation must not be constrained to occur only word-finally.

Words with the same suffixes as those involved in the canonical derivation (63), but with vowel-final stems having a multiply-attached low tone (e.g., *màlà*, *ɓàtsə̀*), will expectedly not end up carrying rising tones (*màlárì*, *ɓàtswá*) (see (36) above for further examples). The canonical derivation for such combinations is given in (65).

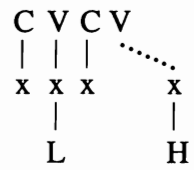
(65) a. 

Output of UAC and Tone-Spreading

b. 

Vowel Elision (V1-deletion)

[27] For the same conclusion under different circumstances, see Section 4 above. For the special cases allowing the creation of falling tones, see Section 8 below.

c. 

Result of Vowel Melody Association

Since Vowel Elision in (65b) does not trap the low tone (because of its multiple attachment), L-Association is not applicable; the following high tone is, consequently, neither delinked nor trapped. There is thus no reason for the formation of a rising tone.

In this section, I have shown that at the stem/suffix interface, tone sandhi under Vowel Elision (V1-deletion) follows from the operation of two processes, L-Association (Rule 60) and Rising-Tone Formation (Rule 2), which can be broadly viewed as rescuing trapped tones in Margi words. This analysis crucially rests on the distinction between multiply-linked and singly-linked tones, itself a consequence of the OCP and the concept of tone-spreading.

I turn finally to the four counterexamples to this account listed in (38) above and repeated here in (66).[28]

(66) a. *sə̀* *sárì* 'thing'
mír?ù *mír?wárì* 'porridge'

b. *vì?ì* *vì?yǎrì* 'night'
gòdò *gòdǒrì* 'a Hausa cloth'

The forms in (66b) behave as if, in defiance of the OCP, the final low tone on the stems was singly rather than multiply attached. This type of representation can be obtained without an OCP violation by assuming that the first vowel in these stems is extratonal. The low-tone lexical melody of the stems will thus associate to the last vowel only; in the definite forms, Vowel Elision (V1-deletion) will create a trapped low tone that will combine with the suffixal high tone to form the observed rising tone (through L-Association and Rising-Tone Formation). L-Default will eventually supply the initial vowel with a low tone in both the bare and suffixed forms. The presumed invisibility of the first syllable to tonal association might help explain why the LH melody appears on *vi?i* after the preposition *wú/ú*, as shown in (67a) (§420).

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28 The definite form *vì?yǎrì* comes from §74 in Hoffmann; it appears as *ví?yárì* in §56, which suggests that *vi?i* may also occur lexically as either toneless or high tone (cf. also *wàcì ví?ì* 'all night long' in §387).

(67)	a.	*vìʔì*	'night'	*ú vəʔí*	'in the night'	*vìʔyǎrì* (definite)
	b.	*làgə̀*	'way'	*wú lágə́*	'on the way'	*làgwárì* (definite)
	c.	*wàgə̀*	'afternoon'	*ú wàgə́*	'in the afternoon'	(definite not available)

According to Hoffmann, "*wú* influences the tone(s) of the following word in some cases, [_ _] becoming [˝ ˝] or [_ ˝]" (§420). Thus, as shown with *làgə̀* in (67b), the high tone of the preposition can apparently spread rightward onto a following complement, but skipping the invisible initial syllable in the case of *viʔi*. Noteworthy is the expected tonal contrast between the definite forms of these two stems: *vìʔyǎrì* with a rising tone versus *làgwárì* with level tones and the surface appearance of a low tone loss. Hoffmann's comment and the example in (67c) suggest further that *viʔi* is not an isolated case with an initial invisible syllable (the definite form for *wàgə̀* is not given by Hoffmann, but a rising tone is predicted).[29]

Regarding the forms in (66a), I would suggest that the two stems are exceptional in not allowing the morpheme *árì* to cliticize onto them, so that the type of phonological relation which obtains between them and *árì* is akin to that across words. Since rising tones are not formed across words (instead, low tones are eliminated in favor of high tones; see Section 7.7. below), the absence of a rising tone in the two definite forms *sárì* and *mírʔwárì* would follow from the exceptional lack of cliticization proposed. There is corroborative evidence in Hoffmann's grammar, at least in the case of *sə̀*, that this explanation is on the right track. From Hoffmann's observations, one can infer that the demonstrative morphemes *kə* 'this' (near), *ta* 'that' (far), and *na* 'that' (known) can appear either as clitics (§132) or as individual words (§134). When they occur as clitics, their tone is always low in their final form, except after *sə̀*, where their tone is always high. When they occur as individual words, their tone is always high. If it is true that the stem *sə̀* prohibits cliticization onto it, as just suggested to account for the definite form *sárì*, then the behavior of these demonstrative morphemes after *sə̀* is also explained: they must occur after *sə̀* in their full, rather than clitic, garb, i.e., with a high tone. Although I have not found in Hoffmann's grammar appropriate examples involving the other stem *mírʔù*, it seems reasonable to extend to it the solution motivated for *sə̀*. I view the anti-cliticization properties of these two stems as lexical idiosyncrasies.

7.6. Vowel-initial verbs. The conjugation of vowel-initial verbs provides additional evidence in favor of the rule of L-Association already proposed (see 60 above) and also for the postulation of a parallel rule of H-Association (see 72 below), as the trapped tones generated by prefixes losing their final vowel before

[29] The difficulty with this analysis is that the Peripherality Condition predicts the removal of the extratonality marking when *viʔi* or *wagə* combines with the preposition *ú*.

vowel-initial stems get transmitted to the stems in ways displaying the effects of the two rules. Before considering these cases of tone sandhi, however, we need to digress briefly in order to clarify how vowel sequences at the prefix/stem interface are resolved.

We have seen so far that in Margi, when two vowels come together, only one survives. This general process has been abundantly illustrated with instances where a vowel-initial suffix is added to a vowel-final noun or verb stem. With prefixes, the evidence is more restricted, because prefixes seem to occur only with verbs, and only a few verb stems begin in a vowel (§211). In addition, there are vowel quality distributional constraints at work: prefixes typically end in the vowel [a] and the first vowel in a vowel-initial verb can only be [i] or [u]. I provide examples of these morphemes in (68) and (69). Lexically, the prefixes in (68a) are low-tone, while those in (68b) have a high tone. The verbs in (69a) are lexically toneless, those in (69b) low-tone.

(68) Verbal prefixes

a. *à* conjunctive (§306-7)
gà narrative (§282-3)
ndà negative past (§286-7)

b. *á* morpheme used in the present, past, subjunctive, and exclusive I (§313-4, 321-5, 329-30, 333-4, 336-7)
ská exclusive II (§339-40)

(69) Vowel-initial verb stems (§211)

a. *iɗa* 'to rot'
ulə 'to see, to look'
ushi 'to stir'

b. *ìndà* 'to sit'
ùɗə 'to finish'
ùzà 'to hoe'
ùzhì 'to bend'

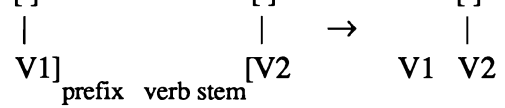
Although a single vowel position results at the interface between such morphemes, indicating that Vowel Elision has occurred, the vowel quality outcome is not what might be expected from the application of Vowel Melody Association, since the /a/ loses out to the high vowel melodies. Vowel Melody Association must somehow be barred from occurring at a prefix/stem interface.

Perhaps the most inviting account for this phenomenon is one based on Lexical Phonology's organization of grammar. As I shall argue shortly, the domain constituted by a "prefix + stem" combination must not be acted upon until the post-lexical phonology. If Vowel Melody Association were exclusively a lexical

rule, then when the post-lexical version of Vowel Elision applies to a "prefix + stem" combination, eliminating the vowel position of the prefixal /*a*/, the vowel melody /*a*/ would remain trapped and, thus, would not be realized phonetically. I have not been able to find in Hoffmann's grammar the crucial data to test this approach, namely vowel sequences such as /*e*+*a*/ and /*o*+*a*/ across words. The analysis restricting the operation of Vowel Melody Association to the lexicon would be justified if the outcome of such post-lexical concatenations were [a], but not if it were [e] and [o].[30]

An alternative approach is to posit a special rule of Vowel Melody Deletion deleting the final vowel of a prefix when it is adjacent to the initial vowel of a verb stem. This rule is formalized in (70), where [ ] represents vowel melodies (root nodes), and V1 and V2 represent vowel positions on the skeletal tier. For the sake of concreteness, I will use Rule (70) as a working assumption in the remainder of the paper.[31]

(70) Vowel Melody Deletion:



Note that when Vowel Melody Deletion and Vowel Elision are both applicable to a form, Vowel Melody Deletion, being the more specific rule, will automatically apply first (cf. Koutsoudas, Sanders, and Noll's [1974] Principle of Proper Inclusion Precedence). Vowel Elision will subsequently eliminate the first vowel position. The intrinsic ordering of Vowel Melody Deletion before Vowel Elision correctly avoids, in such derivations, the application of Vowel Melody Association, which is normally fed by Vowel Elision.

Whereas a final prefixal vowel melody /*a*/ is eliminated before vowel-initial verb stems, the tones which come to be associated with the vowel position for the /*a*/ are by contrast stable and end up on the verb stems, as we shall see. In fact, as Pulleyblank [1986: 205-8] has shown, prefixal tones may affect the tonal configurations found on verb stems even when these stems are consonant-initial. What is particularly interesting with vowel-initial verb stems is that the tonal impact of the prefix has more striking surface effects, derivable by the language-specific

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[30] This approach has interesting implications for the analysis of Margi /*ə*/ within Charm and Government Theory (see Sections 7.2.-7.4. and also note 24 above): Margi /*ə*/ would have to be viewed as an empty vowel position, rather than as the identity element, for otherwise /*ə*/ would win over a preceding vowel melody across words.

[31] Rule (70) is akin to the approach suggested by Maddieson [1987: 338-9], who assumes that vowel-initial verbs actually begin in /*yə*/ and /*wə*/ underlyingly, with prefixal /*a*/ deleting before a glide followed by /*ə*/ (/*yə*/ and /*wə*/ eventually yield [i] and [u]).

rules of L-Association and H-Association and bearing, in addition, on issues regarding the domain of phonological rules and the placement of default rules.

As already stated, Margi has only a few verb stems beginning with a vowel, such as the low-tone verb stem *ìndà* 'to sit' and the lexically toneless verb stem *ulə* 'to see, to look'. Hoffmann's list of about a dozen verbs in §211 and his examples in later paragraphs on Margi conjugation provide no cases of vowel-initial verb stems with a high tone.[32] Given these tonal restrictions on the available data, I shall focus on the cases where prefixes have a lexical high tone, since this is when the tonal influence of a prefix on a low-tone or toneless vowel-initial verb stem is visible (a low-tone prefix will be tonally neutral before such verb stems, since the resulting tonal sequences will only involve low tones). The prefixation of the high-tone morpheme *a* used for instance in the present tense will serve here as a representative illustration. Before consonant-initial verb stems, this prefix actually carries what Hoffmann calls "a contrast tone" (§313), which means that it has a high tone in front of a low-tone or rising-tone stem (e.g., *wì* 'to run' / present: *áwì*; *vǎl* 'to jump, to fly' / present: *ávǎl*) and a low tone in front of a high-tone stem (e.g., *sá* 'to err, to go astray'; present: *àsá*). When this prefix combines with lexically toneless stems, the resulting forms exhibit the same properties as those involving high-tone stems (e.g., *sa* 'to drink'; infinitive: *sà*; present: *àsá*). As already mentioned, with vowel-initial verb stems like (low-tone) *ìndà* and (toneless) *ulə*, the prefixal vowel deletes, but not without leaving a tonal mark on the verb form; thus, the present of *ìndà* is *índà* and the present of *ulə* is *ùlə́* (§313). I will show that the derivation of *índà* requires that the present prefix have a lexical high tone which becomes trapped and which, through H-Association (see 72 below), links to the verb stem's initial low-tone vowel, concurrently delinking its low tone. In the case of *ùlə́*, I will propose that the final high tone originated as the prefix's lexical high tone and that the initial low tone results from the application of L-Association (Rule 60) to a trapped low tone generated by L-Default on the vowel position of the prefixal vowel.

The behavior of the present prefix with vowel-initial verb stems offers striking support for Pulleyblank's [1986: 205-8] insightful treatment of the "polarity" behavior of the present prefix with consonant-initial verb stems. Pulleyblank analyzes this prefix as an extratonal high-tone morpheme, that is, as a morpheme with a lexical high tone, but whose tone-bearing element is unable to become associated with a tone until the phonetic level, where extratonality is lost by universal convention. The derivations of the three representative present forms *áwì* (from low-tone *wi* 'run'), *àsá* (from high-tone *sa* 'err'), and *àsá* (from toneless *sa* 'drink') are given in (73) below, following Pulleyblank [1986: 205-7].

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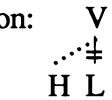
[32] The tonal pattern on the infinitive *ìndìdə́* 'to go across', given in §211, appears to involve a lexical LH tonal sequence, with at least some prelinking, but this stem is not used by Hoffmann to illustrate the conjugation of vowel-initial verbs; at any rate, one would surmise that it would behave like low-tone vowel-initial verb stems.

Floating H-Deletion (Rule 71), shown to apply in (73d), is a cyclic process which deletes (in mirror-image fashion) a floating high tone adjacent to another high tone [Pulleyblank 1986: 206-7, 209-13].[33]

(71) Floating H-Deletion: Floating H → Ø / H

The derivation in (74) below shows how I propose to derive the present form *índà* (from low-tone verb stem *inda*). This derivation, given in parallel with the derivation of the present form *áwì* (from low-tone verb stem *wi*), involves the additional application of the following rules: Tone-Spreading (see 74c), Vowel Melody Deletion and Vowel Elision (see 74f-g), and H-Association (Rule 72), a new rule parallel in form to L-Association.[34]

(72) H-Association:



While H-Association is parallel in form to L-Association, it differs from it with respect to its interaction with Rising-Tone Formation (Rule 2). Thus, we have seen that L-Association precedes (and feeds) Rising-Tone Formation. By contrast, H-Association must *not* precede (and bleed) Rising-Tone Formation. Derivation (64) above can serve to illustrate these relations: L-Association creates a trapped high tone between two anchored low tones (see 64e), and it is Rising-Tone Formation, not H-Association, which must apply to the output of L-Association (see 64f).[35] The discussion of other rule interactions follows derivation (75).

---

[33] The effect of this rule could alternatively be attributed to the OCP [see Pulleyblank 1986: 213; 235, note 12].

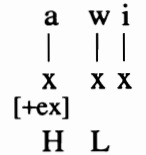
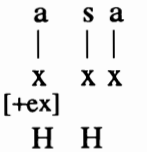
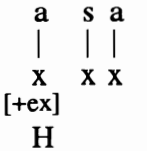
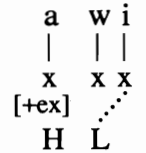
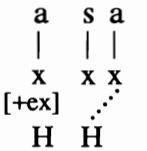
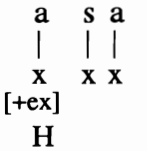
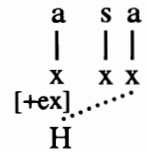
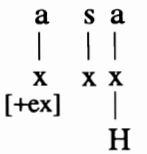
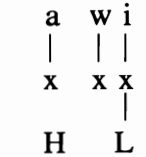
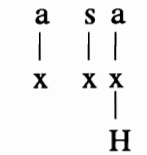
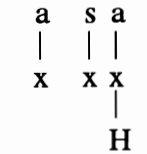
[34] A few examples in Hoffmann suggest that H-Association also applies across words under Vowel Elision (cf. *pád áfárì* 'the rain ceased', from *pádə́ àfárì* and *Íj áyə́* 'God wants', from *Íjə́ àyə́*; §38). However, in these cases, the high tone on the deleted vowel takes over even though the preceding vowel is also high tone. Perhaps the deletion of the vowel here is due to a late application of Vowel Elision, at a stage such as the phonetic level, where each vowel has presumably been specified for its individual tone. If this were not the case, Vowel Elision would delete a vowel position associated to a multiply-attached tone and would not create a trapped high tone; there would then be little motivation for the observed high-tone take-over, since there seems to be no general evidence in the language for a word-final linked high tone displacing a word-initial low tone. Vowel deletion in *pád áfárì* and *Íj áyə́* is clearly dependent upon speech rate, a typical characteristic of late phonetic processes (cf. Hoffmann, page xii and §38). See also note 37 below. For a discussion of the related issue raised by late phonetic rules of vowel deletion with respect to antigemination OCP effects, see McCarthy [1986: 249-53].

[35] The feeding relation between L-Association and Rising-Tone Formation corresponds to an unmarked ordering in any theory. As to Rising-Tone Formation and H-Association, their mutually bleeding relationship does not allow the selection of an unmarked ordering, but their order of application seems to follow naturally from the fact that Rising-Tone Formation must be restricted to

...continued on next page

The figures in (75) below provide the derivation of the present form *ùlɔ́* (from toneless verb stem *ulə*); it is given in parallel with the derivation of the present form *àsá* (from toneless verb stem *sa*), but with the additional application of Tone Spreading (see 75d), Vowel Melody Deletion (see 75g), Vowel Elision (see 75h), and L-Association (see 75i).

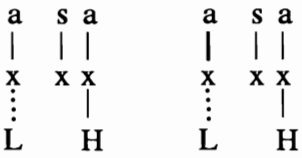
(73)

	I. *áwì*	II. *àsá*	III. *àsá*	
a.				Underlying Representations
b.				UAC (on stem cycle)
c.	N/A	N/A		UAC (on prefix + stem domain)
d.	N/A		N/A	Floating H-Deletion/ OCP
e.				Loss of extratonality

operate within morphemes up to the stem/suffix interface, whereas H-Association does not start applying until the prefix/stem interface (see also note 40 below).

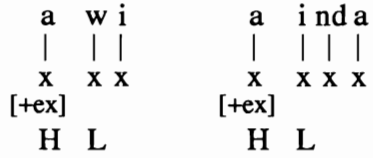
f. a w i — N/A — N/A — UAC

g. N/A — a s a — a s a — L-Default

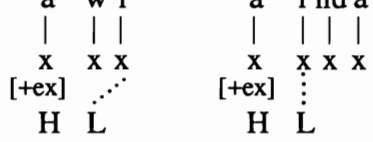


(74) I. *áwì* II. *índà*

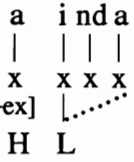
a. Underlying Representations



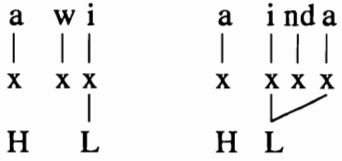
b. UAC (on stem cycle)



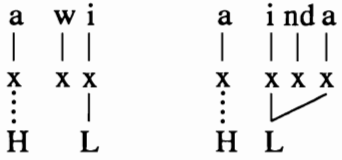
c. N/A — Tone-Spreading



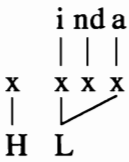
d. Loss of extratonality



e. UAC

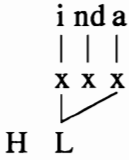


f. N/A



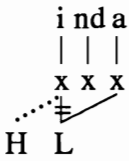
Vowel Melody Deletion

g. N/A



Vowel Elision

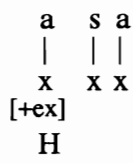
h. N/A

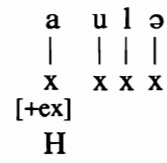


H-Association

(75) I. *àsá* II. *ùlɔ́*

a.



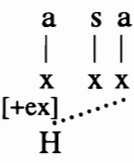


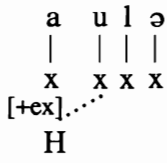
Underlying Representations

b. N/A N/A

UAC
(on stem cycle)

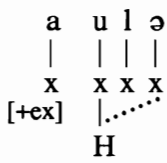
c.



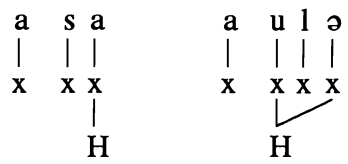


UAC
(on prefix + stem domain)

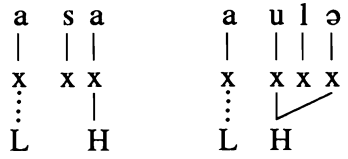
d. N/A



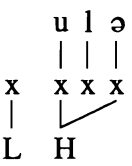
Tone-Spreading

e. 

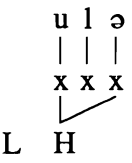
Loss of extratonality

f. 

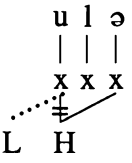
L-Default

g. N/A 

Vowel Melody Deletion

h. N/A 

Vowel Elision

i. N/A 

L-Association

Derivation (75) requires special comments regarding the placement of L-Default and the nature of the present prefix with respect to cyclicity. It is clear that L-Default must apply before Vowel Elision in this derivation, because there would otherwise be no vowel position to which a low tone could be assigned by default. The question is how to ensure this ordering without stipulation. We have already determined that Vowel Elision applies both lexically and post-lexically (see Section 6). What about L-Default? As concluded by Pulleyblank [1986: 142], "[i]n Margi, as in Tiv, default tones must not be assigned cyclically". If they were, then a derivation like that of *àsá* 'drink' in (73III) would go awry by having L-Default incorrectly place a low tone on the stem vowel in the stem

cycle.[36] Since L-Default cannot apply lexically, and since in derivation (75), it must apply before a rule (namely, Vowel Elision) which applies both lexically and post-lexically, the conclusion must be that the applications of both L-Default and Vowel Elision in (75) are post-lexical.[37]

We must still confront the problem of the ordering of L-Default and Vowel Elision, since a lexical application of Vowel Elision will necessarily precede the post-lexical application of L-Default. To ensure that the elimination of the prefixal vowel positions in the derivations of the present forms *índà* and *ùlɔ́* is due to a post-lexical application of Vowel Elision, it must be assumed that the "prefix + stem" domain found in (73), (74), and (75) does not constitute a cyclic domain. One way to encode this notion formally is simply to mark the present prefix as a non-cyclic affix (cf. Halle and Vergnaud [1987: 79-83]). As a result, the "prefix + stem" domain in (74) and (75) will not be subject to the lexical application of Vowel Elision, but it will be subject to its post-lexical application (Vowel Melody Deletion is also post-lexical). Now that the applications of both L-Default and Vowel Elision in (75) take place in the same (post-lexical) component, it remains to ensure that L-Default applies before Vowel Elision. This ordering does not in fact have to be stipulated. It follows from the general principle, articulated for example in Pulleyblank [1986: 136-40], that "[d]efault rules are ordered as early as possible in their component" (see also Archangeli and Pulleyblank [1986]).

Note finally that the application of L-Association in (75), as well as that of H-Association in (74), must be post-lexical, since they are fed by the post-lexical application of Vowel Elision. This result converges with earlier arguments for regarding L-Association as a post-lexical rule and reinforces the view that L-Association's high-tone delinking cannot follow from the rule's placement in the grammar (see Sections 5 and 7.5. above).

7.7. Vowel Elision and tone sandhi across words. I now come to the set of cases where the formation of a rising-tone does not occur under Vowel

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[36] The same argument could be made with the cases where toneless stems acquire their surface tones from a following lexically toned suffix on the "stem + suffix" cycle. For relevant derivations, see Pulleyblank [1986: 71-74].

[37] Note however that this analysis makes it apparently impossible to follow Pulleyblank's suggestion [1986: 206] that the loss of extratonality in (73e), (74d), and (75e) is due to a phonetic requirement; assuming that post-lexical L-Default is fed by the loss of extratonality, the latter must occur post-lexically in these derivations, i.e., earlier than the phonetic level. How the loss of extratonality is actually achieved in such cases is, therefore, a problem. An alternative approach would be to assume that, together with the loss of extratonality and L-Default, the non-lexical application of Vowel Elision is a phonetic-level operation (and that there is no post-lexical application of Vowel Elision, and thus, that a phonological rule may occur in non-adjacent components, contra Mohanan's tentative generalization [1986: 47] that "[t]he domain of a rule may not contain non-adjacent strata"). For some tonal evidence in favor of a phonetic-level application of Vowel Elision, see note 34 above.

Elision, even though all phonological conditions (see 34 and 35a above) are met. Three such situations were identified earlier: (i) in reduplication, (ii) across words, and (iii) in constructions with the genitive morpheme *á*. For convenience, I repeat in (76a-c) below the examples from (39-41). What happens in these cases is that the low tone loses out to the high tone instead of forming a rising tone with it. I propose that this result is due to the following: (i) the low tone and the high tone belong to two different words (see Constraint 35b above) and (ii) L-Association does not apply across words.

(76) a. Across constituents in reduplication:

ə́mhyà	'a small clay-dish'	>	*mhyímhyà*	'something like a clay-dish'
ə́mdlə̀	'nine'	>	*ə́mdlə́mdlə̀*	'nine each'

b. Across words:

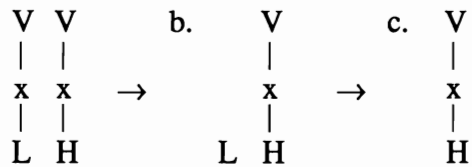
ə́mckà ə́skwàr	>	*ə́mcká skwàr*	'soup pot'
sà ə́ntàbà	>	*sá ntàbà*	'to smoke tobacco'

c. With the high-tone genitive morpheme *a* ("possessed + *á* + possessor"):

ŋwà + á + bzə́r	>	*ŋwá bzə́r*	'the boy's face'
mnyà + á + màlà	>	*mnyá màlà*	'the woman's mouth'
ʔyà + á + màmpə́lə́ŋù	>	*ʔyá màmpə́lə́ŋù*	'the hyena's thigh'
lì + á + Mádə̀	>	*lía Mádə̀*	'Madu's lip'
tsì + á + wù	>	*tsía wù*	'branch' (= "hand of tree")
hyì + á + Tlàmà	>	*hyá Tlàmà*	'Tlama's leg'

The figure in (77a) schematizes the relevant input configuration; that in (77b) represents the results of Vowel Elision and vowel melody loss (see Section 7.4 above); and (77c) reflects the surface phonetic facts.

(77)



The loss of the trapped low tone in (77) follows automatically provided L-Association does not apply to (77b): the tone remains trapped and, thus, fails to be realized phonetically. Given that the low tone in (77b) is word-final, the failure of L-Association to apply is exactly what is expected from our earlier investigation of Vowel Apocope (Section 4 above): Low tones trapped at the end of words by Vowel Apocope do not affect the tones of immediately following words; in other words, L-Association must not extend across words. In sum, as a word-internal rule, L-Association will apply within domains such as "stem +

suffix" (see 59 above) and "prefix + stem" (see 75 above), but not across the word-like constituents of reduplicated forms (see 76a) and between the members of a compound or between a verb and its object (see 76b).[38]

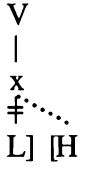
With respect to the genitive forms in (76c), I suggest (contra Hoffmann's analysis; §87) that the particle *á* is prefixed to the second word of the construction rather than suffixed to the first word, and that the relevant sandhi is, therefore, between the first word and the new constituent, thus across words, where L-Association does not operate. This type of constituent structure makes sense syntactically, since these genitive constructions seem parallel to noun phrase constructions like French *le visage du garçon* (literally 'the face of the boy'), which are traditionally analyzed as [NP + PP], and not as [[NP + P] [NP]]. Hoffmann's assumption that the particle *á* is suffixed to the first word leaves no explanation for why a rising tone does not occur in these examples (contrast for instance the genitive phrase *ŋwá bzə́r*, obtained from *ŋwà + á + bzə́r* 'face of boy', with the definite form for 'face', *ŋwărì*, obtained by suffixation of *árì* onto *ŋwà*; see 41-42 above).

An LH tonal sequence across words also reduces to a high tone under Vowel Syncope. I repeat in (78) relevant examples from Section 5 above.

(78) *wù + r + ə́sənì* > *wúr sənì* 'the tree Khaya senegalensis' (§40, 90)
màl + ə́sənì > *mál sənì* 'the oil of Khaya senegalensis' (§40, 86)

In these constructions, Vowel Syncope deletes the vowel position at the beginning of the last word, trapping a high tone in word-initial position. I propose a new tone-sandhi rule, H-Attachment, given in (79), to account for the high-tone take-over in such cases.[39]

(79) H-Attachment:



[38] An alternative explanation is available for the phrase *sà ə̀ntə̀bà* > *sá ntə̀bà* 'to smoke tobacco' (literally 'to drink tobacco'). Since the verb stem *sa* is lexically toneless (see Section 7.6) and since the noun *ə́ntə̀bà* is probably susceptible to Vowel Syncope on its initial vowel (see Section 5), the high tone transfer from the noun to the verb might be the result of the UAC (i.e., the noun's initial high tone, freed by Vowel Syncope, is automatically associated to the toneless vowel of the verb).

[39] Contrary to a reviewer's suggestion, it cannot be claimed that the vowels in *wu* 'tree' and *mal* 'oil' are lexically toneless and, therefore, available anchors for the high tone freed by Vowel Syncope through the UAC (cf. the treatment of *sà ə̀ntə̀bà* > *sá ntə̀bà* suggested in note 38 above). The fact that these two words have a *lexical* low tone is shown by the corresponding definite forms *wărì* (§75) and *màlárì* (§78), obtained by the suffixation of *árì*. If they were lexically toneless, one would expect **wárì* and **málárì* (see Section 7.1. above).

H-Attachment operates across words and links a word-initial trapped high tone to the final tone-bearing element in the preceding word, delinking its low tone. H-Attachment is similar to Rising-Tone Formation (Rule 2), in that both rules link a trapped high tone leftward; but they are considered independent, because Rising-Tone Formation is restricted to applying within words and does not cause delinking, whereas H-Attachment operates across words and does cause delinking. Note that H-Association (Rule 72) must not apply to the data in (78) (**wùr sánì*, **màl sánì*); this would follow from restricting the operation of H-Association to trapped high tones that are morpheme-final (in particular, when they occur at the end of a prefix; see derivation 74 above).[40]

Summary of Section 7 results:

(i) Vowel Elision consists in the deletion of the first vowel position in a sequence of two on the skeletal tier. This rule feeds the application of Vowel Melody Association, which accounts for the observed vowel melody loss accompanying Vowel Elision. The special yielding property of Margi /ə/ is explained by viewing this vowel as unspecified.

(ii) In "stem + suffix" combinations, Vowel Elision exhibits tone stability, as evidenced when the deleted vowel position carried a singly-attached low tone. The trapped low tone generated by Vowel Elision survives on the next vowel position, either alone as a level tone (when the following high tone is multiply attached), or as the first element of a rising tone (when the following high tone is singly attached). Two tonal processes combine to account for these two types of tone sandhi: L-Association (Rule 60) and Rising-Tone Formation (Rule 2).

(iii) In combinations involving vowel-final prefixes and vowel-initial verb stems, the preservation of the second vowel melody, rather than the first, results from the application of a special rule of Vowel Melody Deletion before Vowel Elision (or from some equivalent means of preventing the application of Vowel Melody Association after Vowel Elision). With prefixes whose final vowel position is high-tone but extratonal (e.g., the present tense marker), derivations are completed with either L-Association (Rule 60) or H-Association (Rule 72), depending on whether the verb stem is lexically toneless or low-tone. The operation of L-Association in such cases is particularly interesting because the low tone which undergoes L-Association has been generated by L-Default on the prefixal vowel's skeletal position and then trapped by Vowel Elision.

(iv) Verb prefixes such as the present tense marker are non-cyclic affixes. This stipulation preempts a lexical application of Vowel Elision in prefixed constructions in favor of a post-lexical one, thereby allowing the post-lexical rule of L-

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40 This added specification on H-Association would also formally resolve the question of its interaction with Rising-Tone Formation (see note 35 above) by making the two rules apply in non-competing circumstances.

Default to generate the low tone subsequently needed for the operation of L-Association.

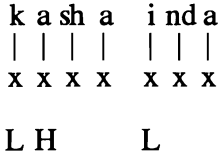
(v) At the prefix/stem interface and across words, HL and LH sequences (with either tone trapped) reduce to high tones. When the high tone is trapped, its survival at the expense of the anchored low tone is ensured by the application of H-Association (Rule 72) or H-Attachment (Rule 79). When the low tone is trapped, no universal principle or language-specific rule can rescue it, and it consequently receives no phonetic realization.

(vi) L-Association, Rising-Tone Formation, H-Association, and H-Attachment are all post-lexical rules. L-Association and Rising-Tone Formation apply word-internally, H-Association applies at the prefix/stem interface and across words (on morpheme-final high tones), and H-Attachment applies across words (on word-initial high tones).

8. Falling tones

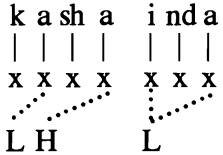
As already mentioned in Section 2, although "extremely rare", falling tones do occur in Margi, and it is the question of their status as lexical or derived elements which I address in this section. The falling tone which occurs in the construction *kàsh ìndà*! 'quick, sit (down)!' (from *kàshá* 'be quick' + *ìndà* 'sit'; §272) is clearly derived through the linking of a morpheme-final trapped high tone to a stem-initial low-tone vowel, as sketched in (80).

(80) a.



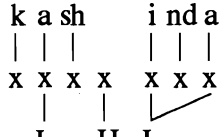
Underlying Representation

b.

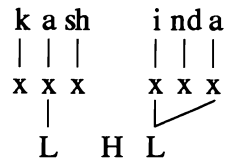


UAC and Tone-Spreading
(on each stem cycle)

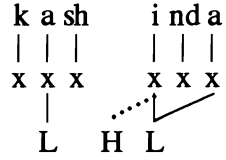
c.



Vowel Melody Deletion (Rule 70)
(post-lexically)

d. 

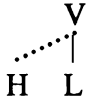
Vowel Elision
(post-lexically)

e. 

FallingTone Formation
(post-lexically)

Post-lexically, the word *kàshá* (taken in this construction as a type of prefix) undergoes the rules of Vowel Melody Deletion and Vowel Elision before the vowel-initial verb stem *ìndà* (see 80c-d), like the present prefix examined in Section 7.6. above. What is different about this "emphatic" imperative construction is that the (prefix-final) trapped high tone associates to the next morpheme's initial low-tone vowel without causing the low tone to delink (see 80e) (compare the present tense derivation in (74)). In other words, the tonal process required here cannot be H-Association (Rule 72), which delinks a low tone in the process of anchoring a trapped high tone. If H-Association applied in (80), the delinking of the (multiply-attached) low tone from the verb's initial vowel position would in effect "eliminate" the low tone which is part of the falling tone that must ultimately surface. A special rule of Falling-Tone Formation is, thus, required, limited to apply in "expressive" contexts such as the emphatic imperative.[41]

(81) Falling-Tone Formation: (in expressive contexts)



Potentially, Falling-Tone Formation competes with three other rules linking trapped high tones, Rising-Tone Formation (Rule 2), H-Association (Rule 72), and H-Attachment (Rule 79). It must preempt them to avoid the derivations of **kăsh ìndà* (through Rising-Tone Formation), **kàsh índà* (through H-Association), and **kásh ìndá* (through H-Attachment). The precedence of Falling-Tone

[41] A reviewer suggested the possibility of letting H-Association (Rule 72) perform the task of creating falling tones by not having it trigger delinking, and by adding a general process of low-tone delinking on falling tones that would be blocked in expressive contexts. This analysis faces two minor disadvantages: (i) As noted by the reviewer himself, the nouns *ghâghá* 'ibis' and *pâm* 'pound' mentioned below would have to be marked as exceptions to the new delinking process; (ii) The blocking of the new delinking process would require a negative condition on the rule (namely, "except in expressive contexts").

Formation over Rising-Tone Formation and H-Association follows from the Elsewhere Condition (Kiparsky [1982]; see also Koutsoudas , Sanders, and Noll's [1974] Principle of Proper Inclusion Precedence), since Falling-Tone Formation is more specific than either Rising-Tone Formation or H-Association (both rules lack the "expressive context" condition). Falling-Tone Formation is also more specific than H-Attachment, but the two rules do not actually compete for the same high tones anyway (H-Attachment only affects word-initial high tones).

In cases such as the suffix *êi* of emphatic vocative forms (§95), the sentence emphasizer *wâ* (§457), and a handful of interjections and greetings (e.g., *àsê*!; §460), the expressive character of the morphemes makes it tempting to assume that Falling-Tone Formation is also responsible for their falling tones. For the morpheme *wâ*, for example, the possibility of such a derivation would require Falling-Tone Formation to apply within as well as across morphemes and to allow a trapped low tone to be linked leftward to a high-tone vowel. I state in (82) the required generalized version of Falling-Tone Formation.

(82) Falling-Tone Formation (Generalized Version):
In an HL tonal sequence with one tone free and the other anchored, link the free tone to the vowel bearing the other tone (in "expressive" contexts).

It is important to emphasize again that the application of Rule (82) is restricted to "expressive" contexts. Recall for example that the study of Vowel Apocope (see Section 4 above) indicated that a word-final trapped low tone to the right of a high-tone vowel does not normally link to that vowel, but remains stranded and is phonetically unrealized. Similarly, in cases of Vowel Syncope (see Section 5 above), a low tone trapped between two high tones does not attach leftward to form a falling tone; it attaches rightward, delinking the high tone and subsequently forming a rising tone with it. Finally, derivation (64) (see Section 7.5. above) showed that a high tone trapped between two low tones does not attach rightward to form a falling tone; it attaches leftward to form a rising tone.

It is interesting to note that words like *wâ* and *àsê* have alternative pronunciations with a high tone instead of a falling tone (*wá*, *àsé*; §457, 460); such an alternative is not mentioned by Hoffmann for the emphatic imperative construction. This difference may indicate that the part of Rule (82) which attaches a trapped low tone to a high-tone vowel on its left does not apply obligatorily. This observation is congruent with a general pattern in Margi whereby trapped high tones are always rescued, whereas trapped low tones may be lost (see Section 9 below).

Finally, it should be pointed out that lexical falling tones appear necessary in order to account for at least two additional words, namely the nouns *ghâghá* 'ibis' and *pâm* 'pound sterling' (§34). The falling tones in these words are not a priori derivable from Falling-Tone Formation (Rule 82). *Ghâghá* is clearly formed by

CV-reduplication, perhaps of an onomatopeic nature; the tonal pattern might also be onomatopeic. The segmental and tonal structures of *pâm* identify the word as a borrowing from English "pound". In sum, independent characteristics such as onomatopeia and borrowing make these two words likely candidates for lexicalization, and it seems reasonable to assume that their tonal properties are fixed lexical patterns.

Summary of Section 8 results:

(i) I have proposed in this section that the falling tones of Margi which occur in emphatic imperatives be derived by a process of Falling-Tone Formation linking a prefix-final trapped high tone to a stem-initial low-tone vowel position in "expressive contexts" (Rule 81).

(ii) Falling tones appear to be lexical in the two nouns *ghâghá* and *pâm*, which are onomatopeic and borrowed items naturally subject to lexicalization. The falling tone which occurs in expressive morphemes such as the sentence emphasizer *wâ* might also be lexical, although it could be derived by assuming that the formation of a falling tone may also result from the (seemingly optional) association of a trapped low tone to a high-tone vowel position on its left (see 82).

9. Concluding Remarks

In this final section I recapitulate the main characteristics of the language-specific rules proposed in this study to account for Margi's phenomena of vowel deletion and tone sandhi.

Three types of "vowel deletion" have been analyzed as the loss of vowel positions on the skeletal tier; two processes, *Vowel Apocope* and *Vowel Syncope* affect vowel positions linked to high vowels. In Vowel Apocope, a morpheme-final vowel position is lost in a number of morphemes when they are not phrase-final; this process also applies optionally to other morphemes (e.g., the plural imperative suffix) regardless of their phrasal position (Section 4). Vowel Syncope consists in the optional loss of an interconsonantal vowel position (Section 5). The third process is *Vowel Elision*, the loss of a vowel position before an adjacent vowel position (Section 7). A fourth process of "vowel deletion", *Vowel Melody Deletion*, consists in the loss of a prefix-final vowel melody before a vowel-initial verb stem; within the overall treatment proposed for the reduction of vowel sequences in Margi, this rule specifically accounts for the stability of the initial vowel melody of vowel-initial verbs (cf. 74, 75, 80) (On possible alternatives to Vowel Melody Deletion, see Section 7.6).

All four rules of "vowel deletion" apply post-lexically. The sensitivity of Vowel Apocope to the position of words in phrases automatically classifies this process as post-lexical. Vowel Syncope is post-lexical because it applies in non-derived environments and also because it takes place across words. Although Vowel Elision applies in the lexical phonology (for example, on cyclic domains

such as "stem + suffix" combinations, it creates inputs for Reduplication; see Section 6), it must also occur post-lexically, since it applies across words. In addition, Vowel Elision must affect non-cyclic domains such as "prefix + stem" combinations in their post-lexical incarnation. Vowel Melody Deletion, which must be post-lexical for the same reason, is intrinsically ordered before the post-lexical application of Vowel Elision.

The elimination of vowel positions by Vowel Apocope, Vowel Syncope, and Vowel Elision may leave behind floating vowel melodies and floating tones. Floating vowel melodies do not occur when the application of Vowel Melody Deletion has preceded the elimination of a vowel position by Vowel Elision; they also do not occur if the vowel position subject to deletion is underlyingly assumed to be melodically empty (a possibility entertained for the representation of the vowel /ə/; see Sections 7.2.-7.4). Floating tones fail to occur in cases of multiple tonal attachments, i.e., when the tone anchored to the vowel position subject to deletion is also anchored to another, stable, vowel position.

When these floating elements cannot be anchored by means of the UAC, they are trapped. Their fate is then determined by *language-specific* processes of association. If these language-specific processes cannot apply either, the floating elements remain trapped and by *universal convention* fail to be realized phonetically. One vowel melody rule and five tonal rules have been identified to operate in the language-specific rescue of trapped elements. *Vowel Melody Association* saves specified vowel melodies by anchoring them to the next vowel position and delinking that position's melody (see Section 7.4, where alternatives are also considered). Vowel Melody Association saves vowel melodies trapped by Vowel Elision, not those trapped by Vowel Apocope or Vowel Syncope. This distinction follows from the Principle against the crossing of association lines [Goldsmith 1976] and the fact that there is no planar segregation between consonants and vowels in Margi.

The five rules which rescue trapped tones can be divided into two categories, depending on whether or not they create contour tones. Three attach trapped tones to an adjacent vowel position and simultaneously delink the tone borne by that vowel position. Two of these rules, *L-Association* (13/60) and *H-Association* (72) operate rightward, word-internally in the case of L-Association, and at the prefix/stem interface and across words in the case of H-Association. The third rule, *H-Attachment* (79), operates leftward across words. The remaining two tonal rules, *Rising-Tone Formation* (2) and *Falling-Tone Formation* (81) create contour tones word-internally by linking a trapped tone to a tone-bearing position without concurrent delinking. All five tonal rules apply post-lexically without any ordering stipulation.

The rescue of trapped tones in Margi is characterized by an interesting asymmetry between low and high tones. Excluding Falling-Tone Formation, which in its generalized form may link either tone, just one tonal rule saves trapped *low* tones (L-Association); the other tonal rules all affect trapped *high*

tones. As a consequence, trapped low tones often fail to be phonetically realized, whereas trapped high tones always survive. The overall language-specific "strategy" governing tone sandhi in Margi would, thus, appear to be geared toward saving high tones at all costs and low tones only accessorily.

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[Received June 1990;
accepted June 30, 1991;
revision received August 11, 1991]

Studies in African Linguistics
Volume 23, Number 2, 1992-1994

EPENTHESIS, MUTATION, AND STRUCTURE PRESERVATION IN THE SHONA CAUSATIVE

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In Shona (Bantu: Zimbabwe), the causative form of a verb is formed in one of two ways: either with the suffix *-is-/-es-* or by changing the root final consonant to a corresponding coronal continuant. The author argues for an analysis in which both forms are derived from a common underlying suffix /s/. The suffixal form is the result of an independently motivated process of epenthesis. The mutation, on the other hand, comes about by fusion of the /s/ with the preceding consonant. This fusion leads in some cases to feature combinations disallowed in Shona. The effects of mutation in these cases can be captured exploiting an active version of Kiparsky's Structure Preservation in terms of "persistent rules".

1. Introduction

In Shona, a Bantu language of Zimbabwe, the causative of a verb is formed in one of two ways. The more productive way is to add the verbal suffix *-is-* ~ *-es-*, as illustrated in (1) and (2), respectively.[1]

(1) a.	*-ɓika*	'cook'	*-ɓikisa*	'make (so.) cook'
b.	*-ɓátá*	'hold'	*-ɓátísá*	'cause (so.) to hold'

[1] The final *-a* in these and all other verbs cited is the unmarked inflectional suffix. It is replaced by *-e* in some marked inflections such as negative or subjunctive [Fortune 1982].

All forms are from the Zezuru dialect, spoken around Harare. Unless otherwise noted, examples and glosses are from Hannan [1984] and have been checked with Ms. Drusilla Chambati, a speaker of Zezuru Shona. Forms with a reference to Hannan [1984] were found in that work, but were not familiar to Ms. Chambati.

The abbreviations so. and sth. stand for someone and something, respectively.

(2) a. *-enda* 'go' *-endesa* 'make (so. or sth.) go'
b. *-téŋgá* 'buy' *-téŋgésá* 'sell'

The vowel of this suffix is subject to vowel harmony: it is [e] if the preceding vowel is mid, otherwise it is [i].

The second way of forming a causative involves changing the last consonant of the root, as in (3).

(3)	a.	k	→ ts:	*-seka*	'laugh'	*-setsa*	'cause X to laugh'
	b.	r	→ d̻z̻:	*-rira*	'make a sound'	*-riḏ̻za*	'cause X to make a sound'
	c.	t	→ ts:	*-neta*	'become tired'	*-netsa*	'make X tired'
	d.	nd	→ n̻z̻:	*-wanda*	'be numerous'	*-wanz̻a*	'make X numerous'
	e.	ŋg	→ n̻z̻:	*-téŋgá*	'buy'	*-tén̻zá*	'sell'
	f.	ɓ	→ d̻z̻ʏ:	*-reɓa*	'be long'	*-red̻z̻ʏa*	'lengthen'
	g.	ʊ	→ z̻ʏ:	*-ɲóróvá*	'be soft, moist'	*-ɲóróz̻ʏa*	'soften, moisten'
	h.	mb	→ n̻z̻ʏ:	*-vimba*	'be proud'	*-vin̻z̻ʏa*	'make X proud'

This change I refer to as the causative mutation.

The choice of causative type is an arbitrary lexical property of a given stem; there is no way to predict whether the causative of a stem will be formed with the productive causative or the consonant mutation. Indeed, some radicals take both allomorphs, in which case the mutation often indicates a more direct causation, e.g., *-kwíḏ̻zá* 'lift up' vs. *-kwírísá* 'make someone climb' (cf. *-kwírá* 'climb'). Another doublet is *-tén̻zá* in (3) vs. *-téŋgésá* in (2), both derived from *-téŋgá* 'buy' and both meaning 'sell'.

One observes that all the mutated consonants in (3) have in common an alveolar fricative articulation, a feature that distinguishes them from the corresponding unmutated form. It is striking that the consonant in the other causative form, as in (1) and (2), is also an alveolar fricative. In this paper, I will argue for an analysis that derives the two forms of the causative from a common underlying form.[2]

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[2] The basic idea here is due to Carter and Kahari [1979: 24]: "The vowel [in the causative suffix] is frequently omitted after *-t-*: *-net-s-* 'make tired, annoy' from *-net-* 'become tired'. In some cases the last consonant of the radical fuses with the causative ...". This is all they have to say about the matter, aside from giving a few examples of the mutation. But it is the same basic proposal as I am pursuing here, and quite different from the analysis given in Fortune [1955, 1982], according to which the causative mutation is triggered by an abstract reflex of Proto-Bantu *ŷ [Fortune 1955: 212]. The problem with this historically-based analysis when interpreted synchronically is that the putative *ŷ (Guthrie's *j̨) never surfaces in Shona and does not have palatalization effects, as it does in other Bantu languages (on which see Section 5 below).

(4) a. There is just one causative suffix /-s/, found both in the productive cases in (1) and (2), and in the mutation cases in (3).

b. This /-s/ can be fused with the preceding consonant to form a complex continuant, e.g., an affricate or prenasalized fricative. This is the mutation.

c. If this optional fusion does not take place, a productive rule of epenthesis results in the insertion of the default vowel [i]. This is the productive suffixation.

After establishing some representational assumptions in Section 1, I present in Section 2 an argument for the epenthesis of [i], posited in (4c). I then formulate the "fusion" posited in (4b), by which a sequence of a consonant and [s] are turned into a single complex continuant. I will argue that this one rule of fusion can derive all the causative mutation effects, provided that the notion of "structure preservation" [Kiparsky 1985] be interpreted in terms of "persistent rules" [Halle and Vergnaud 1987, Myers 1991]. In Section 5, I conclude with a look at the causative in other Bantu languages and the historical development of the Shona case.

2. The Consonants of Shona and their Representation

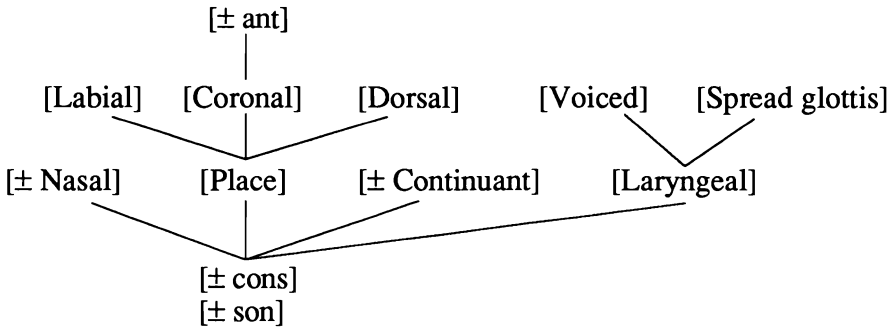
The (surface) consonant inventory of Shona is given in (5), asterisks indicating gaps.

(5)	Labial	Coronal	Labio-coronal	Alveo-palatal	Palatal	Velar	Laryngeal
a. Stops							
voiceless	p	t	*	*	*	k	*
voiced	ɓ	ɗ	*	*	*	*	*
murmur	b̤	d̤	*	*	*	g̈	*
prenasal	mb	nd	*	*	*	ŋg	*
b. Fricatives							
voiceless	f	s	sv	š	*	*	*
voiced	*	*	*	*	*	*	*
murmur	v̤	z̤	z̤v̤	ž̤	*	*	*
prenasal	mv̤	nz̤	nz̤v̤	*	*	*	*
c. Affricates							
voiceless	pf	ts	tsv	č	*	*	*
voiced	*	*	*	*	*	*	*
murmur	b̤v̤	d̤z̤	d̤z̤v̤	ǰ	*	*	*
prenasal	*	*	*	ɲǰ	*	*	*

	Labial	Coronal	Labio-coronal	Alveo-palatal	Palatal	Velar	Laryngeal
d. Sonorants							
nasal/vd	m	n	*	*	ɲ	ŋ	*
nasal/mur	m̥	n̥	*	*	*	*	*
liquid	ʋ	r	*	*	*	*	*
murmur	*	*	*	*	*	*	ɦ

In the representations of the consonants in (5), I assume the following set of hierarchically organized features, from McCarthy [1988].

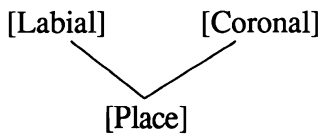
(6)



However, nothing in the analysis hinges crucially on the particular hierarchy chosen, and the main points would be unaffected if we assumed another model, e.g., that of Sagey [1986].

Among the places of articulation given in (5), the only one that might be unfamiliar is "labiocoronal". These are fricatives or affricates, produced with two simultaneous fricative occlusions: a bilabial one and an apico-alveopalatal one [Doke 1931: 87]. They are called "whistling" fricatives, and we represent them, as in the conventional orthography, with the digraphs *sv* and *zv*. It should be emphasized, however, that these are not sequences: the two articulations are simultaneous. They will be represented as complex segments with both labial and coronal specifications, as in (7).

(7)

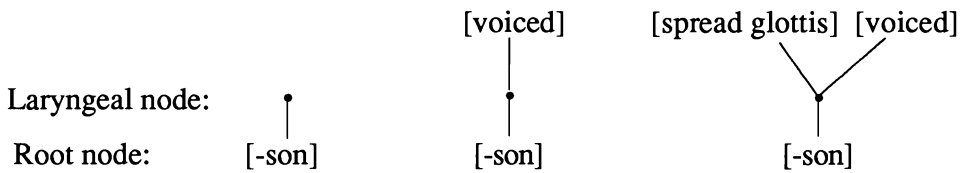


These segments are phonetically also [-anterior] (i.e., alveopalatal), but this specification plays no role in the phonology, and I will assume that it is introduced by a late default rule.

There is a three-way laryngeal distinction: voiceless, plain voiced, and murmur-voiced. The first two are as in English. The murmured consonants are characterized by breathy voicing and extremely low pitch (lower than low tone on a vowel); they are also known as "depressor" consonants.[3] We indicate murmur by a pair of subscript dots, as in *b̤* or *m̤*.[4] The murmured /ɦ̤/ is like English /h/ in that it has no intrinsic tongue position and simply takes over the articulation of the following vowel. It differs in that it is voiced and murmured.

Murmur will be represented by the combination of the privative laryngeal features [spread glottis] (i.e., breathiness) and [voiced] (cf. Lombardi [1991]). Voiceless obstruents, on the other hand, are unmarked. The laryngeal specifications for obstruents will thus be as in (8).

(8)



The plain-voiced implosive stops [ɓ] and [ɗ] appear frequently in native morphemes and alternate with plain-voiced explosive [b] and [d]. The plain voiced allophone appears when prenasalized or before a following [w], the implosive appears elsewhere, i.e., in the cases in which the stop is alone in the onset. These plain-voiced stops contrast with murmur-voiced [b̤] and [d̤], which appear mainly in loan morphemes and do not participate in any alternations.[5] I therefore represent the implosives as underlyingly plain-voiced, as in (8b), with implosion a redundant addition. They therefore differ underlyingly from the murmur-voiced stops only in that the latter bear the additional feature [spread glottis].

There is only one voiced velar plosive: the murmur-voiced [g̈]. But although this segment would be classed phonetically with the murmur-voiced [b̤] and [d̤], it patterns phonologically with the plain-voiced stops. It appears frequently in native morphemes and alternates with the plain-voiced [g] (e.g., when pre-

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[3] Pongweni [1981,1984] provides instrumental data on this distinction in Shona, and Traill et al. [1987] is an excellent instrumental study of the corresponding consonants in Zulu.

[4] The dots will be superscript in [g̈] to keep them visible. In the standard orthography, murmur is indicated by a digraph with *h*, e.g. *bh* or *mh*.

[5] For example, the voiced stops of English typically appear in Shona as murmured stops: (e.g., *b̤áz̤i* 'bus' or *d̤óra* 'dollar'.

nasalized). Therefore, I analyze it as underlyingly plain-voiced, its murmur specification added late in the derivation like the implosion specification of [ɓ] and [ɗ].

All voiced continuants are murmured. I will assume that they are underlyingly specified just as voiced, as in (8b), and that the redundant [spread glottis] specification is introduced by a late default rule.

To summarize, in the discussion that follows I will systematically ignore various redundant laryngeal specifications apparent in the surface forms: [constricted glottis] in implosives, and [spread glottis] in fricatives, affricates and velar stops. The relevant phonological classifications will thus be as in (9).

(9) a. No Laryngeal Specification (as in (8a)): voiceless obstruents.
b. Plain-Voiced (as in (8b)): /ɓ, ɗ, g̈/, voiced fricatives and affricates, plain-voiced sonorants.
c. Murmur-Voiced (as in (8c)): /b̤, d̤, m̤, n̤/.

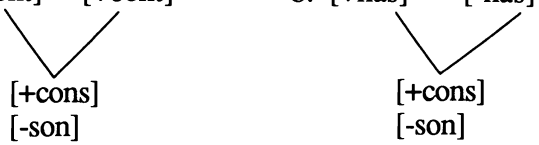
This rather abstract categorization corresponds to that underlying the orthography. Only the consonants in (9c) are written with the *h* indicating breathy-voicing (i.e., *bh*, *dh*, *mh*, *nh*); those in (9b) are written without *h* even when they are phonetically breathy-voiced (e.g., orthographic *z* and *g*).

More generally, I will assume a hypothesis of *contrastive underspecification*, according to which only redundant feature specifications are absent from underlying forms [Steriade 1987, Mester and Itô 1989]. Continuancy, for example, is contrastive for obstruents, but predictable for sonorants. We thus include a specification for [continuant] in the representation of any obstruent, but not in that of a sonorant. All place specifications will likewise be specified, except for the redundant [+anterior] specification of labiocoronals. Crucially, the analysis below cannot be made to work if one assumes a hypothesis of radical underspecification [Kiparsky 1981, Archangeli and Pulleyblank 1986], according to which only one value may be specified underlyingly for any given feature.

Following Sagey [1986], affricates and prenasalized segments are represented as contour segments, i.e., sequences of conflicting features connected to a single root node. An affricate is thus represented as in (10a), and a prenasalized segment as in (10b).[6]

[6] I will assume that, as in (9b), a prenasalized obstruent is [-son], i.e., that its major class features reflect those of its oral portion. This assumption proves useful below in the account of the prenasalization of /r/.

(10) a. [-cont] [+cont] b. [+nas] [-nas]



It is contour segments of these two sorts that are produced by causative mutation, and which are the key to the understanding of this process.

Finally, a note on notation. A line in a rule will indicate not association, but connection; two nodes A and B are connected iff they are dominated by the same root node. I assume this convention in order to avoid cluttering rules with predictable and irrelevant intervening nodes.

2. Epenthesis

As suggested above in (4), the productive causative *-is-* can be derived on the basis of an underlying suffix of the form /s/. All we need is a rule epenthesizing [i], and it turns out that such a process is independently motivated in Shona.[7]

The causative suffix has the form *-is-* or *-es-*, as shown in (1) and (2), respectively, when it has been suffixed to a verb radical. The causative is usually suffixed to a verb radical, and verb radicals are always consonant-final. But the causative can also be added to adjective stems, which always end in a vowel. In these cases, the *-s-* appears without a preceding *i/e* vowel, as in (11) (from Fortune [1982: 27]).

(11) a. *-pfúpi* 'short' *-pfúpí-s-á* 'shorten'
b. *-ɗúku* 'small' *-ɗúkú-s-á* 'make small'

The same pattern of V ~ Ø alternation is evident with the other verbal suffixes, as in (12) and (13).

(12) The neuter passive suffix: *-ik-* ~ *-ek-* ~*-k-*

a.	*-ɓik-a*	'cook'	*-ɓik-ik-a*	'be cookable'
	-vereŋg-a	'read'	*-vereŋg-ek-a*	'be readable'
b.	*páru*	'idph. of tearing'	*-párú-k-á*	'get torn'
	koche	'idph. of joining by hooking together'	*-koche-k-a*	'get joined by being hooked together'
	-pfúpi	'short'	*-pfúpí-k-á*	'be short'
	-tsvene	'pure'	*-tsvene-k-a*	'be pure'
	-kobvu	'thick'	*-kobvu-k-a*	'be thick'

[7] Watkins (1937) made a similar proposal for the Bantu language Chichewa, describing the vowels of the verbal suffixes as "connecting vowels" which are "determined on a purely phonetic basis" (p. 47).

(13) The applicative suffix: *-ir- ~ -er- ~ -r-*

a.	*-ɓik-a*	'cook'	*-ɓik-ir-a*	'cook for'
	-vereŋg-a	'read'	*-vereŋg-er-a*	'read for'
b.	*páru*	'idph. of tearing'	*-párú-r-á*	'tear'
	gaší	'idph. of receiving (esp. in hands)'	*-gaši-r-a*	'receive (esp. in hands)'
	ma-kókó	'pot scrapings'	*-kókó-r-á*	'scrape (a pot)'
	cha-púpu	'witness'	*-púpú-r-á*	'give evidence'

These suffixes, like the causative, appear in their vowel-initial form when they are suffixed to verb radicals, i.e., when they follow a consonant. But they appear without the vowel when they are suffixed to vowel-final adjectives, nouns or ideophones, as in (12b) and (13b).[8]

The passive morpheme shows the same alternation, but under somewhat different conditions.

(14) The passive suffix: *-iw- ~ -ew- ~ -w-*

a.	*-úráy-á*	'kill'	*-úráy-íw-á*	'be killed'
	-téy-á	'trap'	*-téy-éw-á*	'be trapped'
	-pfúw-á	'raise cattle'	*-pfúw-íw-á*	'be raised (cattle)'
b.	*-d-á*	'love'	*-d-íw-á*	'be loved'
	-p-á	'give'	*-p-íw-á*	'be given'
c.	*-ɓát-á*	'catch, hold'	*-ɓát-w-á*	'be caught, held'
	-vereŋg-a	'read'	*-vereŋg-w-a*	'be read'
	-ɓik-a	'cook'	*-ɓik-w-a*	'be cooked'
	-rip-a	'pay for'	*-rip-w-a*	'be paid for'

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[8] The examples in (11b) and (12b) are drawn from Fortune [1955, 1982]. Suffixation of extensions to ideophones (idph.) or substantives to make verbs is by no means straightforwardly productive. For a survey of the glitches and subgeneralizations, see Fortune [1982: 19-27].

A reviewer points out that with ideophone bases ending in *o* or *u*, it becomes difficult to distinguish the applicative and neuter passive suffixes from the reversive suffixes *-ur-/-or-* and *-uk-/-ok-*, as in *-namura* 'unseal' and *-namuka* 'get unsealed' (cf. *-nama* 'plaster, cover'). I have taken the hallmark of the reversive-*ur-* to be the interpretation "reverse the action of V-ing". The applicative *-r-*, on the other hand, adds an internal argument [Alsina and Mchombo 1989], which in the case of an ideophone (which takes no arguments), will just make the resulting verb transitive. Likewise the reversive *-uk-* means 'get un-V-ed', while the neuter passive *-k-* suppresses an external argument, resulting in an intransitive.

The reviewer also suggests that it might be that the ideophone was derived from the verb in these cases, by a process of subtractive morphology. This account would however have to explain why the consonant deleted from the verb to form the ideophone was always one of those associated with one of the verbal suffixes.

The vowel-initial form appears after a glide, as in (14a), or after a radical consisting just of a consonant, as in (14b). Otherwise it appears without the vowel, as in (14c).

We have a vowel-zero alternation and so could in principle posit either a vowel deletion or a vowel epenthesis. The quality of the alternating vowel is predictable, being either [e] or [i], depending on vowel harmony. Its position is also predictable, since it occurs only between consonants. The properties of the vowel are therefore redundant, and it should be omitted from underlying representation. This indicates that an epenthesis analysis is to be preferred.[9]

The epenthesis clearly depends on syllable structure. Syllables in Shona, as in many Bantu languages, are of the form (C)(w)V, i.e., they are all open and allow only a single consonant in the onset, or a sequence of a consonant and a glide. There are no consonant-final words and no consonant clusters except for Cw.[10] When a consonant cluster or word-final consonant appears in a loanword, a vowel is inserted to maintain the (C)(w)V syllable structure.

(15) a. *ápirikoti* 'apricot'
b. *sikurúḍiraiva* 'screwdriver'
c. *sitiróŋgo sitáfu* 'potent alcoholic drink (i.e., strong stuff)'[11]
d. *ḍiráikirína* 'dry cleaner'
e. *ḍirámu* 'drum (metal)'

The inserted vowel is generally [i], although one also finds [u] after velars or labials (15c,e), or a copy of a preceding or following vowel (15b,c). I will assume that what is inserted is an empty position, which is filled either by default rules as [i], or by processes of assimilatory spread from neighboring consonants or vowels.

The epenthesis in verb suffixes can be seen as another instance of the same pattern: the default vowel [i] is inserted to break up unsyllabifiable consonant clusters. In order to capture the relation between epenthesis and syllabifiability, I

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9 There is a process in Shona deleting vowels in hiatus in some morphological contexts, but it is always the *first* vowel that is lost: *nd-a-ɓíka* 'I cooked' vs. *ndi-nó-ɓika* 'I cook', *ḍz-ósé* 'all (cl 10)' vs. *i-ḍzi* 'these (cl. 10)' [Myers 1987: 220-261]. This deletion process thus cannot be responsible for the alternations in the verbal suffixes.

10 These sequences, orthographically represented by a consonant symbol followed by **w**, have often been interpreted as complex segments with a secondary labio-velar articulation [Doke 1931, Sagey 1986]. Recent instrumental studies by Ian Maddieson, however, indicate a clear succession of elements, with release of the consonant before the onset of the labio-velar articulation [Maddieson 1989]. I therefore follow Maddieson (and Myers 1987) in interpreting these sounds as clusters.

Depending on dialect, the velar portion of the cluster varies in degree of stricture from a stop to a semivowel. The sequence written **pw**, for example, can be pronounced [pk] or [px] or [pw] [Doke 1931].

11 This example is taken from a recent issue of the Shona newspaper *Kwayedza*.

adopt the approach of Halle and Vergnaud [1979], Selkirk [1981] and Itô [1989], according to which epenthesis is built into the syllabification process. When a sequence of segments is unsyllabifiable because it includes no segment that can stand as a nucleus, we can construct a "degenerate" syllable with an unfilled nucleus position. This position is then filled by the default vowel. This is illustrated in (16), a derivation of the causative stem *-ɓikisa* from (1a).

(16) a. -ɓ i k-s-a

b. σ σ σ
-ɓ i k - s - a

c. σ σ σ
-ɓ i k - i s - a

The underlying form in (16a) is syllabified as in (16b), with a degenerate syllable without nucleus erected over the otherwise unsyllabifiable [k]. The default vowel [i] is then inserted to fill the empty slot, yielding (16c).

The conditions on epenthesis are somewhat different for [w] because it has a special status in syllable structure: it is the only segment that can fit between a consonant and a vowel in the same syllable. The passive marker *-w-* can generally appear after a consonant-final radical without an epenthetic vowel because it can form a complex onset with almost any preceding consonant. The one exception is where the preceding consonant is a glide: there are no sequences of glides in Shona, so we must exclude such sequences as possible onsets, presumably by reference to sonority. A sequence of a glide followed by the passive *-w-* will therefore be unsyllabifiable without epenthesis.[12]

I conclude that the basic form of these verbal suffixes is monoconsonantal: causative /-s-/, applicative /-r-/, neuter /-k-/, and passive /-w-/.

3. Causative Mutation

We can now turn to the analysis of the causative mutation, summarized in (17). The radical-final consonants to the left of each arrow correspond to the mutated consonants to the right.

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[12] The vowel [i] is also inserted before monosyllabic stems, as in *iǧo* "wasp" (cf. *ne-ǧó* 'with a wasp', *ma-ǧo* 'wasps'), or *iḇẏá* 'leave!' (cf. *iḇẏa* 'to leave', *a-ḇẏá* 'he left').This *i* appears only before monosyllabic stems, and only if they are not preceded by any clitic or prefix in the same phonological word. In this case, we can say that epenthesis enforces the requirement that a phonological word have at least two syllables (i.e. one binary foot) [Myers 1987: 128-134].

I have no explanation as to why there must be epenthesis with monoconsonantal roots, as in *-píwá*, the passive of *-pá* 'give' in (14b). Certainly [pw] is a possible onset, as in the verb stem *-pwanya* 'crush', and it is possible to have a monosyllabic stem as in the active *-pá*. A reviewer suggests that the root could be analyzed as /pi/, with the vowel deleting before a vowel (cf. fn. 9) and surfacing elsewhere. The problem would be then to explain why all CV roots have [i] as the V, since all roots of this form take i/e in the passive.

(17)

t, k	→	ts	p	→	sv
r	→	d̤z̤	ɓ	→	d̤z̤v̤
nd, ŋg	→	nz̤	υ	→	z̤v̤
			mb	→	nz̤v̤

These are the only consonants for which there are attested examples of mutation. Asked for causatives of roots ending in other consonants, my consultant would only accept forms in *-is-* or *-es-*. Moreover, of the mutations in (17), the only fully productive ones are r → d̤z̤ and k → ts, which occur in hundreds of examples. In all other cases, the examples I give are all that I have been able to find.

Any of the consonants in (17) can be followed by the more productive causative with epenthetic vowel, as we see in (18).

(18)

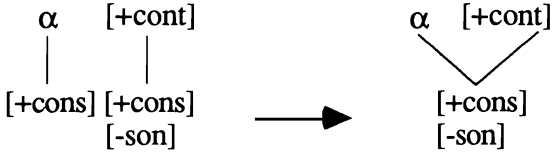
a.	*-ɓika* 'cook'	*-ɓikisa*	'make (so.) cook'
b.	*-ɓárá* 'bear offspring'	*-ɓárísá*	'impregnate'
c.	*-ɓáta* 'hold'	*-ɓátísá*	'cause (so.) to hold'
d.	*-enda* 'go'	*-endesa*	'make (so. or sth.) go'
e.	*-téŋgá* 'buy'	*-téŋgésá*	'sell'
f.	*-rapa* 'cure'	*-rapisa*	'help (so.) to cure or be cured'
g.	*-fámbá* 'move (intr.)'	*-fámbísá*	'deliver'

There is, then, no radical-final consonant that is incompatible with the epenthesis. Indeed, as we noted above, some radicals take both allomorphs, e.g., *-kwíd̤z̤á* 'lift up' vs. *-kwírísá* 'make someone climb' (cf. *-kwírá* 'climb'), or *-ténz̤á* 'sell' vs. *-téŋgésá* 'sell' (cf. *-téŋgá* 'buy'). There is no way to predict which causative form a given radical will occur with.

As I pointed out above, the one thing all the mutated forms have in common which distinguishes them from the corresponding unmutated forms is an alveolar fricative articulation, i.e., an [s] or [z] component. I have attributed this component to a causative suffix of the form /s/. There are two questions that must be answered, however, to make this analysis work. One, how does the sequence of a consonant and /s/ come to be a single complex consonant? Two, what is responsible for the other changes in the mutated as compared with the unmutated form: changes in place of articulation, degree of stricture and voicing?

In answer to the first question, I propose the following coalescence operation.

(19) Affrication



Affrication fuses a continuant with a preceding consonant by unifying the two root nodes of the successive consonants. If the preceding consonant is a stop, this will produce an affricate. Some such rule must be quite common cross-linguistically, to account for the rarity of a contrast between affricates and stop-fricative clusters.

The rule is optional; if it fails to apply, the unsyllabifiable [s] will trigger epenthesis, producing what we have called the productive causative. The rule only induces alternations within verb stems, so it must be a lexical rule. I follow Kiparsky [1982] in assuming that the output of each lexical cycle is stored in the lexicon, which allows the speaker to keep track of whether the rule applies with a particular root.[13] The lexical blocking effect [Aronoff 1976, Kiparsky 1982] will then account for the fact that a given root generally only has one causative form, and for the semantic differentiation of the few cases of causative doublets like *-kwídzá /-kwírísá*.[14]

Consider the simplest causative mutation, in which the sequence t + s is reorganized into the affricate [ts]. Instances of this alternation are given in (20).

(20) t ~ ts

-neta 'become tired'	*-netsa* 'bother, make (so.) tired'
-rótá 'dream'	*-rótsá* 'cause (so.) to dream'

[Fortune 1955: 212]

The cluster t + s cannot simply surface as a cluster, since Shona syllable structure does not allow such a cluster.[15] The derivation of the affricate would run as in (21).

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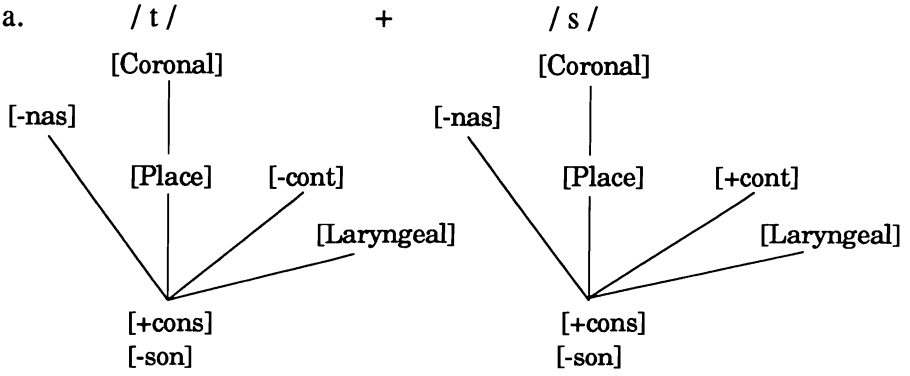
[13] An optional postlexical rule would of course have quite a different effect. Because the output of postlexical operations are not stored, an optional postlexical rule produces a pattern of free variation.

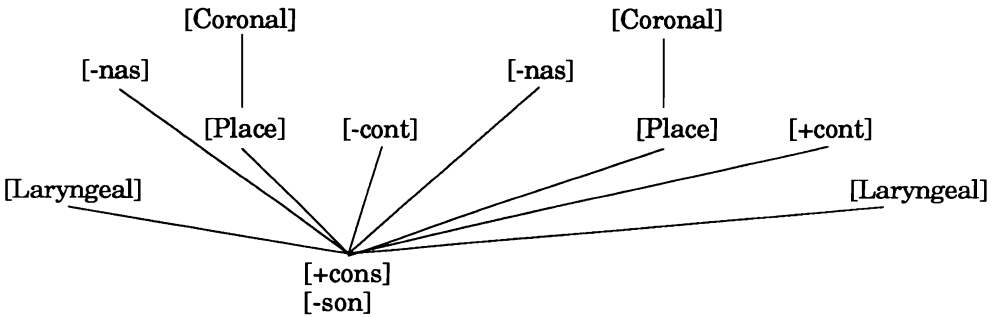
[14] Bastin [1986: 116] notes a similar pattern of semantic differentiation in causative doublets in a number of Bantu languages.

[15] The [ts] in these forms cannot be a heterosyllabic cluster because [t] cannot appear in a coda position, i.e., it never appears word-finally nor before any consonant but [s]. Nor can it be interpreted as an onset cluster, since then one would expect to find sequences of [t] followed by fricatives other than [s], or by more sonorous elements such as [r], [y], and [w] . We conclude that the orthographic *ts* in Shona is a monosegmental affricate. Similar arguments rule out a cluster analysis for the other affricates and the prenasalized segments.

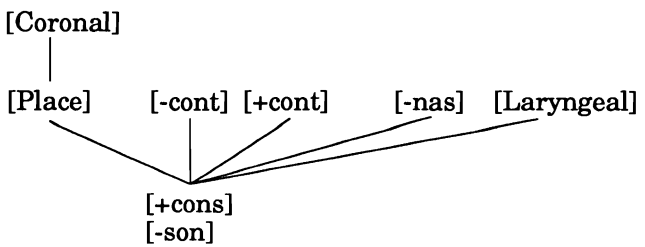
(21) a.



b. Affrication



c. Twin Sisters Convention



We begin, in (21a), with the sequence of the stem-final [t] of /net/ followed by the causative /s/. In the first step (21b), the root node of the continuant is unified with that of the preceding stop, creating an affricate, i.e., a sequence of [-cont] followed by [+cont] associated with the same root.

The representation is then pruned in (21c) by the Twin Sisters Convention [Clements and Keyser 1983: 95]: two identical specifications associated with the same element are converted to a single such specification.[16] According to this convention, for example, two high tones associated with the same tone-bearer never contrast with and never behave differently from a single high tone associated with a tone-bearer (e.g., Odden [1981: 211]). In (21b), we have two Place nodes associated with the same root node, so these are fused together into one. Then we have two Coronal nodes associated with the same Place node, so those are fused into one. The final result is (21c): a single affricate with a stop portion from the [t] and a fricative portion from the [s].

The most productive of all the causative mutations takes the sequence r + s and converts it into [d̻z̻]. Examples are given in (22).

(22) r ~ d̻z̻

-rira	'make a sound'	*-rid̻z̻a*	'cause (sth.) to make a sound'
-rárá	'lie down'	*-rád̻z̻á*	'bury'
-fára	'be happy'	*-fád̻z̻a*	'make (so.) happy'
-pérá	'come to an end'	*-péd̻z̻á*	'bring (sth.) to an end'
-y̻aira	'come to a boil'	*-y̻aid̻z̻a*	'bring to a boil'
-z̻árá	'be full'	*-z̻ád̻z̻á*	'fill'

The resulting affricate has the voicing of the first consonant, and the continuancy of the second, just as we would expect from our formulation of Affrication. But how does the sonorant [r] become an obstruent stop articulation within the affricate?

It should first be noted that the [r] in Shona in fact has a lot in common with [d]: they're both voiced, coronal consonants with closure at the alveolar ridge. All that distinguishes them is that the duration of that closure, which in the [r] is a mere tap or sequence of taps [Doke 1931: 72]. Moreover, [r] does alternate with [d] in another environment, namely after a nasal in a prenasalized segment:

(23)

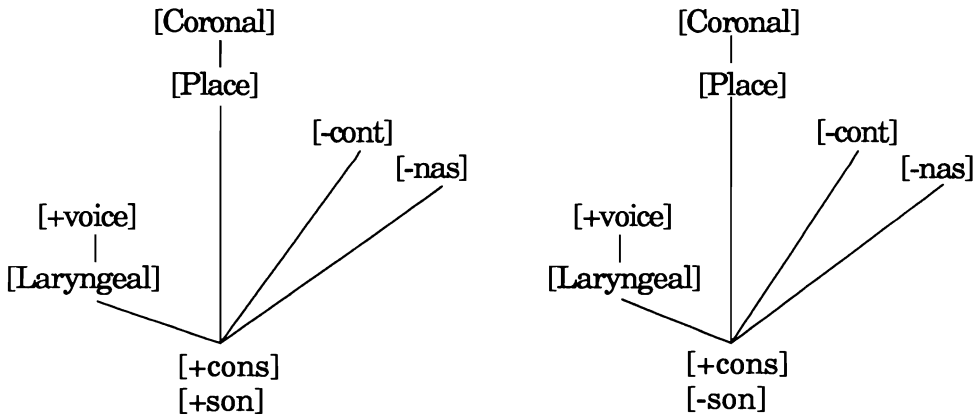
mu-refú	'long (1)'	*ndefú*	'long (9/10)'
-ramba kuúdzwá	'refuse to be told'	*ndambakuúdzwá*	'unruly person' (9/10)

In these examples, the class 9/10 marker /n/ has been juxtaposed with a stem beginning with [r], and the two consonants end up fused into a single prenasalized

16 This requires a slight generalization of Clements and Keyser's convention to include nodes as well as feature specifications, and the assumption that, for example, a Place node is identical with any other Place node. The convention, so interpreted, subsumes the Shared Feature Convention of Steriade [1982: 48] and the "no branching class nodes" convention of Sagey [1990: 50].

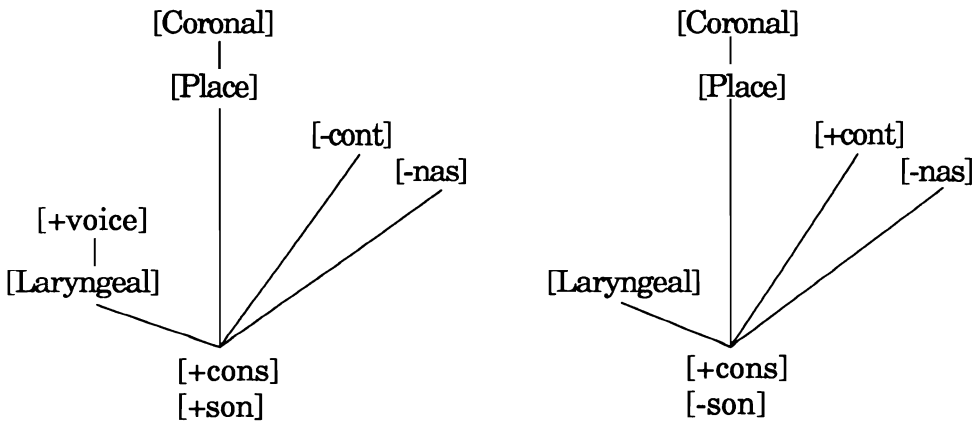
consonant [nd]. I therefore propose that [r] and [d] be distinguished only by the feature [sonorant], as in (24).

(24) a. [r] b. [d]

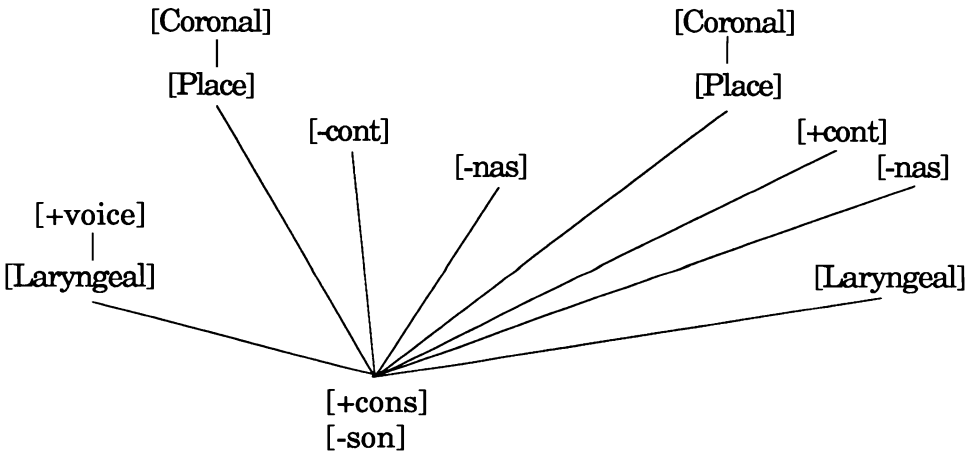


Now consider the application of Affrication to the sequence r + s. The root node of /r/, which is [+son], will be unified with that of /s/, which is [-son], raising a question of priority. All consonants resulting from the causative mutation are obstruents, so apparently it is always the [-son] of /s/ that "wins". I have encoded this into the Affrication rule by specifying the output as [-son]. In the case of r + s, the result will be that Affrication will have as a side effect the change of /r/ to [d], as in (25).

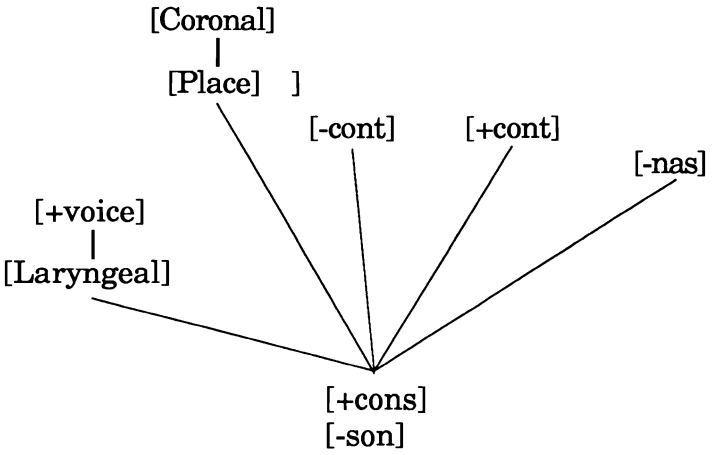
(25) a. /r/ + / s /



b. Affrication



c. Twin Sisters Convention



The input sequence is given in (25a). Affrication results in the single segment shown in (25b), which is pruned in accordance with the Twin Sisters Convention to yield (25c). This representation is voiced because the /r/ was voiced and the /s/ had no laryngeal specification. It is coronal and non-nasal because those are properties of both input segments. It has a stop portion from the /r/ and a fricative portion from the /s/. It is [-son] as a side-effect of Affrication. In short, it is the voiced alveolar affricate [d̬z̬].

4. Affrication and Structure Preservation

The other instances of the mutation are less trivial in that the mutated consonant is not merely the sum of the features of the unmutated consonant with those of /s/. The mutation of /k/ to the coronal affricate [ts], for example, involves a change in place of articulation as well as affrication.

In all such cases, as we will see, application of Affrication as formulated would produce a segment type that is not attested in Shona. Application of the rule to the sequence k + s, for example, would create a coronal-velar affricate, which is neither a phoneme of Shona nor a surface phone.

Causative mutation in Shona is structure-preserving, i.e., it produces no segment that is not a Shona phoneme. That this is the case is evident from a comparison of the mutated consonants (from (17), repeated here for ease of reference) with the set of [+continuant] phonemes, given in (26).

(17)

t, k	→	ts	p	→	sv
r	→	d̤z̤	ɓ	→	d̤z̤v̤
nd, ŋg	→	nz̤	υ	→	z̤v̤
			mb	→	nz̤v̤

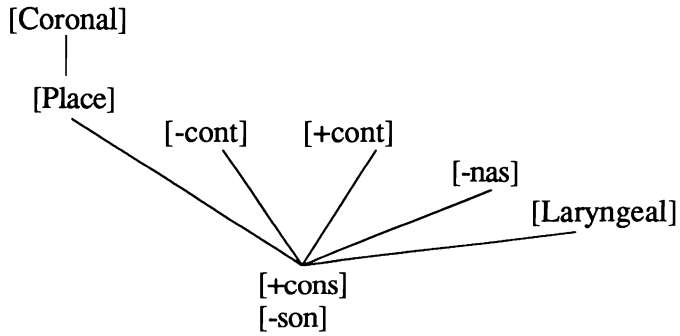
(26)

	Labial	Coronal	Labio-coronal	Alveo-palatal	Palatal	Velar	Laryngeal
a. Fricatives							
voiceless	f	s	sv	š	*	*	*
voiced	*	*	*	*	*	*	*
murmur	v̤	z̤	z̤v̤	ž̤	*	*	*
prenasal	mv̤	nz̤	nz̤v̤	*	*	*	*
b. Affricates							
voiceless	pf	ts	tsv	č	*	*	*
voiced	*	*	*	*	*	*	*
murmur	bv̤	d̤z̤	d̤z̤v̤	ǰ	*	*	*
prenasal	*	*	*	ɲǰ	*	*	*

It is clear that every one of the mutated consonants is also a member of the phoneme set given in (26), i.e., all of them appear in underlying forms independently of the mutation. Thus the mutation is structure-preserving in the sense of Kiparsky [1985]. I would suggest that this is a crucial property, and one that will allow us to account for the remaining mutations in (17).

Let us consider the restrictions on possible [+cont] segments in Shona. One striking property of the set (26) is the fact that it includes no dorsal consonants, neither velars or palatals. There are, then, no dorsal continuants in Shona,

d. Dorsal Rule (27b)



In (29a), we see the sequence *k* + *s*. Affrication produces (29b), in which two Place nodes are associated to the same Root node. The Twin Sisters Convention therefore applies, producing the representation (29c), which includes a connection between [Dorsal] and [+continuant]. This triggers the persistent rule (27b), which deletes [Dorsal], yielding (29d). This is a coronal segment with a sequence of [-cont] + [+cont], i.e., the desired coronal affricate [ts].

If, on the other hand, we used the filter (27a) to represent the lack of dorsal continuants in Shona, the filter would simply block Affrication, since application of that rule would create a representation violating the filter. The filter, then, incorrectly predicts that an affricate should not result from the sequence *k* + *s*. The persistent rule makes the right prediction in this case, because it allows the affricate to be formed, but then changes it to something that does not include a dorsal articulation.[19]

Another case of the same sort involves another gap in (26). That chart shows that while there is a contrast between fricatives and affricates in Shona (e.g., /s/ vs. /ts/, /f/ vs. /pf/), there is no such contrast in the prenasalized segments. The only prenasalized affricate is the alveopalatal /ɲǰ/, but there is no corresponding prenasalized fricative */ɲž/. On the other hand, there are prenasalized fricatives at the other places of articulation /mv̈, nz̈, nz̈v̈/, but no corresponding prenasalized affricates: */mbv̈, ndz̈, ndz̈v̈/. I will take the broad generalization to be that there are no prenasalized affricates in Shona, and will assume that there is a more particular rule governing alveopalatals which takes precedence over the broad generalization by the Elsewhere Condition of Kiparsky [1973]. However, because I have found no alternations involving the alveopalatals, I will not attempt to formulate this particular rule.

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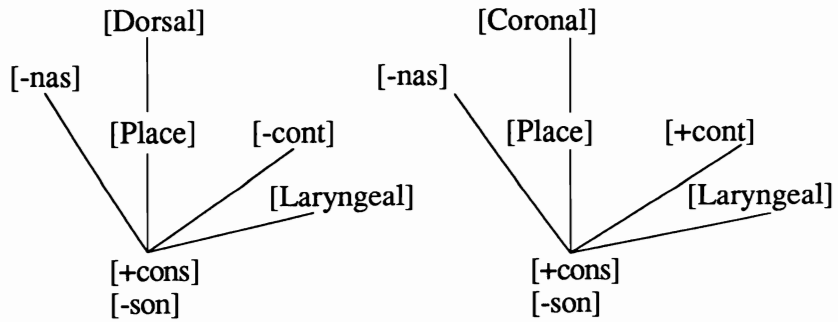
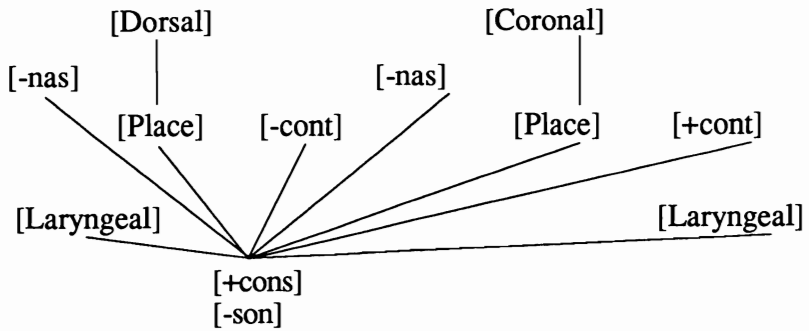
[19] In the Athapaskan language Slave a general process turning fricatives into affricates must, as in Shona, be prevented from creating a non-phonemic dorsal affricate. In Slave, however, it is the fricative component of the affricate which is sacrificed, not the dorsal articulation, so the result is the dorsal stop *g* [Rice 1987].

Assuming the persistent rule (27b), we derive these affricates straightforwardly as in (29).

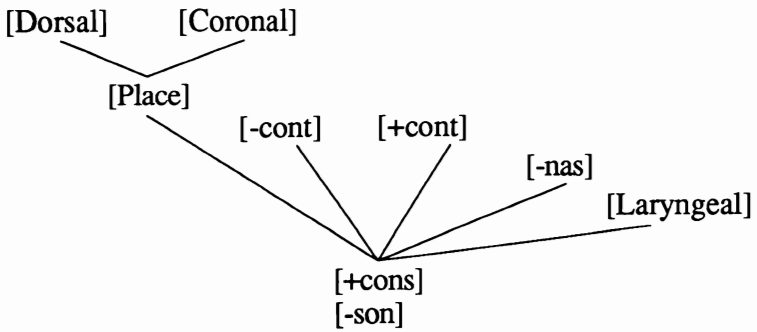
(29) a. / k / + / s /



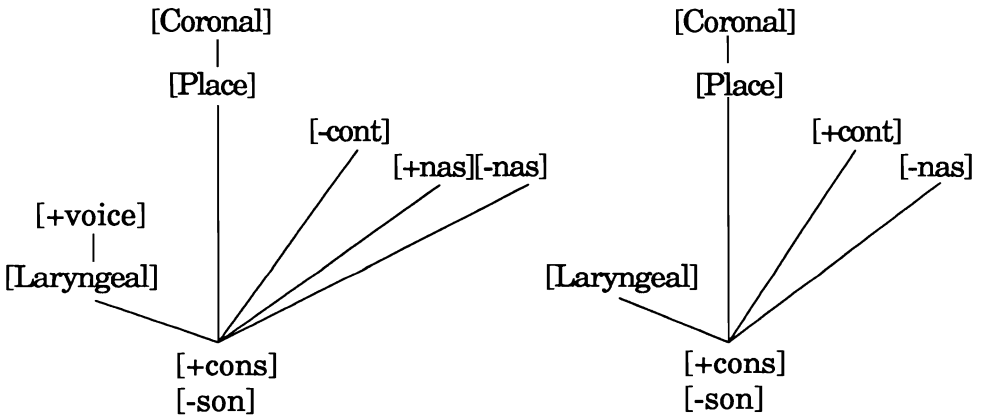
b. Affrication



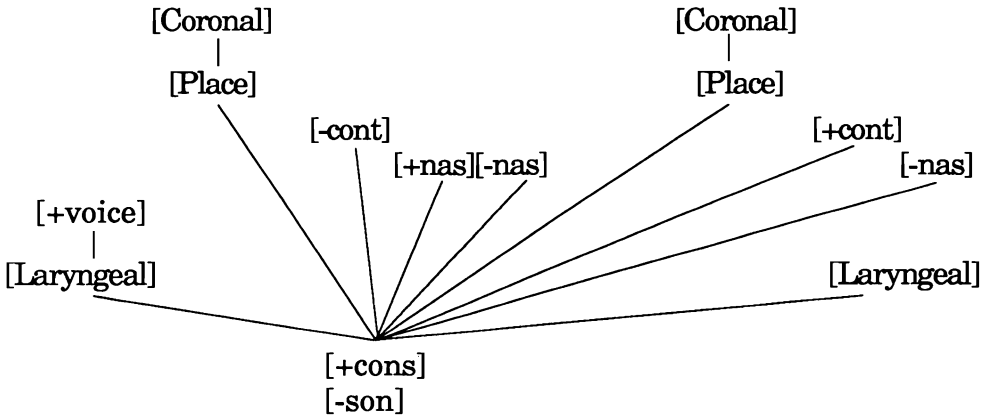
c. Twin Sisters Convention



(32) a. /nd/ /s/



b. Affrication



Assuming that the broad generalization is that there are no prenasalized affricates, we can state it either with the filter (30a), or the persistent rule (30b).[20]

(30) a. *[-cont] [+cont] b. Ø ← [-cont] [+cont]
[+nasal] [+nasal]

The filter simply says that prenasalized affricates are ill-formed, while the persistent rule (30b) says that they are always converted to prenasalized fricatives. Both would account for the fact that Shona lacks a contrast between prenasalized fricatives and prenasalized affricates.

But once again the causative mutations provide evidence favoring the persistent rule. The relevant alternations involve prenasalized radical-final consonants, as in (31).

(31) a. nd ~ nz̪

-wanda	'be numerous'	*-wanz̪a*	'make (sth.) numerous'
-pinda	'enter'	*-pinz̪a*	'cause (so. or sth.) to enter'
-óndá	'become thin'	*-ónz̪á*	'make (so. or sth.) thin'

b. ŋg ~ nz̪

-téŋgá	'buy'	*-ténz̪á*	'sell' (Hannan 1984: 642)
-péŋgá	'go mad'	*-pénz̪á*	'make (so.) go mad'

By our hypothesis, the mutated consonants in these cases are derived from a sequence of a prenasalized stop followed by the causative /s/. Assuming the persistent rule (30b), we derive the [nz̪] in (31a) as follows.

---

[20] I will assume that in a prenasalized segment, specifications for [continuant], [sonorant] and the laryngeal features are interpreted as specifications of the oral portion, not the nasal portion. A simple nasal, for example, is [-continuant], but a prenasalized fricative is [+continuant], and a sequence of [-continuant]-[+continuant] connected to nasal is interpreted as a prenasalized affricate. This interpretation might be language-particular; [+nas] connected to [+cont] could also quite plausibly be the representation of a nasal fricative, and one might wonder if the difference between that and a prenasalized fricative could be attributed to differences in low-level coordination of gestures.

The contrast between prenasalized fricatives and affricates is neutralized in most Bantu languages, usually in favor of the latter.

wrongly leads us to expect no mutation in this case, since the /s/ would not be fused with the preceding consonant.

Further motivation for the persistent rule (27b) comes from the Class 9/10 mutations (cf. (23) above). When the Class 9/10 marker is juxtaposed with a voiced affricate, the result is not a prenasalized affricate, but a prenasalized fricative.[21]

(33) a. *-bʋ̈úká* 'foretell' *mʋ̈úkó* 'presentiment (9)'
-bʋ̈uma 'allow' *mʋ̈umo* 'permission (9)'

b. *mu-dz̈ambíriŋgwa* 'creeper' *nz̈ambíriŋgwa* 'fruit of creeper (9)'

The derivation of the mutated consonant in these cases is just as in (32), except that the persistent rule (30b) is fed by Prenasalization, a fusion process analogous to Affrication which creates prenasalized segments from nasal + consonant sequences.

The remaining causative mutations all involve labial consonants (examples from Fortune [1982: 36]).

(34) a. p ~ sv
-tépá 'be thin' *-tésvá* 'make thin'

b. ɓ ~ dz̈ʋ̈
-reɓa 'be long' *-redz̈ʋ̈a* 'lengthen'

c. ʋ ~ z̈ʋ̈
-vává 'be bitter' *-vaz̈ʋ̈á* 'make (sth.) bitter'
-ɲóróvá 'be soft, moist' *-ɲóróz̈ʋ̈a* 'soften, moisten'

d. mb ~ nz̈ʋ̈
-vimba 'be proud' *-vinz̈ʋ̈a* 'make (so.) proud'

These are all the examples of this sort that I know of, so one would not want to base too much on them. But it is interesting that the analysis as it stands would account for all of these alternations except for that in (34a). As an example, I offer the following derivation of the mutated consonant in (34b).

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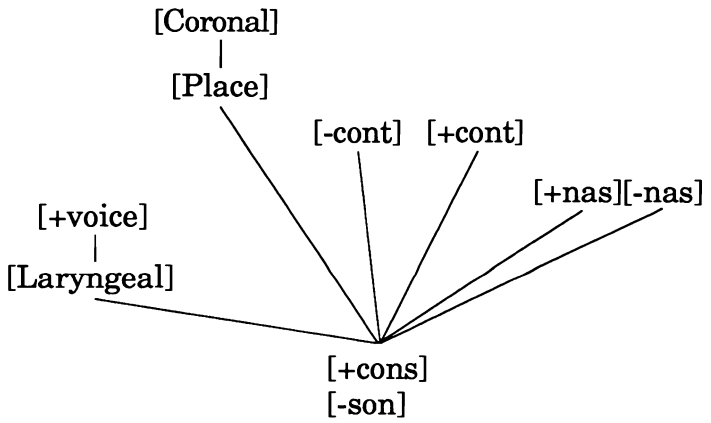
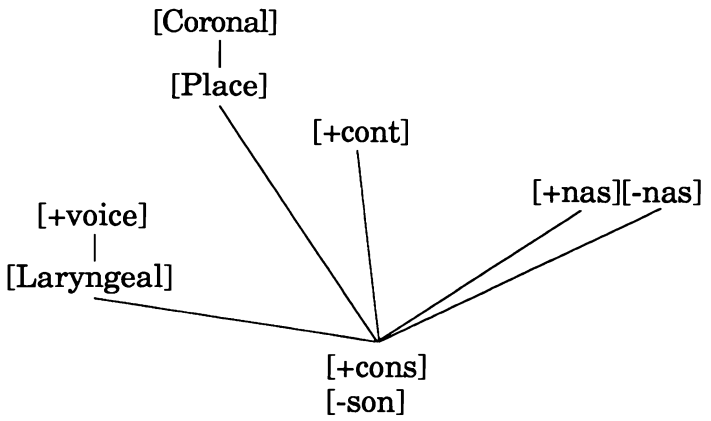
[21] Other words show another pattern according to which the Class 9/10 mutation of a voiced affricate is a voiced affricate. This can be expressed with a persistent rule like (30b) except that it deletes the nasal specification instead of the stop specification.

c. Twin Sisters Convention



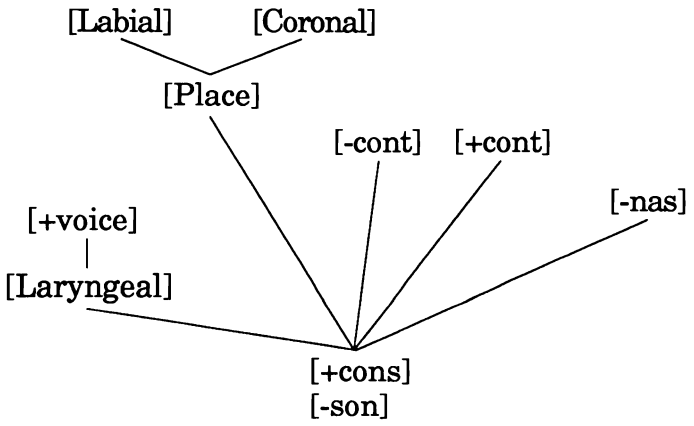
d. Persistent Rule (30b)



The representation in (32a) is the sequence nd + s, and that in (32b) is the result of Affrication. This representation includes the illicit feature combination of a prenasalized affricate, which is eliminated by the persistent rule (30b). Note that the mutated consonant inherits the voicing of the prenasalized stop, because the /s/ lacks any laryngeal specification. Voicing of the mutated consonant is, thus, always determined by the radical consonant, not the affixal /s/. The derivation from /ŋg/ to [nz̪], as in (31b), is the same, but with the additional application of (27b) to remove the dorsal place specification.

The filter makes the wrong predictions here. It predicts that Spirantization will be blocked because it would create an ill-formed prenasalized affricate. It thus

c. Twin Sisters Convention



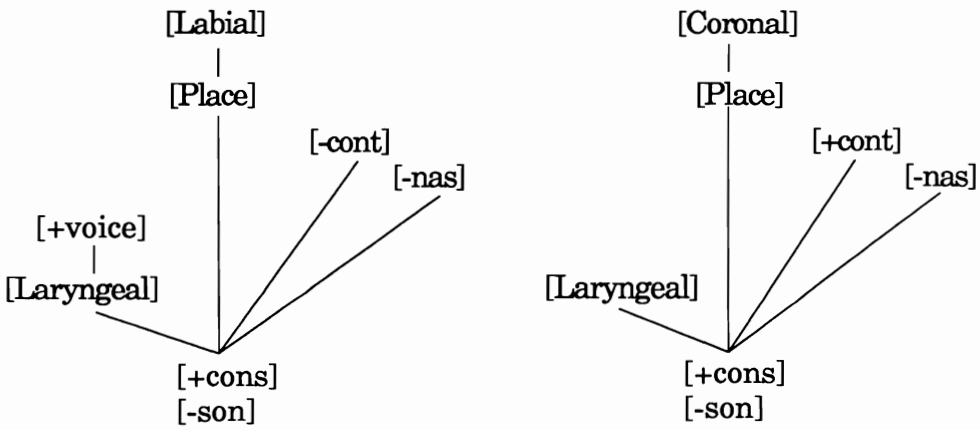
Affrication adds a coronal place of articulation and a continuant manner of articulation to a segment that has a labial stop articulation. But this combination of features is fine in Shona; the result is labiocoronal because it has both labial and coronal place specifications, and it is an affricate because it has both [-cont] and [+cont] specifications. The example (34c) differs in that both of the fused consonants are [+cont] in that case, while (34d) simply involves the additional step of eliminating the resulting prenasalized affricate by rule (30b). The example (34a), on the other hand, is anomalous, because we would expect the mutated consonant to be an affricate [tsv], by analogy with (34b).

We have now examined all the alternations associated with the Shona causative mutation. I have argued here that both the productive causative suffix *-is-* ~ *-es-* and the causative mutations are derived from a single causative suffix /-s-/. The vowel in the productive allomorph is due to a general rule of epenthesis that breaks up illicit consonant clusters. The mutations are due to the interaction of Affrication with the various persistent rules governing the Shona continuants. Affrication is optional, and when it doesn't apply, the unsyllabified /s/ triggers epenthesis.

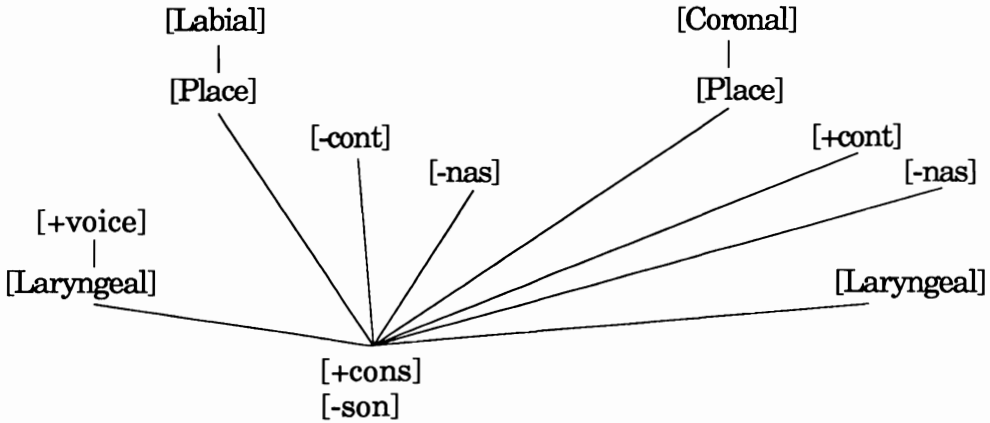
There are a number of advantages to this analysis. First, all the rules involved, except for Affrication itself, are independently motivated. The epenthesis rule is needed anyway for the other extensions, and for the other cases discussed in Section 2. Likewise, there must somewhere in the grammar be a specification of what continuants are allowed in Shona. If we formulate this specification in terms of persistent rules, then we also get the mutation effects by structure preservation.

Second, this account of mutation goes quite a ways toward explaining which consonants have mutated counterparts and which don't. It is notable, for example, that there are no mutated versions of any coronal continuants. If these were fused

(35) a. /b/ /s/



b. Affrication



Broselow and Niyondagara propose that the mutation is triggered by a causative marker /i/, which spreads a coronal specification to the preceding consonant.[23] In the case of velars, Broselow and Niyondagara [1990] note that the output of this assimilation would be palatalized velars (*kʸ ,*gʸ), which do not occur in Kirundi. They posit a rule of Dorsal Delinking which delinks the Dorsal node of the consonant, leaving just the Coronal node. This rule is straightforwardly interpretable as a persistent rule; it is indeed very similar in effect to our persistent rule (27b). The causative mutation can then be seen as a simple assimilation operation, the output of which is subjected to active operations expressing feature co-occurrence conditions, as in our analysis of the Shona case.

The Shona causative mutation supports the reconstruction of the mutation-inducing causative as *-i̯. The basic Proto-Bantu stop series, for example, remains unchanged in Shona, except before Proto-Bantu *i̯ [Guthrie 1971, vol. 2: 62]. Before *i̯ Shona consistently has coronal continuants, i.e., the segments that now arise in the consonant mutations.

(37) Correspondences before Proto-Bantu *i̯ [Guthrie 1967]

PB	Shona			PB root
b	z̪v̪	e.g., *-z̪v̪ar-*	'bear (child)'	*-bi̯ád-
d	d̪z̪	e.g., *-d̪z̪i*	'root'	*-di̯
g	z̪	e.g., *z̪íná*	'name'	*-gi̯na
p	sv	e.g., *-svik-*	'arrive'	*-pi̯k-
t	s	e.g., *u-síkú*	'night'	*-ti̯ku
k	ts	e.g., *mu-tsíndo*	'audible footstep'	*-ki̯ndɔ

The difference between Shona and other Bantu languages such as Kirundi is that in Shona there is no longer any *synchronic* motivation for positing a high front vocalic or semi-vocalic articulation in the mutation-inducing causative.

I would suggest that the innovation in Shona has to do with the absence in that language of the common Bantu process of palatalization, according to which CiV → CʸV. In Shona, there is simply deletion: CiV → CV.

(38) a. *nd-a-véreŋga*
1S-PST-read
'I read (earlier today)'

cf. *ndi-nó-vereŋga*
1S-HAB-read
'I read'

[23] Broselow and Niyondagara assume, following Clements [1976] and Mester and Ito [1989], that front vowels are coronal.

by Affrication with /s/, they would be unaffected, so there would be no mark of the causative suffix. Given that Affrication is optional, pragmatic considerations will favor the epenthetic version of the causative in these cases. Likewise, a plain nasal cannot be combined with a voiceless fricative such as /s/ in Shona, as is apparent from the Class 9/10 mutations. This then accounts for the fact that no plain nasal has a mutated counterpart. The murmur stops are generally restricted to borrowed radicals, and the mutation never seems to apply to those. There are no cases of mutation with /ɗ/, /ɠ/, or /ɲ̤/, but these consonants appear so rarely in radical-final position that this would not be a surprising accidental gap.[22] That leaves unexplained only the non-participation of the labial continuants.

5. Diachronic Development

It is quite common in the Bantu family for a language to have two forms of the causative: one a suffix corresponding to Shona *-is-/-es-* and the other a mutation. Guthrie [1967] traces the contrast back to Proto-Bantu. Bastin [1986] reconstructs the mutation-inducing suffix as *-i̱, and the other one as *-i̱ci̱, where i̱ is an extra-high (i.e., "tense") high vowel.

The reconstruction of the mutation-inducing suffix is uncontroversial. The original high front articulation is preserved in many languages as a secondary palatalization of some radical-final consonants. Consider, for instance, the following alternations in Kirundi [Broselow and Niyondagara 1991].

(36)

Unmutated		Mutated	Unmutated		Mutated
k	———	ts	g	———	dz
t	———	s/sh	r	———	dz/y
sh	———	sh	ǰ	———	ǰ
s	———	sh	β	———	vy
h	———	sh	m	———	my
			n	———	ny

In most cases the mutated consonant differs from the unmutated consonant in having a coronal articulation. In the case of m, β, and n, this is a secondary palatal articulation.

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[22] I conducted a search of Hannan [1984] for radicals of the form -CVɗ-a, -CVɠ-a, and -CVɲ̤-a, since -CVC-a is by far the most common structure for radicals, and most longer forms are constructed by addition of a set of (often lexicalized) suffixes that do not include ɗ, ɠ, and ɲ̤. In the 757 pages of the Shona-English dictionary, there were only 21 native Zezuru radicals of the form -CVɗ-a, 11 of the form -CVɠ-a, and none of the form -CVɲ̤-a (-ǰaɲ̤a 'gallop' is borrowed from Nguni).

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b. *t-ó-véreŋga*	cf. *ti-nó-vereŋga*
1P-EXCL-read	1P-HAB-read
'We are about to read'	'We read'
c. *č-otó* 'fireplace (Cl. 7)'	cf. *či-n̪u* 'thing (Cl. 7)'

The vowel [i] does not alternate with a secondary palatal articulation, as in other Bantu languages, and in fact there are no consonants with secondary palatal articulations.[24]

The loss of phonological palatalization and its effects (palatalized consonants and alternations with [i]) removed the motivation in Shona for positing any kind of palatal vowel or glide as the causative marker.[25] It became simpler at this point to analyze the causative as *-s-*, and this had the further advantage of allowing the two causative markers to be collapsed. The result was the current Shona pattern of causative formation.

6. Conclusion

I have argued that both forms of the Shona causative are derived from a single affix of the form /s/. When affixed to a vowel-final root, as in (11), this affix is realized simply as /s/. When affixed to a consonant-final root, however, an unsyllabifiable consonant cluster results. This is eliminated either through prosodically-motivated epenthesis or through fusion of the two consonants into one (Affrication).

Consonant mutation results from the interaction of Affrication with structure preservation. When Affrication would create a segment that does not occur in Shona, application of the rule does not simply block. Rather, the ill-formed segment is created and then transformed into something else by persistent rules. If structure preservation is stated in terms of persistent rules, it can capture the relation between the gaps in the segment inventory and the mutation alternations. This analysis therefore supports the position of Myers [1991] that language-particular restrictions on segment structure are better represented by active operations rather than passive filters.[26]

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[24] There are sounds that are represented in the standard orthography as *ty* and *dy* (e.g. *-tya* 'fear' and *-dya* 'eat'). But these are velarized, not palatalized: *ty* and *dy* being pronounced [čk], and [ǰg], respectively. These sounds or sound-sequences don't participate in any alternations in Shona.

[25] Here and elsewhere I use the term "palatalization" for any assimilation in the direction of a high frony articulation, whether this is instantiated as coronalization ($k \rightarrow s$ or $k \rightarrow ʃ$) or as the addition of a secondary palatal articulation ($k \rightarrow k^y$).

[26] This article was written and submitted before the advent of Optimality Theory [Prince and Smolensky 1993]. The active structure preservation effects described here can be expressed in that model by having the filters on feature co-occurrence dominating members of the PARSE family of constraints.

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[Received June 22, 1992;
revision received September 1, 1993;
accepted October 8, 1993]

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The book is divided into four sections. Papers in the first section (of which there are five), which is entitled "Conceptual Background", essentially address basic conceptual issues, such as "What is meant by the terms 'Africanism'?"and "What is the substratum and what is its influence?". The second section, comprising eight papers, is devoted to "African Influence and Creole Genesis". The third section, "Defending and Identifying African Substrate Influence", contains twelve papers ranging in content from the Ijo element in Berbice Dutch to the Africanness of counterlanguage among Afro-Americans. The final section, comprising two papers, offers "Some Historiographical Notes".

Studies in African Linguistics
Volume 23, Number 2, 1992-1994

PUBLICATIONS RECEIVED

Antonia Yétúndé Fọlárìn Schleicher. *Jẹ́ K'á Sọ Yorùbá*. New Haven and London: Yale University Press. 1993. Pp. xv, 341. $30.00 (text) [softcover], $20.00 (audio).

This textbook for the study of Yoruba contains a preliminary lesson on social interaction followed by 18 lessons focused around different topics. Each of these lessons is divided into the several parts: a monologue, a discussion of selected grammar points (with exercises), a dialogue, a discussion of a custom or aspect of Yoruba culture, and a discussion of pronunciation and tones. Appendices include tables of the sounds, pronouns, verb tenses, the verb "be", and numbers. The book includes a two-way vocabulary list and a grammatical list. A set of two audio tapes to accompany the book is also available.

Salikoko S. Mufwene and Lioba Moshi (eds.). *Topics in African Linguistics*. Amsterdam/Philadelphia: John Benjamins Publishing Company. 1993. Pp. x, 307. Hfl. 130.00/$72.00 [hardcover].

This book contains a selection of papers from the 21st Annual Conference on African Linguistics, which was held at the University of Georgia, April 1990. Part I (6 papers) focuses on the morphosyntax of verbs and verb phrases in Bantu, Ewe, Yoruba, and Gbaya 'Bodoe. The four papers in Part II address semantic issues in Krahn, Luo, Kivunjo-Chaga, and Emai. Two papers on the phonology of Chiyao and Manding comprise Part III. And the four papers of Part IV address issues of language contact.

Salikoko S. Mufwene (ed.). *Africanisms in Afro-American Language Varieties*. Athens, Georgia and London: The University of Georgia Press. 1993. Pp. 512. $40.00 [hardcover].

[From the Editor's introduction]: "The papers published in this book are revisions of those presented at the International Round Table on Africanisms in Afro-American Language Varieties, sponsored by the National Science Foundation ... and hosted by this editor at the University of Georgia during February 25-27, 1988. The term "Afro-American" was borrowed from Alleyne (1980) as a cover term for the creoles and semicreoles that have emerged in the New World since the seventeenth century out of the contact of Africans with speakers of the European languages from which the bulk of their vocabularies has been selected, at least in form. As used here, the term is in no way restricted to North America; it covers as much the American Black English vernacular (BEV) and Gullah as those typologically, if not genetically, related varieties spoken in the Bahamas, the Caribbean, and Central and South America."

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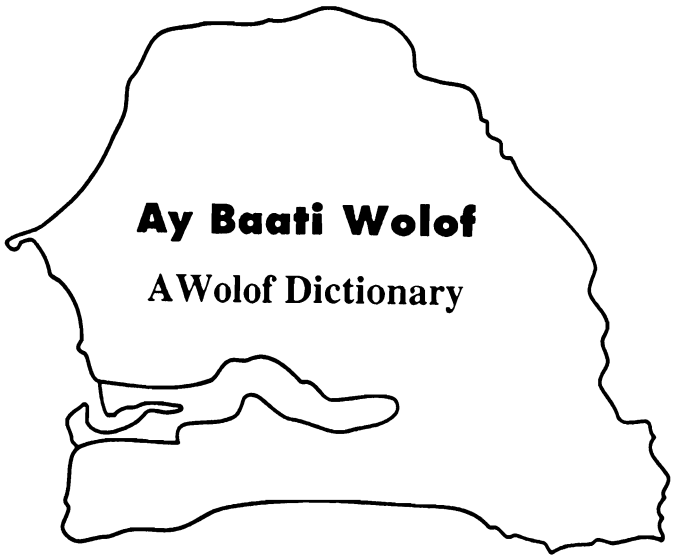

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