ALTERNATE PHONOLOGIES AND MORPHOLDGIES
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## ALTERNATE PHONOLOGIES AND MORPHOLOGIES

## ABSTRACT

This thesis investigates two types of alternate languages: LUDLINGS (also known as language games, speech disguises, etc.), which involve primarily nonconcatenative morphological manipulation of their source languages, and SURRDGATE LANGLAGES, which substitute alternative soundproducing mechanisms (whistling or a musical instrument) for the larynx.

Chapter 2 explores the autonomy of surrogate systems in relation to both their own modalities and their source language phonologies. After presenting a formal analysis of Akan drum speech, I develop a complete model of the surrogate component. I argue that many properties which distinguish whistle surrogates from instrumental surrogates can only be attributed to the modular organization of this component. The last part of the chapter provides an inventory of the types of processes present in each module of the surrogate component.

Chapter 3 presents theoretical treatments of representatives of each of the three major categories of ludlings (templatic, infixing, and reversing), beginning with the katajjait (throat games) of the Canadian Inuit. Although customarily regarded as a form of music, the katajjait are actually a welldeveloped form of templatic ludling. The implications of an infixing ludling in Tigrinya for tiered and planar geometry are then investigated. The chapter concludes with a detailed analysis of reversing ludlings, based on a parametrized version of the Crossing Constraint.

In Chapter 4 I develop an integrated model of alternate linguistic systems, starting with an investigation of where in the grammar the ludling component is located. Drawing on data from more than fifty languages, I
propose that there are three conversion modules in this component, each taking a well-defined level of representation as its input. In the last portion of the chapter I explore the possibility that one or more of these modules overlaps with the last module of the surrogate component. I conclude that the similarities exhibited by ludlings and surrogates are not due to a shared conversion module, but rather reflect the interaction of three factors: 1) the salience of certain levels of representation within the grammar; 2) general properties of the domains in which conversion takes place; and 3) membership in a common alternate linguistic component.

## alternate phonologies and horphologies

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LIST OF ABEREVIATIONS

AL Association Line
ASL. American Sign Language
BHA Bedouin Hijazi Arabic
CC Crossing Constraint
CSP Classical Structure Preservation
CSPR The Content and Structure of Phonological Representations (Archangeli and Pulleyblank 1986)

DSP Derivational Structure Preservation
EC Elsewhere Condition
EVF Echo Vowel Formation (Kekchi)
FG Final Gemination (Finnish)
FR a Fronting and Raising (Mandarin)
GI Geminate Integrity
GLI Glide Insertion (Cuna)
GS Glide Spreading (Mandarin)
MPH Morpheme Plane Hypothesis
NA Nasal Assimilation (Cuna)

NL non-ludling/normal language
0CP Obligatory Contour Principle
OR Dnset Reduction (Mandarin)
P1 rules of external sandhi (Kaisse 1985)
P2 fast speech rules (Kaisse 1985)
PC Plane Conflation
PCI Principle of the Categorial Invisibility of Function Words
PMO Principle of Morphological Dpacity
PDSP Point-of-Origin Structure Preservation
RR Rime Reduction (Mandarin)

RSP Revised Structure Preservation
SP Structure Preservation
TN Tone Neutralization (Thai)
TSS Trisyllabic Shortening (English)
UG Universal Grammar

- VS Vowel Shortening (Thai)

VW Velar Weakening (Cuna)

```
I am the only one who is insane
The one who sees with tangent focused eyes
and it is not their fault
if I walk in the rain
or sit in a cave
eating raw meat
and singing
discordant songs
```

```
--Anne Cameron, 'I Watch the Ghosts of My Brothers',
    The Annie Poems, 1987
```

for Andat,
gracious wanderer

Chapter One: INTRODUCTION

## 0. Introduction

Within the phonological and morphological systems of most, if not all, languages there exist what may be broadly called 'alternate' phonologies and morphologies. These are variant linguistic domains occurring alongside ordinary spoken languages, characterized by systematic manipulation of the phonological and/or morphological structure of the normal spoken language they are based on. This thesis is devoted to the investigation of two important types of such alternate languages: LUDLINGS (also known as language games, speech disguises, secret languages, etc.), which involve primarily nonconcatenative morphological manipulation, and SURRDGATE LANGUAGES, which involve substitution of an alternative sound-producing mechanism (whistling or a musical instrument) for the larynx in the articulation of spoken language, along with various other phonological modifications.

Although very widespread, alternate linguistic systems such as ludings and surrogates have typically been consigned to a somewhat peripheral role in linguistic theory as 'external evidence'. This is unfortunate, since the full potential of these systems to enrich our understanding of the organization of the phonological component is not being realized. The goal of this thesis is essentially to 'mainstream' these systems, bringing them under the rigorous theoretical scrutiny offered by current nonlinear models
of phonology and a modularized, level-ordered conception of the interaction between morphology, phonology, and syntax. Three crucial issues in the analysis of alternate language will be at the core of this dissertation:
a) What formal characteristics set alternate phonological and morphological systems apart from ordinary languages, and what characteristics are shared with them?
b) What level or levels of linguistic representation serve as input to an alternate phonological or morphological system?
and $c$ ) Are ludings and surrogates entirely distinct from each other, or are they manifestations of a single alternate linguistic component within the grammar?

These questions will be investigated by analyzing alternate phonologies and morphologies as legitimate languages in their own right. At the same time, the ability of these systems to illuminate aspects of their source languages and of linguistic theory in general will also be exploited. Ludling and surrogate language data will be brought to bear upon a number of current theoretical issues relating to the nature of linguistic representations and processes, among them the status of the Crossing Constraint as an autonomous phonological principle, the parametric formulation of autosegmental spreading processes, the elaboration of the postlexical component of the grammar, and the interface of phonology and morphology in the area of semantically empty affixation. More broadly, the significance of these findings for the recognition of the phonological component as an independent, and uniquely linguistic, cognitive domain will be explored in some detail.

The data base for this study is extensive and diverse. This work offers, for the first time, a comprehensive survey of the vast number of
luding and surrogate systems which have been reported in the literature. A significant portion of this thesis is also dedicated to the analysis of a number of individual systems in greater detail, thereby bringing to light previously inaccessible or overlooked alternate languages. Included among these are Akan speech drumming, Tigrinya ludlings, Inuit katajjait or throat game-songs, and so-called 'backwards languages'. Because these alternate speech forms are extremely varied and generally fall somewhat outside the domain of what is considered to be ordinary 'language', I have drawn upon descriptive accounts from a broad range of disciplines in addition to linguistics: among them, anthropology, semiotics, ethnomusicology, and folklore. Along with the ludling data I have collected myself, I also incorporate the full spectrum of strictly linguistic studies which are available. These range from purely descriptive accounts of alternate linguistic systems, through various theoretical analyses, as well as detailed acoustic and instrumental studies of, for example, whistle speech.

In the remainder of this chapter, I will focus on three preliminary tasks. First, I will contextualize the study of ludlings and surrogates by providing an overview of the wide variety of other alternate linguistic systems encountered in the world's languages. Particular attention will be paid to sorting out exactly what characteristics distinguish these systems from each other, and where ludlings and surrogates find their place in this typology. Second, I will reexamine the notion of 'external evidence' and show how the approach to alternate languages taken in this work will differ from most previous ones. At the same time, I will provide a historical comparison of the differential treatment afforded ludlings as opposed to surrogates in the scholarly literature. Finally, I will give a detailed layout of the organization of the thesis.

## 1. Languages Within Languages

### 1.1. Functional Definitions

Before we proceed with a detailed investigation of various alternate linguistic systems, it is important to clarify which phenomena fall under this classification. What exactly is an alternate language? The number and types of linguistic (and in some cases, extralinguistic) systems which could be categorized as alternate languages are in fact enormous. The difficult task of organizing them into a meaningful typology has, in the past, been hampered by a focus on the sociolinguistic functions of such systems rather than their formal properties, as well as by a lack of standard terminology. The main problem is that there simply is not a one-to-one relationship between the form of an alternate linguistic system and the particular function which it performs.

For example, alternate languages which have similar functions often assume the most bewildering variety of different forms. Consider the category of 'speech disguise' or 'secret language', that is, alternate linguistic systems used primarily to disguise the identity of their speakers and/or facilitate private communication between them. This is a label commonly applied to various languages characterized by morphological and/or phonological manipulation of ordinary language words, such as 'Pig Latin' in English. However, the same function may be performed by alternate linguistic systems involving vocabularies which are distinct from the ordinary language-- for example, the merchant's argot used among Amharic speakers (Leslau 1964). The function of concealment may also be served by a surrogate language: an example is the whistle language of Ibo adolescents described in Carrington (1949). Another form of 'speech disguise' is the purely phonetic
modification found in Fensterle, a speech form of Swiss German in which pulmonic ingressive airstream is used to conceal the identity of the speaker in courtship situations (Dieth 1950, Cat ford 1977). Finally, within this same functional category one could probably also include such diverse phenomena as voice-disguisers and even Morse code. Voice-disguisers are tube-like implements fitted with a membrane at one end which alters the voice quality when spoken into. They are used to conceal the speaker's identity and create a distinctive speech timbre among, for example, Ibibio marionette oper ators in Nigeria (Bal four 1948). Morse code represents a type of surrogate language which Stern (1957) calls non-abridging, that is, one which is not directly based on the phonology of a natural language. The use of Morse code as a secret language is of course well known, and it is clear that from a functional perspective this phenomenon (and even more divergent systems) would be subsumed under the same general category.

Similarly, the function of some alternate languages as ritualistic or religious languages is embodied by a wide array of formal types. These range from the semantic inversion of Warlpiri tjiliwiri or 'upside-down-speech' (Hale 1971), the lexical substitution of the zar argot in Ethiopia (Leslau 1964) and the dasin ritual language of the Lardil (Hale 1973), the alternate morphology in the speech of Kanara 'devil-dancers' (Shankara Bhat 1968), the whistle language employed by trance-mediums in the New Guinea Highlands (Laycock 1975), and voice-disguisers used in Tiv ancestor cults (Bal four 1948), to name just a few (see also Sherzer 1982).

Just as a given sociolinguistic function may be carried out by a variety of forms of alternate language, so too may alternate linguistic systems with the same formal properties be used for a number of divergent functions. To take one simple example, whistle languages-- which all involve
substitution of a whistle pitch for the fundamental frequency-- may be used by only a tiny fraction of the speech community in ritualistic contexts, as in the New Guinea example cited above; as a form of disguised speech among adolescents in the aforementioned lbo example; as a means of long distance communication for shepherds among the La Gomeran Spanish (Classe 1957, Busnel and Classe 1976); as a mode of ordinary conversation between Mazateco men (Cowan 1948); or as a second language spoken and understood by an entire speech community, as is the case with whistled Turkish (Busnel 1970a). Moreover, in many cases a given alternate language will serve a number of different functions, and it is often quite difficult to draw clear boundaries between them. Many ludlings, for example, combine the functions of speech disguise, language game, secret language, argot, and/or ritual language, if these can even be precisely distinguished.

### 1.2. Formal Definitions

A significant advance in the classification of alternate languages was heralded by the appearance of Laycock (1972), in which attention was shifted away from the sociolinguistic functions of 'play languages' to their formal properties. Laycock recognized that most of what had previously been labeled as play languages, secret languages, etc., share a very specific type of manipulation of linguistic structure; this property transcends the particular functions of these alternate linguistic systems and can be used as the basis for a meaningful classification of them. ${ }^{2}$ He coined the term LUDLING ${ }^{2}$ to refer to such systems, and provided the following (tentative) definition:
(1) "A ludling is [...] the result of a transformation or series of transformations acting regularly on an ordinary language text, with the
intent of altering the form but not the content of the original message, for purposes of concealment or comic effect." (Laycock 1972:61)

As can be seen from the last phrase in this definition, reference to sociolinguistic function has not been totally abandoned; the work presented in this article is important, nevertheless, in its attempt to clearly delineate the formal properties which characterize a particular subset of alternate languages.

In this section I will outline a typology of alternate languages which is based entirely on their formal characteristics and which encompasses systems other than ludlings. In this way I will be continuing and expanding the approach which Laycock (1972) advocated. For the purposes of this typology I will recognize five domains of linguistic structure in which alternate languages may diverge from (or converge with) their source languages:
(2) a) Syntax (S), consisting of the way in which words are organized into higher phrasal units and sentences;
b) Lexicon (L), consisting of the lexical representations of nonaffixal units, that is, the sound-meaning pairs of roots and stems (this category would therefore include the semantic manipulation found in some alternate languages);
c) Morphology ( $\mu$ ), encompassing both the lexical representations of affixes as well as concatenative and nonconcatenative morphological processes such as affixation, compounding, reduplication, etc.;
d) Phonology ( ( ), consisting of the phonological processes, rules, principles, etc., found in a given language, as well as the sound inventory of that system (where, for languages which do not involve
acoustic signals, 'sound' is to be understood metaphorically as the smallest meaning-less unit);
e) Modality (M), referring to the particular articulatory and perceptual channels through which the language is passed. For example, sign languages have a different modality from spoken languages since they are passed through the manual-visual channels rather than through the vocal-auditory channels (cf. Klima and Bellugi 1979). For spoken languages, 'modality' will also be used here to refer to any modification in the primary sound-producing mechanism (i.e. the fundamental frequency) such as different phonation types (whispering, whistling, pulmonic ingressive air, esophageal speech), as well as purely external or mechanical impositions on the vocal tract, such as voice-disguisers or bite-block articulation. ${ }^{3}$

These five categories are intended to be informal characterizations of certain linguistic domains, recognized as such because they seem to be the ones which are consistently subject to manipulation by alternate languages. They should not necessarily be equated with any of the linguistic components or modules of grammar which have been postulated in recent theories of syntax, phonology, morphology, etc. In particular, the strict separation of the domains in this typology is idealized and, in many ways, quite arbitrary. For example, the sound-meaning pairings which make up the lexical representations of words incorporate the sound inventory of the language, yet I have grouped the latter with Phonology rather than Lexicon. I have also chosen to place the lexical representations of affixes in the domain of Morphology rather than Lexicon (even though grouping it with the latter would perhaps be more consistent). This is because many alternate languages have distinct vocabularies for non-affixal units while maintaining the
affixal morphology of their source languages intact. Finally, for the purposes of this typology I have had to abstract away from any sorts of interactions between these various domains, for example, the intercalation of phonology with morphology which is reflected in current frameworks such as Lexical Phonology. When I turn to examine individual alternate languages in detail in subsequent chapters of this thesis, these mutual interactions will of course be a prime focus of attention.

It is now possible to develop a classification of alternate languages based on which of these domains they share with their parent languages. It should be noted at the outset, though, that this typology is not intended to be a rigid categorization of alternate languages, but rather a tool which can be used to determine the axes along which they vary. In particular, I will try to avoid a common pitfall of many typologies, that of trying to force a given set of phenomena into all the logically possible combinations of a predetermined set of characteristics or domains. The categories to which I assign various systems are but one way of viewing those systems.

Consider first two separate languages such as English and Spanish. The relationship between these two systems may be schematized as in (3).
(3)


That is, these systems differ significantly in their Syntax, Lexicon, Morphology, and Phonology, but share a common Modality (the articulatoryauditory channels of spoken language). By saying that these systems differ in Syntax, Phonology, etc. I am not claiming, of course, that they have
nothing in common: they will share, for example, those things which can be attributed to Universal Grammar. The configuration in (3) can also represent any two sign languages (e.g. American Sign Language (ASL) and Chinese Sign Language), since they share only a common modality. Another examples of separate, rather than alternate, languages is diagrammed in (4).


This corresponds to the relationship between, for example, spoken English and ASL. This is the same relationship as (3) (i.e. significant differences in $5, L, \mu$, and $\delta$ ) except that the Modality is no longer shared. 4

In the preceding examples the two languages maintain separate $5-L-\mu-\bar{s}$ series, occasionally sharing M. It is this property which distinguishes separate languages from alternate languages. In all the remaining systems, one or more of $L, \mu$, 조, or $M$ is shared between the two systems, and $S$ is always shared. Where the systems diverge-- for example, if there are two distinct $\mu$ domains-- one will typically be more impoverished than the other. This language is in a sense 'parasitic' upon the other, sharing many if not most aspects of its structures, and it is such systems which will be designated 'Alternate Languages' in this classification.

There are two broad categories of Alternate Languages. The first of these, what I will call Speech Modifications, are the simplest in that they involve only the use of an alternate Modality. This is schematized in (5).
(5)


Examples include substitution of alternate phonation mechanisms (e.g. whispered speech; pulmonic ingressive speech as in Swiss German Fensterle), as well as additions to or replacements of the larynx (e.g. voice disguisers; esophageal speech). These are generally low-level, 'phonetic' or mechanical substitutions which involve no codified alterations in the phonological system of the language involved.

The remaining types of Alternate Languages I will designate 'Languages Within Languages': these involve systematic, rule- or principle-governed alterations in the $\Phi$, $\mu$, and/or $L$ domains of the source language. There are three principal categories of Language Within Language. The first type, Surrogate Language, is schematized in (6), and is exemplified by the relationship between drummed Akan and spoken Akan (Nketia 1971) or whistled Turkish and spoken Turkish (Busnel 1970).
(6)


A sample sentence in spoken and drummed Akan is given in (7). (L=low-toned beat; $H=h i g h-t o n e d ~ b e a t ; ~ L:=l e n g t h e n e d ~ b e a t ; ~ L-=s h o r t e n e d ~ b e a t) ~$
(7) Gloss 'He created Kwao Awua's son as principal state executioner.'

Spoken Akan j̀bò̀ kwà (o) (a)wúá kwá brà fò títìré
Druped Akan L L: L H: H L-L L: H L-H
(Nketia 1963:798)
Surrogate systems, like Speech Modifications, involve substitution of an alternate sound-producing mechanism for the larynx. While this feature is the most widely recognized diagnostic for surrogate languages in the literature (see Sebeok and Umiker-Sebeok 1976), surrogate systems differ from speech modifications in that they typically also involve an alternate phonological system. That is, surrogate languages employ phonological rules and principles whose presence cannot be explained simply by the alternate modality of the system. Chapter 2 of this thesis will explore in greater detail exactly how these alternate phonologies differ from their parent languages, as well as how they are independent of the particular modality involved. $=$

The second type of Language Within Language, the Ludling, is illustrated by the various configurations in (8).
(B) a. 5
b. ${ }^{5}$
c. ${ }^{5}$

Although Laycock (1972) considers ludlings to involve phonological manipulation, these systems are more properly described as utilizing various forms of nonconcatenative (and occasionally concatenative) morphological manipulation. Two examples of ludling sentences are given in (9) and (10): the first, the Seselan language of Javanese, involves infixing -pU-after
each vowel of the ordinary language, while the second is the familiar game of Pig Latin in English (in the version illustrated here, the initial consonant of each word is moved to the end and -ey is added).
(9) 6loss 'Kikik is a naughty boy.'

Javanese kikik anak nakal
Seselan kipikipik apanapak napakapal
(Sadtano 1971:33)
(10) English The man is home.

Pig Latin ethey anmay isey omehey.
(Sherzer 1982:186)
The full range of structural modifications encountered in luding systems will be explored extensively in Chapter 3, but for now the configuration in (8a) will be recognized as the paradigm case of a ludling. Instances of purely phonological alterations as in (8b); or alternate phonological systems in conjunction with alternate morphologies as in (8c), are much more difficult to find. 6 This is because, with the advent of nonlinear phonology, it is possible to analyze many apparently 'phonological' processes as the insertion of a quasi-morphemic, feature-sized autosegment (as in the descriptions of consonant mutation in McCarthy (1983) and Lieber (1983)). For example, the vowel nasalization which accompanies infixation in a Fula luding described by Noye (1975) may be regarded as the presence of a [+nasal] autosegment in the lexical representation of the ludling affix, which docks onto the word when the affix is added. Similarly, the syllable deletion ludings surveyed in Davis (1985) can probably be regarded as a form of morphological truncation, perhaps mapping onto a reduced prosodic template as in McCarthy and Prince (1986). Nevertheless, it does appear that in at least some ludlings a number of truly phonological processes must
be recognized. For example, ludlings in Mandarin, Cantonese, and Kunshan incorporate dissimilation rules not found in their respective source languages (Yip 1982); several English segment reversal ludlings described in Cowan, Braine, and Leavitt (1985) and Cowan and Leavitt (1982) appear to have ludling-specific rules of glottal stop insertion; while certain infixing ludlings in Sanga seem to require their own rules of tone association and spreading (Coupez 1969). (See Chapter 4 for more detailed discussion of these ludlings.)

The final type of alternate language to be considered here is illustrated in (11). These systems involve alternate lexical domains. There is no established term in the literature which covers the full range of phenomena embodied by this type; however, a number of such systems are referred to as 'Argots' and I will adopt this as a generic term.
(11)a

b. $S$



Examples of (11a) can be found in any system involving alternate vocabularies or semantic representations. For example, this would include the Warlpiri ritual language tjiliwiri cited earlier, in which words are essentially assigned their opposite meaning; the Gurage mayat argot described in Leslau (1964), in which a new vocabulary has been created through paraphrase, transferred meaning, semantic generalization, borrowing, etc.; the Jalguy 'mother-in-law' avoidance vocabulary of the Dyirbal language, in which each lexical item in the ordinary language (except for affixes and some pronouns and kin terms) has a different form in the
alternate language (Dixon 1980); and the hIonipa women's avoidance vocabulary of the Zulu (Faye 1923-25) and Xhosa (Finlayson 1981), in which an alternate lexicon has been created by making specific consonant substitutions in words. ${ }^{7}$ Samples of tjiliwiri and Jalguy speech are given in (12) and (13).
(12) Gloss 'I am sitting on the ground.'

| Marlpiri | $\underset{I}{\text { gat ju }}$ | ka-na <br> present-I | wal ja-gka ground-locative | $\begin{aligned} & \text { njina-mi } \\ & \text { sit-nonpast } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| Tjilimiri | kari other | $k a-\emptyset$ <br> present-he | guru-ŋka sky-locative | kari-mi stand-nonpas |

(Hale 1971:473)
(13) Gloss 'He was saying that he'd been spearing eels.'

Dyirbal jaban+gu bayi wagay+marri+nyumi wurrba+nyu eel+PURP, hetABS speart ? +PERF-REL talk+PRES/PAST

Jalguy balbiji+gu bayi nyirrindatrri+nyumi wuyubatrri+nyu eEI+PURP hetARS spear+REFL+PERF-REL teII+REFL+PRES/PAST
(Dixon 1980:62-3)
An example of (11b), with divergent Lexicon and Morphology, might be exemplified by a poetic speech form of the Buin language described by Laycock (1969). In this system, a portion of the vocabulary of ordinary Buin is arbitrarily divided into approximately eighty different categories, each of which may contain anywhere from one to forty lexical items. Each category is marked by a specific suffix belonging to the alternate language (usually also accompanied by truncation of the original word). Finally, an example of (11c), with alternate Lexicon and Phonology but shared Morphology, is the damin language of the Lardil (Hale 1973). This ritual language has a vocabulary and phonological system which are quite distinct from its parent language. Its consonant inventory is enriched with a number of unusual segments not found in ordinary Lardil (clicks, ejectives, etc.) while its
vowel system is considerably reduced, and it has a different canonical shape for roots. The forms of lexical items are entirely unrelated to their Lardil counterparts, and the lexicon is highly impoverished (containing a large proportion of generic terms). However, the inflectional and derivational morphology of damin is exactly the same as Lardil's.

A summary of the classification of alternate languages presented in this section is given in (14). This typology is by no means complete, nor is it necessarily the only possible classification based on formal properties that could be set up. It is sufficient, however, to identify those systems which will form the basis of the remainder of this thesis. In the body of this dissertation $I$ will be directing my attention almost exclusively to alternate languages of types $B$ and $C$-- that is, those involving shared lexicons but alternate phonological and/or morphological systems.
(14)
separate languages
a.

b.

spoken English-spoken Spanish
alternate languages

## languages hithin lamguages

A. Argots
a. 5

b.

c.


Xhosa-hlonipha
Buin-Buin poetic speech
Lardil-danin
B. Ludlings


English-Pig Latin
C. Surrogates

spoken Akan-drumened Akan
SPEECH HODIFICATIONS


## 2. On the Notion of 'External Evidence'

Much of linguistic theory and practice is predicated on the notion-either explicit or implicit-- that a clear distinction can be drawn between the types of phenomena which are relevant to linguistic research. Those things which are considered to be truly 'linguistic' data have received the bulk of attention from the field, while those phenomena which are considered only marginally to comprise 'linguistic' data have received comparatively little or no attention. Most often this distinction is stated in terms of an opposition between 'external' evidence and 'internal' evidence. Athough in many cases it is relatively uncontroversial, this distinction is curious in two respects: i) it is by and large not based on any inherent differences between the two types of data, nor on any consistent differences made by language users when producing the two types of data; rather, it reflects the perceptions of those evaluating the data once they have been produced; and 2) when data are classified as 'external', this often means that they are only considered worthwhile as evidence for the analysis of 'internal' data, if even that. In this section 1 will explore these aspects of the internal/external distinction, and investigate some of the motivations for its adoption.

### 2.1. Neither 'External' Nor Merely 'Evidence'

The range of phenomena which have been traditionally classified as 'external' data is extremely diverse. An early characterization may be found in Saussure (1916: Chapter 5), where such things as cultural influences on language, dialectal/geographic variation, and borrowing are included in his category of "external elements of language". More recently, Kenstowicz and Kisseberth (1979) have offered the following
characterization:
(15)"First, there is corpus-internal evidence: here the argumentation is based on the primary body of data the linguist works with, a corpus of utterances in phonetic transcription with each utterance given at least a rudimentary grammatical and semantic analysis. [...] Second, there is corpus-external evidence: Here the argumentation is based not on the language data itself, but on various types of linguistic behavior a full explanation of which seems to require appeal to the speaker's knowledge of the language. The kinds of linguistic behavior we have in mind here include foreign language acquisition, speech errors (slips of the tongue), systematic distortions of the language (language games), and so on." (Kenstowicz and Kisseberth 1979:139).

In addition to the types of external evidence mentioned above, Kenstowicz and Kisseberth also include examples involving native orthographies, poetry, songs, and historical change. This characterization is echoed by Campbell (1986:164), who states that external evidence is "evidence not confined to surface-pattern regularities, but evidence showing speakers behaving linguistically in ways where they must call upon their knowledge of the rules and underlying forms of their language in overt and revealing ways." He cites such things as metrics and verse, word games, experiments, borrowing, speech errors, orthography construction, and language change as examples of external evidence.

While it is true that speakers must draw upon their linguistic knowledge in an 'overt', i.e. conscious, way in the production of language games, verse/ song, orthography construction, and some experiments, this is not true for speech errors, first and second language acquisition data, and historical forms. Why, then, should the latter be classified as external
data? We can provide a more consistent characterization if we consider the role of intuition or conscious reflection not in the production of such data (as Kenstowicz \& Kisseberth and Campbell suggest), but rather in their assessment. Native speakers will systematically and consistently judge speech error data, for example, as distinct from an intended and produceable target. This metalinguistic awareness of a distinction between so-called natural language data and 'external' data probably also extends to other types: borrowed words, first and second language forms, poetic language, ludling words, and historical forms are all perceptibly 'different' from ordinary language. Notice, however, that if we use such a characterization, then we can no longer rely on an inherent property of the data themselves to determine objectively what is 'external'. Rather, it is the impressionistic evaluation of that data by native speakers which determines its status with respect to this dichotomy. This raises a number of questions: Do all native speakers concur in their judgements of particular data as exceptional ('external')? Must different degrees of exceptionality be recognized, and if so, where does one draw the line between internal (non-exceptional) and external (exceptional)? ${ }^{8}$

Native intuitions are not the only kinds of subjective evaluations which can be used to classify external and internal data. Particular theoretical approaches may select only certain kinds of data as relevant ('internal'), relegating others to a peripheral status ('external'). For example, Zwicky (1975) offers the following fairly extensive list of what comprises 'external' data (16b) when 'internal' data is considered to be only alternations and distributional restrictions (16a). The latter he calls "the orthodox list", comprising the data "treated by structuralist morphophonemics and phonemics taken together" (p.154).
(16) a. 'Internal' data

1. variant shapes of morphemes
2. distributional restrictions on phonological elements
b. 'External' data
3. speech errors
4. misperceptions
5. language replacement
6. aphasia
7. borrowing
8. cross-linguistic surveys of inventories
9. cross-linguistic surveys of processes
10. linguistic games
11. productivity of processes
12. poetic requirements
13. historical change
14. acquisition
15. stylistic variation
16. patterns of dialect and idiolect variation
17. statistics of variation
18. or thography
19. articulatory phonetics
20. acoustic phonetics
21. patterns of exceptions
22. informant judgements on novel forms
23. psycholinguistic investigations
24. distorted speech

This is obviously a very restrictive definition of what comprises 'internal' evidence: many of the categories which fall outside of this definition are used regularly in current phonological descriptions (e.g. (16.b.6,7,9,17)) and would not likely be classed as 'external' by those who use them.'

At this point one must question the fundamental relevance of this distinction. Campbell (1986) maintains that the internal/external distinction is a clear and useful one. However, he concludes that a major distinguishing criterion of external evidence is that it "yields information not normally considered in the corpus of material upon which linguistic descriptions are typically based" (p.171; emphasis mine). In other words, external evidence is 'external' precisely because it has not yet been considered 'internal'. An even more damaging assessment of the internal/ external distinction is articulated by Ohala (1986):
(17) "This is a very curious distinction to make. There seems to be no single relevant property inherent to these sources of evidence that would allow one to classify them as internal or external. It cannot be a matter of the data collection being done in wivo (i.e. under natural conditions) as opposed to in vitro (i.e. under artificial circumstances): the field worker's elicitation of the pronunciation of words is typically done in as unnatural a language-using situation as are most psycholinguistic experiments. On the other hand, speech errors and texts can both be produced under natural conditions.

Apparently, however, the most important differentiating characteristic between them is that internal evidence comes from the kind of data that the majority of phonologists have been working with since the early nineteenth century whereas external evidence doesn't. Internal evidence is traditional and external evidence is 'new-

## fangled'."

(Dhala 1986:4)
The primary difference between 'external' and 'internal' evidence, then, lies not so much in the inherent characteristics which set these types of linguistic phenomena apart, but rather in the particular way that Iinguistic theory looks at them. Every theory must necessarily delimit the range of phenomena which it will address; unfortunately, labeling something as 'external' is often simply a way of either ignoring it altogether or using it as a marginal form of evidence without having to provide a formal account of it. Consider the way in which language acquisition data have been dealt with in linguistic theory. In the development of recent syntactic frameworks such as Chomsky's (1981) Government and Binding theory, learnability has emerged as one of the central criteria for the assessment of competing analyses and hypotheses. Data from first language acquisition are, arguably, extremely relevant to this endeavour, yet as Davis (1987) shows, the relationship between language acquisition and syntactic theory has always been an uneasy one. In most cases, language acquisition data have been relegated to the role of 'external evidence', brought in somewhat on the side when it appears that they might confirm the particular argumentation being pursued. The reason for this, as Davis points out, is not that such data are only marginally important, but rather that certain difficulties present themselves when it comes to incorporating these data within current frameworks. This stems both from some rather unusual aspects of the data themselves (e.g. extensive inter- and intra-speaker variation), as well as from the lack of a theory of language acquisition which approaches the comprehensiveness and rigor of theories of adult grammar.

The parallels between the treatment of language acquisition data and
alternate language data (as well as other forms of 'external evidenie') are obvious. Alternate language systems are considered to be 'unusual' from the perspective of ordinary languages because they interact more directly with extralinguistic components. Consequently, linguistic theory has generally shied away from the task of determining what strictly linguistic elements are operative in them. It is much simpler to regard alternate languages as a mere curiosity, uniformly extralinguistic, and suitable only for a secondary role as 'evidence', than it is actually to work out a systematic account of their organization.

While researchers such as Ohala (1986) have recognized that the external/internal distinction may ultimately not be a useful one (as we have seen), they nevertheless continue to regard alternate languages in a strictly utilitarian fashion. The question is usually, "What do these systems tell us about their source languages?" rather than, "Why do these systems take the forms that they do, and how do they manifest the human linguistic capacity in its broadest sense?" This is not to deny, of course, the importance of asking questions such as the first; nor is it always possible entirely to separate the two questions. In this thesis, however, I hope to demonstrate that 'external evidence' is significantly more than a handy source of 'evidence', and that there is value in attempting to answer questions such as the second one.

This view of alternate languages departs significantly from the standard treatment, as reflected in the available literature on ludings. Studies of ludings divide almost uniformly into two categories (although there may, of course, be some overlap between these): (i) descriptive, nontheoretical studies of individual ludling systems, and (ii) ludlings used as external evidence. Examples of the first type range from early accounts
with only a handful of data items, such as Hirshberg (1913) and Schlegel (1891), to recent, more detailed studies such as Teshome Demisse and Bender (1983). 10 The bulk of the sources to be used in this thesis fall into this category; for more extensive bibliographic listings, see KirshenblattGimblett (1976) and Laycock (1972). A number of authors have also developed typologies of ludling systems within a descriptive vein, most notably Laycock (1972) and Haas (1967); see also Davis (1985) for a more recent survey, and Seppänen (1982) for a typology of Finnish ludlings from a computational perspective.

Studies in which ludlings are used as external evidence are, by now, fairly well established in the linguistic literature. Ohala (1986), in a survey of the relative merits of different types of evidence in phonological descriptions, ranks ludling data second only to experimental evidence; cf. Campbell (1986) for a similar endorsement. Perhaps the best known example of this type of study is Sherzer (1970), in which ludling data are used to argue for certain syllable structures and other aspects of the phonological representations of the source language. Recent works such as Cowan, Braine, and Leavitt (1985) and Campbell (1980) continue this tradition. Also falling into this category are studies in which ludlings are used as evidence for certain constructs in phonological theory (rather than specific aspects of the structure of their source language); examples include Vago (1985) and Bagemihl (1987). More recently, too, a new type of study which uses ludlings as external evidence has emerged, one in which novel word games are created to test certain aspects of language structure; see Treiman (1983), Hombert (1986), and Campbell (1986).

Conspicuously absent from most of these treatments are theoretical analyses of ludlings as linguistic systems in their own right. Rarely do we
find ludling processes formalized with the same rigor as ordinary language morphological and phonological rules, and generally no explanation is offered for why ludling processes take the forms that they do, or why other conceivable processes never occur. Ludlings are by and large relegated to secondary status, considered to be interesting primarily to the extent that they can illuminate the workings of the 'real' source language on which they are based. Notable exceptions to this trend are a number of recent analyses of ludling systems within the frameworks of nonlinear phonology, particularly the work of McCarthy (1982, 1985), in which the relevance of autosegmental systems of representation for the nonconcatenative morphology of some ludlings is demonstrated. Also in this same vein are studies such as Yip (1982), Broselow and McCarthy (1983), and Lefkowitz and Weinberger (1987). This thesis will continue the approach pioneered by these few studies.

### 2.2. But is it Language?

The representation of surrogate languages in the scholarly literature is even more polarized than that of ludlings. Virtually all of the sources which I have examined in the course of this research fall into the category of descriptive, nontheoretical studies. With the exception of Rialland (1981a), there are no analyses which use surrogate data as external evidence (surrogate languages are not even mentioned in the lists of possible sources of evidence cited in the preceding section), and there are no theoretical accounts of whatever kind. 11 The amount of literature which has been devoted to this topic -- spanning nearly a century of research-- is enormous, yet it has gone virtually untapped by theoretical linguists. What does this discrepancy indicate about the way surrogate languages are perceived by the
linguistic establishment in comparison to the (already marginal) status of ludlings?

In the case of surrogate languages, there is an obvious reluctance to delve into an area which smacks of the nonlinguistic. Because surrogate languages involve a different modality from spoken languages, the assumption seems to be that they are governed entirely by extralinguistic factors. To analyze even a portion of a surrogate language from a strictly linguistic perspective is tantamount to saying that there must be a locus in the grammar where surrogate language structures are handled. If one takes this to its logical conclusion within a mentalist view of the linguistic faculty, then this implies that there is a 'component' of the grammar where rules, processes, principles, or whatever else that is specific to the surrogate system are localized. In fact, this is precisely the claim I make in this thesis. I argue, fur thermore, that such a component is not only the site of surrogate-specific processes, but also the location where linguistic and extralinguistic faculties interface. Just as the phonetic component of spoken language grammar is partly responsible for interfacing phonological representations with the articulatory apparatus, so too is the phonetic end of the surrogate component responsible for meshing phonological representations with the particulars of their surrogate modalities (instrumental or whistle).

To make such a claim, however, implies certain other parallels with the linguistic components that have been postulated for spoken language. For example, how are alternate phonologies and morphologies learned? Much of the motivation for setting up discrete modules in current theories of (spoken language) grammar is that such modules are taken to represent, in part, the innate component of language which does not need to be learned. It is not
clear whether such a strong claim can or should be made about the acquisition of alternate languages, since we know so little about the process. However, at least in the case of ludlings, the lack of an explicit theory of alternate language acquisition has not prevented researchers from exploring the theoretical implications of ludling data. (The same can in fact be said for ordinary languages, where much of the acquisition process is still poorly understood.) Mohanan (1982), for example, postulates what is essentially a luding 'component' between the lexical and postlexical modules of the grammar; in so doing, he is able to elucidate a number of critical issues in the theory of Lexical Phonology as well as in the formalization of ludling processes. This is in spite of the uncertainties which exist around the acquisition of ludling systems. Moreover, the acquisition of many surrogate systems is probably much closer to first language acquisition than the acquisition of ludling systems, even though the extralinguistic aspects of the latter are much less prominent. As I will show in Chapter 2, many surrogate languages are acquired automatically, at the same time as the spoken language, and are often used for the remainder of the speaker's life. In contrast, most ludling systems are acquired during adolescence, often as a result of conscious effort, and are frequently abandoned once the speaker reaches adulthood (Laycock 1972). Some would conclude from this that in fact neither of these alternate languages should be incorporated into linguistic theory. On the contrary, I take the position that significant advances in our understanding of both alternate and nonalternate language can still be made, while at the same time we try to piece together the puzzle of their respective acquisition processes.

For those who would still insist on granting alternate languages only marginal status, using them merely as external evidence, it must also be
pointed out that such systems are only useful to the extent that their mechanisms are thoroughly understood. Consider the following simple example. In Fula there is a ludling which reverses the first two consonants of a word, converting e.g. 7umaru' (personal name)' into maparu (Noye 1975). This is quite similar to an Arabic ludling described by McCarthy (1986), in which consonants may be freely permuted. The segregation of consonants and vowels onto separate tiers in Arabic is already well-motivated on morphological grounds; Prunet (1986) has recently proposed a similar treatment for Fula, though on strictly phonological grounds. Can the Fula ludling therefore be used as additional support for such a segregation in the source language, analogous to the Arabic case?

If we regard the ludling operation to be one of simple switching of consonants, it would seem quite reasonable to assume that the Fula case requires consonants to be on a separate tier, as in Arabic. That is, if the operation is formulated as 'Switch the first two elements on tier $X$ ', then tier $X$ can only contain consonants in order for the right results to be obtained. However, as I will show in Chapter 3, the most optimal characterization of reversing ludings such as the one in Fula is in fact in terms of crossing of association lines, rather than simple metathesis. Consonant reversal can be effected through a spreading rule which accesses nonnuclear segments, with such a rule able to apply across intervening vowels (since association lines can be crossed). Consequently, the Fula data are compatible with an approach that does not segregate consonants and vowels, and cannot be used as specific argumentation for such a segregation. In short, then, a closer examination of ludling-specific mechanisms often leads to a radically different perspective on the utility of such data as 'external evidence'.

Let us now return to the question of the distinction between external and internal evidence raised at the beginning of this section. It should be apparent that much of what is considered to be 'external' data is classified as such simply because it does not fit the norm of what 'real' or 'normal' language is supposed to be like. It is instructive to compare this situation with the status of sign language in linguistic theory. Only recently has the formal analysis of sign language systems begun to be accepted as a legitimate domain of linguistic research. Perlmutter (1986) offers an eloquent plea for the full incorporation of sign language data into mainstream linguistic theory; it is interesting to note that virtually all of his arguments hold equally for the case of surrogate languages, yet the attention afforded such systems is nowhere near that given sign languages (or ludlings, for that matter). Moreover, lest we forget the dangers of rigid classifications and arbitrary line-drawing, Pike (1943) reminds us that it was not too long ago that sounds such as clicks, ejectives, implosives, and voiceless vowels were regarded as abnormal and not distinguished from extralinguistic sounds:
(18) "Passy [1914, 1922] does likewise...in relegating [whispered vowels] to a small section containing rather rare speech sounds (clicks), rare variants of speech sounds (inverse), and nonspeech sounds (whistle). These, and elsewhere glides also, he calls "accessories", giving ample evidence that he considers them abnormal. [...] As late as 1912 the alphabet of the International Phonetic Association included merely symbols for sounds made by air from the lungs only." (Pike 1943:5-8) Yet we now know that clicks, ejectives, etc., are not, of course, 'abnormal'; indeed, it is only through the incorporation of such sounds within linguistic theory (in particular, distinctive feature theory) that we
have been able to arrive at some sort of understanding of the range and limits of the human linguistic capacity. Today, alternate languages such as surrogates and ludlings have the same legitimacy within linguistic theory that clicks and ejectives did seventy-five years ago. This thesis is one step towards rectifying this situation.
3. Organization of the Thesis

The basic outline of this thesis is as follows: Chapter 2 is devoted entirely to surrogate languages, Chapter 3 focuses on ludling systems, while Chapter 4 provides a synthesis of the findings for each of these two types of alternate language.

### 3.1. Chapter Two: a theory of Surrogate language

This chapter is devoted to exploring three central questions regarding the autonomy of phonological systems: 1) To what extent are spoken language phonologies independent of their own modalities? 2) To what extent are surrogate language phonologies independent of their own modalities (instrumental or whistled)? and 3) To what extent are surrogate language phonologies independent of their source language (spoken) phonologies? As I will argue, in each of these cases the phonological systems exhibit a significant degree of autonomy. In section 1 I show that surrogate languages occupy an important place in linguistic theory, since they demonstrate that spoken language representations need not be articulated through the vocal apparatus (and hence are not entirely dependent on that modality). In section 2 a formal analysis of Akan surrogate speech is presented, based on an algorithm for translating musical notation into linguistic notation. In section 3 I develop a complete model of the surrogate component, showing
that many properties which distinguish whistle surrogates from instrumental surrogates can only be attributed to the modular organization of that component. An important aspect in the development of this model is the articulation of the detailed internal organization of the postlexical component, based on recent work such as Liberman and Pierrehumbert (1984), Selkirk (1984, 1986), Kaisse (1985), and Mohanan (1986). Finally, in section 4 I examine the types of processes present in each module of the surrogate component. These include both 'phonetic' processes which map phonological structures onto modality-specific elements, and 'phonological' processes which map linguistic elements onto other linguistic elements.

Because surrogate languages have not yet been incorporated into linguistic theory, a number of unique problems and opportunities present themselves in the course of this investigation. For example, there is no established foundation on which to build the proposals I will make, no previous analyses to re-analyze, and no assumptions which one can adopt without providing detailed justification. In this chapter I therefore make a point of presenting all of my lines of reasoning as explicitly as possible, building the strongest case that I can for the many (perhaps controversial) claims which I will be making. A prime example is the lengthy refutation of functional explanations for the absence of certain phonological elements in surrogates, which occupies much of section 3 in this chapter. In current theoretical approaches to the phonology of spoken languages, one need not spend time addressing functional or extralinguistic motivations for processes, since it is generally accepted that language is an essentially self-contained domain (and not e.g. dependent on music). In surrogate languages, however, functional explanations are rife in the literature and in many cases do sound quite plausible. (A functional
explanation is one which appeals to something other than the structure of the linguistic representation or the organization of the grammatical components-- for example, the claim that segments are eliminated from whistled tone languages because they carry a low functional load in the spoken language.) It is therefore incumbent upon anyone who wishes to provide a principled account of these systems to address such explanations. If they are rejected, a thorough documentation of the counterevidence as well as a more successful alternative should also be presented. This is what I strive to achieve in this chapter.

Another problem faced in this endeavour is the following. Any survey of surrogate languages must contend with three separate bodies of literature, each of which is extensive and not necessarily compatible with the others: the descriptive literature on surrogates (and musical systems), the descriptive literature on the corresponding spoken languages, and the literature on phonological theory. In attempting to synthesize these and initiate a theoretical literature on surrogate languages, i could not rely on things being as neatly laid out as I would hope. For example, I am fortunate in that many of the areas of postlexical and sentence-level phonology which are crucial for an analysis of surrogate systems have recently been addressed by a number of theoretical linguists. However, no single author has laid out a framework which incorporates all of the required aspects, and therefore $I$ devote a considerable amount of time in this chapter to providing an adequate synthesis of these accounts for spoken language before I utilize them for surrogate systems. Furthermore, in this chapter I make the very strong claim that surrogate languages can alter the phonological representation independently of the spoken language on which they are based. Since this claim depends crucially on such processes not
forming part of the rule system of the spoken phonologies, I have not limited myself to the descriptions of the spoken languages provided in the surrogate literature (even though in most cases these are completely accurate and explicit). Rather, I have tried wherever possible to obtain verification from outside sources on the spoken languages involved.
3.2. Chapter Three: LUDLING SYSTEMS IN THEORETICAL PERSPECTIUE: Three Case Studies

This chapter will examine in depth three ludling systems which have received little or no previous attention in the theoretical literature. Each has been chosen for inclusion here because of the insights which it can provide into the organization of alternate linguistic systems. Each is also crucial for the discussion in the final chapter, because the analyses to be presented elucidate a number of properties of ludling systems which appear to have something in common with surrogate systems.

Section 1 is devoted to a detailed analysis of the katajjait or throat games of the Inuit. These games have traditionally been classified as a form of music; in this section I explore the boundary between language and music, and ultimately demonstrate that the katajjait represent a type of nonconcatenative morphology found in ludling systems, what McCarthy (1985) calls 'empty morphology'. I arrive at this conclusion by first delineating a number of pervasive characteristics shared by the katajjait with linguistic systems; I then show that a theoretical analysis of katajjait patterns in terms of phonological constituent structure is inadequate, and appeal must also be made to morphological constituent structure. Section 2 provides an analysis of Tigrinya infixing ludlings, which have not been previously mentioned in the descriptive or theoretical literature. This material derives from work with a native speaker of this Ethio-Semitic
language. A full characterization of the ludling morphological and phonological processes is provided, couched within the theoretical frameworks of underspecification theory (Archangeli 1984a, Archangeli and Pulleyblank 1986), a metrical theory of syllabicity (Levin 1985), and a hierarchical theory of feature geometry (Clements 1985, Archangeli and Pulleyblank 1986). After establishing the workings of the ludling system, I examine their interaction with processes of assimilation, spirantization, and gemination in the source language. Finally, section 3 develops a formal account of one type of ludling which has received little theoretical attention in comparison with others, so-called 'backwards languages'. These are ludlings which involve reversal of some or all segments or syllables. I argue that an optimal analysis of these systems entails recognizing the parametric nature of the Crossing Constraint. In particular, reversing ludling utilize the marked setting of this constraint, which allows crossed association lines to be introduced into the representation.

The analyses offered in this chapter provide a number of important clues as to possible connections between ludling and surrogate systems. The account of katajjait which I develop involves interpreting metricallyspecified positions through insertion of features of voicelessness or inspirated breath; this is formally analagous to the tonal interpretation of metrical structures which is represented in, for example, Kickapoo surrogate speech. The study of Tigrinya ludlings reveals a ludling rule of floating segment realization which is quite similar to tonal reconstruction rules of instrumental surrogates. Finally, the investigation of backwards languages will direct attention to other manifestations of reversal which are encountered in alternate languages, e.g. the semantic reversal in Warlpiri tjiliwiri, and reversal of the priority of head/nonhead constituents in node
conservation for surrogates of tone languages.
In this chapter, as in the preceding, my focus is on providing an optimal account of ludling systems and using this to enlarge our understanding of alternate language. Once again, though, the implications of these analyses for aspects of phonological theory as well as for the structures of the source languages are not ignored, and indeed these form an integral part of the investigation of each system. In the broadest sense, by using a number of current theoretical frameworks to explain ludling behaviour, I am necessarily also providing additional support to those theories by showing how they can handle these phenomena. These two objectives are mutually reinforcing and, ultimately, indistinguishable. On an individual level, each ludling system offers a valuable perspective on a number of areas of interest in current phonological and morphological theory. For example, the account of katajjait patterns which I develop will provides some independent support for the notions of constituency and headedness within an arboreal theory of prominence (cf. Hammond 1984). The analysis of Tigrinya ludlings which I pursue leads to some critical insights into the nature of the distinction between 'true' and 'false' geminates (cf. Hayes 1986), the selection of node arguments in the parametric theory of rule formulation developed by Archangeli and Pulleyblank (1986), and the role of Tier Conflation (cf. McCarthy 1986) within ludling and ordinary language systems. Finally, the theory of ludling reversals articulated in Section 3 has a number of implications for the status of the Crossing Constraint within the grammar. Most notably, this constraint is revealed to consist of a hierarchy of parameter settings, with both marked and unmarked (default) values playing a role in ludling systems.
3.3. Chapter Four: TOMARDS A UNIFIED THEORY OF ALTERNATE LINGUISTIC SYSTEMS

In this chapter I attempt to develop an integrated model of alternate linguistic systems, one which can incorporate the range of properties of ludlings and surrogates eluridated in the previous two chapters. In Section 1 I provide a more detailed comparison of these two types of systems. After noting their obvious differences (both formal and functional), I elucidate a number of striking formal similarities which suggest that they might share one or more grammatical components. Among these are processes of reversal and reconstruction (as noted in the preceding section); extrasystemic modifications (i.e. violations of Structure Preservation); as well as the phenomenon of 'vocal surrogates' such as the call languages of New Guinea (Laycock 1975) and the yell language of the Piraha (Everett 1985), which seem to combine characteristics of both ludlings and surrogates.

A crucial step in the development of this model is to determine exactly where in the grammar the ludling component is located. This occupies section 2. I begin by reexamining Mohanan's (1982) proposal, which places the ludling component between the lexical phonology and the postlexical phonology. Seen in terms of the elaborated model of the postlexical phonology developed in Chapter 2, there is actually no motivation for having the component as early as Mohanan places it. In the remainder of this section $I$ consider an extensive range of evidence on this matter, drawn from ludlings in more than fifty languages. My task is to resolve the conflicts between those systems which do seem to require a fairly early location for the ludling component (e.g. within the lexical phonology) with those that require a later placement. In the final model I arrive at, there are three ludling conversion modules, each taking a well-defined level of phonological representation as its input. In the last section of this chapter I explore
the possibility that one or more of these modules overlaps with the last module of the surrogate component, the Whistle Module, in which strictly segmental modifications are effected. My conclusion is that the similarities exhibited by ludlings and surrogates are not in fact due to a shared conversion module. Rather, they reflect the interaction of three factors: 1 ) the salience of certain levels of representation within the grammar (e.g. the output of the Syntactic component of the postlexical phonology) which are accessed by the ludling and surrogate components alike; 2) general properties of the domains in which conversion takes place, e.g. violations of structure preservation as a characteristic feature of postlexical processes (whether ludling, surrogate, or non-alternate language); and 3) membership in a common alternate linguistic component, within which traits such as reversal are made available for varying realizations in ludlings and surrogate languages.

NOTES
${ }^{1}$ This is not to say, of course, that a functional typology of alternate languages is without value and should not be pursued. It is a legitimate axis along which alternate languages can be classified, and a comprehensive catalogue of alternate linguistic functions has yet to be undertaken.

2This term was actually first introduced in Laycock (1969); it also appeared as the Esperanto word for 'language game' in Otsikrev (1963). The origin of the coining is the Latin ludus 'game' and Lingua 'language' (Laycork 1969:14).

3The difference between e.g. whisper and nonwhisper (states of the glottis) is, of course, a very different modality shift than between e.g. drumming and speaking, and a more refined typology would recognize this distinction. For our purposes, though, it is sufficient to consider these simply to be alternative manifestations of modality shifts.

4 Certain systems which share the same Syntax might also be considered to represent separate languages, as schematized in (i.a-b).
(i)


For example, it is reported that in India, speakers who are bilingual in Marathi (an Indo-European language) and Kannada (a Dravidian language) use a common syntactic structure and simply substitute the lexical items belonging to each language in this structure (Gumperz 1969, Burling 1970). This is illustrated in (ii), showing the Marathi and Kannada equivalents of the sentence 'I cut some greens and brought them.' (Constituent structure is
that given in Gumperz (19E9); VS=verb stem; PFL=participial suffix; T=tense; AGR=agreement.)
(ii) Gloss 'I cut some greens and brought them.'

(Gumperz 1969:442)
In this case, the syntactic constituent structure as well as categories of major lexical classes, case markers, inflectional morphemes, etc. are shared; only the lexical entries of these items differ. This corresponds to the situation exemplified by (i.a), that is, shared Syntax and Modality. (Although Gumperz (1969) is not explicit as to whether the morphological processes of the two languages differ, recall from (2) that distinct lexical representations of affixes are sufficient to constitute an alternate $\mu$ dumain in this typology.) If the Modality is not shared, the situation in (i.b) obtains: this is exemplified by Signed English, that is, a language with the word order and syntactic structures of spoken English but with ASL lexical items substituted for the spoken words. According to Klima and Bellugi (1979:193), Signed English "uses ASL signs and adds affix-markers (loan translation signs for articles, for inflections such as -ly, -ing, -ed, for forms of the copula is, was, were, and so on)." A sample sentence contrasting Signed English with ASL is given in (iii). (Words in capital
letters represent English glosses for ASL signs; a bracketed [+] following an ASL sign indicates that the sign is made using one of the processes of morphological inflection found in ASL; italics indicate one of the "signlike inventions" of Signed English which are used to represent spoken English articles, affixes, etc.)
(iii) Spoken English Suddenly a cat came along. ASL $\quad$ WRONG[+], CAT COME-OVER[+]. Signed English SUDDEN+LY A CAT COME PAST ALONG.
(Klima and Bellugi 1979:191,389)
Whether these systems actually represent separate languages is tangential to the central concerns of this section, and I will not pursue this matter any fur ther.

[^0]processes/principles must be involved. In the case of Hlonipha, the substituted consonants are never taken from outside the inventories of the ordinary languages (Zulu and Xhosa), and therefore they do not constitute a new sound system (contrast this with dawin, described below). Moreover, the substitutions cannot be construed as an active 'phonological rule' which converts an ordinary language word into a Hlonipha word. The alterations are by and large arbitrary, so that each Hlonipha form (or at least the consonant substitution which is involved) must be memorized along with its ordinary counterpart. Thus, Hlonipha languages differ only in the lexical representations of certain words and not in the phonological systems.
-An alternative characterization of external evidence, suggested to me by John McCarthy, is "evidence normally unavailable to language learners". This is indeed the case for historical and orthographic forms, laanwords, experimental evidence, and (in most cases) ludling and surrogate language data. However, one must question the notion of 'normally available' in this definition. Consider a case such as Turkish whistle speech (Busnel 1970a), which is spoken by virtually all the inhabitants of the town of Kuskly in Turkey. In this case, surrogate language forms are 'normally' available to language leraners in this speech community; if we then use these data as evidence for a certain aspect of the organization of spoken KuskBy Turkish phonology, does this still constitute 'external evidence'?

Another problem with this definition is that speech errors and baby talk ('motherese') are presumably freely available in the input to language learners, yet these forms of data have also traditionally been classified as 'external'. Moreover, language acquisition data themselves occupy a curious position with regard to this criterion. Though they are arguably not normally available to the language learner, and therefore have traditionally
been dealt with as 'external evidence', a strong case can be made that language acquisition data are in fact central to linguistic theory and hence should not be considered 'external' at all (see the discussion below). In fact, this characterization of the external/internal distinction (like the others considered in this section) simply returns us to the original question, "Why make an internal/external distinction at all?".

PRelated to this categorization is Hockett's notion of 'central' and 'peripheral' subsystems of language. In his classification, grammatical, phonological, and morphophonemic systems are central, while semantic and phonetic systems are peripheral (Hockett 1958:137-138). Again, these divisions would not be recognized by many linguists nowadays.
${ }^{10}$ Ludlings, and in some cases surrogates, have also figured quite prominently in more popular discussions of language behaviour, such as Farb (1973).

1 Moreover, a larger percentage of surrogate language studies are relegated to presentation in nonlinguistic forums. As the table in (i) shows, of those ludling studies which have been published in journals, approximately $55 \%$ have appeared in linguistic publications while $45 \%$ have appeared in nonlinguistic publications. The figures are almost the exact reverse for studies of surrogate languages.
(i) Number and percentage of alternate language studies appearing in linguistic and nonlinguistic journals
a. Ludlings

| Linguistic | Nonlinguistic |  |  |  | Total | Percentage |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $A$ | 5 | $C$ | $M$ | 0 |  |  |  |  |
| 18 | 8 | 6 | - | - | 1 | 33 | $55 \%$ | $45 \%$ |  |
|  |  |  |  |  |  |  |  |  |  |

b. Surrogates

| Linguistic | Nonlinguistic |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | S | C | M | 0 |  |
| 17 | 9 | 9 | 3 | 1 | 1 | 40 |

Percentage

| Linguistic | Nonlinguistic |
| :---: | :---: |
| $42 \%$ | $57 \%$ |

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Journal Types:
    A = anthropology; ethnography; folklore
    S = sociology; area studies
    C = semiotics; communication
    M = music; ethnomusicology
    D = other
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By 'nonlinguistic' is meant a journal which includes papers on topics other than linguistics, rather than one which actually excludes linguistics. For example, although linguistics is a recognized subdiscipline of anthropology, anthropological journals are classified here as nonlinguistic because they cover a broad range of topics in addition to (anthropological) linguistics. A journal such as Anthropological Linguistics, in contrast, has been classified as 'linguistic' because all of its papers are concerned with language in one form or another.

Chapter Two: A theory of surrogate language

## 0. Introduction

In spoken language the primary sound source is the larynx, which produces the fundamental frequency; various obstructions and modulations are imposed on top of this by the organs of the vocal tract. As such, it would seem that this component of articulation is an immutable fact of linguistic communication. In numerous languages throughout the world, though, there have developed alternate linguistic systems that dispense entirely with the glottal tone as the primary sound source, substituting some other mechanism of sound production for it. The substituted sound source may be either a musical instrument (typically some form of drum, but occasionally also wind or string instruments) or a whistle (that is, a pitch stream produced by forcing air through a constriction at the anterior portion of the vocal tract rather than at the larynx). These systems have come to be known in the literature as SURRDGATE LANGUAGES or SPEECH SURRDGATES (Stern 1957; Nketia 1971; Umiker 1974).

In some surrogate systems there is no relationship between the sound structure of the spoken utterance and the sound structure of its surrogate equivalent-- the latter is simply an arbitrary sound code, much like Morse code. In the majority of surrogate systems, though, various phonological and/or phonetic features of a spoken utterance are represented directly in the surrogate. These latter surrogate languages have been dubbed abridging
systems by Stern (1957) and (as noted in Chapter 1) they will be the exclusive concern of this chapter.

A wealth of descriptive literature has accumulated concerning these alternate linguistic systems, most notably the collection of articles in Sebeok and Umiker-Sebeok (1976). From this material it is readily apparent that surrogate languages are not simply a linguistic anomaly, a phenomenon which is too isolated and unusual to be considered within the bounds of normal linguistic capacities. All evidence points to the conclusion that surrogate systems are in fact a natural linguistic behaviour which needs to be incorporated into our general conception of language ability.

In this chapter I hypothesize that there is an independent component of the phonology which is responsible for the generation of surrogate language. My primary aim will be to determine the precise nature and organization of this component-- what universal principles it contains, what types of language-particular (or surrogate-particular) variations it may embody, and its relationship to the phonological and phonetic components of spoken 1 anguage.

I begin in section 1 by enumerating a number of properties of surrogates which lend support to their inclusion in a theory of grammar; I also consider the critical way in which they bear on the status of the phonological component as a uniquely linguistic cognitive domain. In section 2 an introduction to the phonological profile of a surrogate is provided through a detailed examination of one particular surrogate system, the drum language of Akan. The types of rules which I am led to posit in a formal account of this system serve to pinpoint a number of crucial issues concerning the surrogate-spoken language interface; these issues are explored in depth in the next two sections, drawing on data from a wide
range of surrogate languages. In section 3 I address the general question of what level or levels of phonological representation serve as input to the surrogate component. The investigation is guided by a few very simple questions: Why do instrumental surrogates never reproduce downdrift/downstep? Why do surrogates of non-tone languages reproduce consonants and vowels while those of tone languages do not? I will demonstrate that various seemingly plausible functional explanations for these asymmetries are in fact profoundly inadequate; they must instead be made to follow directly from the architecture of the surrogate component and the geometry of the phonological representation. Finally, in section 4 I provide a typology of phonological processes found in surrogate languages and show that a distinction between surrogate 'phonological' and 'phonetic' rules must be recognized.

A number of important theoretical consequences will emerge from this study of surrogate language. First, I will provide a more fully delineated model of the postlexical component of the phonology, and give independent support to Mohanan's (1986) fundamental division of this component into distinct 'Syntactic' and 'Postsyntactic' modules. Second, the relevance of a number of structural notions made available by a hierarchical theory of feature geometry (as originally presented in Clements (1985) and further developed in Archangeli and Pulleyblank (1986) and Shaw (1997)) will be established, among them the distinction between terminal and nonterminal class nodes, node adjacency to the skeleton, and the integrity of the root node. Third, the validity of current theoretical accounts of downdrift and downstep (which treat these two phenomena as manifestations of a single formal apparatus in spite of a number of structural and functional differences between them) will be demonstrated, and some support for the
two-step, constituency-based approaches of Clements (1981a) and Huang (1980) will also be offered. In addition, the accumulating body of evidence favouring the recognition of a level of syllable structure distinct from the skeleton or timing tier (e.g. Lowenstamm and Kaye 1986, Levin 1985) will be further substantiated in this work. Finally, by refuting a number of functional explanations which have been suggested for surrogate language behaviour, as well as by providing evidence for a significant class of surrogate rules whose formulation is not modality-dependent, this chapter will directly address the issue of the autonomy of the phonological component of the grammar. It will be shown that the phonological system must be regarded as a distinct cognitive domain which is to a large extent independent of the particular articulatory apparatus involved, be it spoken, signed, or (in the case of surrogate languages) whistled and drummed.

## 1. Surrogate Languages and Gramatical Theory

### 1.1. Phonology as a Cognitive Domain

Before we begin to look in detail at surrogate systems, it is worthwhile to consider the following very basic question: What does phonology have to contribute to a study of language as a cognitive system, that is, language as a unique domain of human knowledge? Let us suppose that phonology were entirely derivative of other systems, systems which are also shared by extralinguistic domains-- for example, the articulatory and perceptual apparatus which language is passed through. If that were the case, then phonology would have very little to contribute to such a study, since whatever it could tell us would be things about those systems and their interaction with the language faculty rather than about the language faculty itself. So the next question to ask is the following: Are there
fundamental organizational properties of the phonology whose ultimate explanation does not lie in the modality involved? In syntax, of course, the question of modality-independence generally does not even arise: syntactic structures are not directly connected to the vocal apparatus, and obviously no one would think of trying to explain properties of wh-extraction, for example, on the basis of the behaviour of the larynx in speech production. In their attempts to establish the independent cognitive status of the syntactic domain, then, syntacticians have not been burdened with the problem of factoring out influences of the modality.

In phonology, however, the picture is somewhat different. Phonological structures are tied much more intimately to the modality of the language, that is, to its phonetics. Because phonology is influenced in many ways by phonetics, many researchers have been tempted to explain all aspects of phonology on the basis of phonetics (or other extralinguistic
considerations). Such a viewpoint denies the phonological component any independent status, treating it as merely the by-product of other systems. Some have even taken this to indicate that phonology is inherently less interesting to study, since it can tell us nothing directly about language as a cognitive faculty.

The issue of the independent cognitive status of the phonological component is at the very root of the field, and can be traced through a number of seminal works in the literature, beginning with, for example, Sapir's (1933) study on psychological reality of phonemes, through Chomsky and Halle's (1968:3) invocation of the 'competence/performance' distinction with regard to phonology, up to recent work such as Anderson (1981). In the post-SPE generative tradition, it is a widespread assumption that phonology cannot be reduced to properties of the modality invovled, and nearly every
aspect of formal phonology in fact constitutes a claim about cognition. ${ }^{1}$
One of the few explicit defenses of the cognitive basis of phonology is offered by Anderson (1981), who argues for the independence of phonology from modality effects as well as from other extralinguistic considerations. In (1) are provided two quotes from this article, whose sentiment will be echoed throughout this chapter.
(1) "...there are aspects of the sound structure of Language that cannot be explained simply by models of the social uses to which humans put their apparatus for respiration, mastication, deglutition, and general concept formation." (Anderson 1981:496)
"Language is not 'governed by forces implicit in human vocalization and perception'... it is also the product of a distinctive cognitive faculty, for which we have no reason to expect literal analogues in other human capacities or constraints. In this sense, then, phonology is clearly not 'natural'." (Anderson 1981:535)

Anderson arrives at these conclusions on the basis of a wide range of considerations drawn primarily from the domain of spoken language. He also points out, though, the importance of alternative linguistic systems for establishing the independent status of the phonological component, particularly languages realized through a different modality from that used in spoken language. The particular systems he draws attention to are sign languages, whose organization in relation to spoken language can be schematized as in (2). Consider first the spoken language system: its phonological structures-- the output of $A$ in this diagram-- are realized through the vocal articulatory apparatus-- B in (2). The essence of Anderson's arguments is that $A$ is independent of $B$ in nontrivial ways, and therefore to that extent I (Phonology) is independent of II (Phonetics).
(2)


Notice, however, that this position is also supported by the existence of sign languages, by virtue of the fact that these languages are not spoken, i.e. they have no connection to the vocal apparatus. In these systems, the phonological component of the grammar-- C in (2)-is realized through the manual articulatory apparatus-- $D$ in this diagram. In recent years an extensive literature on sign language phonology has developed (see Padden and Perlmutter (1987) and Sandler (1987) for some references). What this literature indicates is that the content of C shares many fundamental properties with the phonological systems of spoken languages (A) (without of course directly sharing any representations). Sign language phonological structures have nothing to do with the vocal articulatory apparatus (B), though, and so whatever similarities are present must be due to modalityindependent considerations. Therefore, it cannot be concluded that all aspects of phonology are derivative of the fact that language is (in most instances) spoken.

Nevertheless, because sign language phonology (C) is not directly
connected to spoken language phonology ( $A$ ), this can only be an indirect argument for the relative autonomy of the latter from its own modality. It should be apparent now why surrogate languages are so important for the recognition of the autonomy of the (spoken) phonological component. Because they use an alternate modality, but are still based on the spoken language phonology, they provide a much stronger argument for the position which Anderson is defending. Consider the schematic representation of spoken and surrogate systems given in (3). 2
(3)


In contrast to sign language phonology, surrogate language phonological representations are drawn directly from the spoken language phonology. Thus, the same phonological representation may be realized either through the vocal (that is, laryngeal) apparatus (B) or through the surrogate articulatory apparatus (D). In other words, spoken language phonology can exist independently of the modality with which it is ultimately realized. It cannot therefore be regarded as entirely derivative of the vocal articulatory apparatus. This is not to deny, of course, any influence at all
of phonetics on phonology (either synchronically or diachronically), only to assert that not all aspects of phonology can be reduced to such influences.

Without the existence of surrogate languages, the claim that there are aspects of phonology which are modality-independent is considerably more difficult to make. That is, if spoken language phonological structures were always and only realized through the vocal articulatory apparatus, one could reasonably conclude that this is because they are so intimately tied to their modality that no other way is possible. What surrogate languages show, very simply, is that this cannot be the case.
1.2. General Characteristics of Surrogates
1.2.1. Distribution and Genesis

In addition to the fact that surrogate languages have important implications for the understanding of the autonomy of the phonological component, a number of general characteristics of surrogates also point to their inclusion in a theory of language ability. First of all, their sheer abundance and geographic spread is notable: surrogate languages have been reported from all regions of the world and in such widely differing language families and groups as Algonquian, Oto-Manguean, Penutian, Macro-Chibchan, Indo-European, Altaic, Niger-Kordofanian, Afro-Asiatic, Sino-Tibetan, and Indo-Pacific (cf. the Appendix). Moreover, within each of the general categories of surrogates (broadly, instrumental and whistle languages) the attested systems display remarkable similarities in terms of the types of sound structure which are represented and the fundamental means by which they are represented- similarities that cut across the genetic affiliations or geographic locations of the spoken languages they are based on.

Secondly, the ability of a spoken language to spawn a surrogate system
is not linked to any particular structural characteristics of that language: rather, the genesis of a surrogate is typically triggered by a particular convergence of topographical and/or social factors. Essentially, the need to communicate information under conditions for which the human voice is inadequate or inappropriate (e.g. mountainous terrain, thick forests, long distances, certain social situations) tends to trigger the development of a surrogate language. Busnel and Classe (1976:107) note that under the right conditions, potentially any spoken language may serve as the source of a surrogate system, and this is confirmed by the diversity of languages reported in the literature. (This is not to say, however, that characteristics of the source language do not determine the form that surrogate will take, as I will show shortly.)

Finally, it appears that speakers of all languages have the ability to convert their language to a surrogate system spontaneously, regardless of whether they speak tone or non-tone languages and even when no such system had prior existence in the language as an organized, culturally-accepted alternate means of communication. This is especially true where the method of surrogate sound production is relatively easy to accomplish physically (as in various forms of whistling). For example, Coberly (1975) found that native speakers of English (with no previous knowledge or ability in surrogate communication) could readily produce a whistled version of their language on a par with, for example, the famed whistle language of La Gomera (though with crucial differences to be discussed below). Similarly, Armstrong (1955) and Wilson (1963) note the ability of speakers of Bijago, Egede, Idoma, Yoruba, and many other African tone languages to produce whistled forms of their language spontaneously in elicitation contexts.

### 1.2.2. Acquisition and Use

When a given spoken language has an established surrogate form, the surrogate is typically not relegated to marginal communicative functions, but is instead thoroughly integrated into the linguistic environment at all levels. Dne of the most fundamental aspects of this integration is in the acquisition of surrogate systems. Unfortunately, little information beyond anecdotal reports is available on the acquisition of surrogate languages, and certainly nothing comparable to the detailed longitudinal studies available for spoken languages. However, in those instances where information is available, it appears to be the case that the surrogate language is acquired automatically, without formal instruction, along with (or shortly after) the spoken language. This is reported for the whistle languages of Mazateco (Cowan 1948:1386; Busnel and Classe 1976:30), Turkish (Leroy 1970b:1033), and La Gomeran Spanish (Classe 1957b:115-16; Busnel and Classe 1976:11), and the hand-fluting language of Kickapoo (Ritzenthaler and Peterson 1954:1411). Carrington (1949:615) reports that in the Congo region children whose parents are from two different tribes often become bilingual in both the spoken and drum languages of each parent.

Exceptions to this pattern of acquisition are of course frequent, but this can in most cases be correlated to certain physical requirements of the modalities involved, and usually results in the comprehension of surrogate speech preceding actual production (Busnel and Classe 1976:30). As Leroy (1970b: 1033) points out, articulation of a whistle language often requires full dentition (not completed until about age 12) in order to produce a pitch stream which is sufficiently clear and strong. However, according to Classe (1957b) children are able to recognize their own names in whistled La Gomer an Spanish before they are even a year old. Similarly, although
children of 5 or 6 years of age can already understand the drum language of Kele, production of instrumental surrogate systems such as this often lags considerably behind, owing to the mastery of fairly complex musical playing techniques which is often required (Carrington 1949:620, 660).

Once the surrogate system has been acquired, it is exploited for the full range of communicative functions that spoken language is, and is usually regarded as a perfectly normal and commonplace linguistic behaviour by its users (cf. Classe 1957b:118). Entire conversations may be conducted in surrogate speech with no spoken language ever intervening (cf. Cowan 1948: 1390; Herzog 1945:569), and such systems are often utilized on a daily basis in the communities where they occur (Cowan 1948; Voorhis 1971:1434). Free conversion between surrogate and spoken language is also encountered: Cowan (1948: 1390) reports that conversations in Mazateco between two people walking towards each other often begin at a distance in whistle speech and conclude in spoken language once the two people are closer. Instrumental surrogates, too, such as the well-known drum languages of West Africa, are not limited to conveying messages relay-fashion over immense distances (contrary to popular misconception). Akan speech drumming, for example, may be employed for a wide variety of purposes, including the transmission of texts on ceremonial occasions, the communication of eulogies, praise poems, and proverbs, as well as the conveying of greetings, warnings, announcements, etc. (Nketia 1963a:43-47). Many other such systems are employed to articulate jokes and insults (Carrington 1949). Finally, some idea of the utter permeation of surrogate languages into a given linguistic system can be gained from the observation that in many communities with drum languages, each individual is given not only a spoken name, but also a drum name which is to be employed exclusively during surrogate speech (Carrington

1949; Wilson 1963).
In conclusion, then, it can be seen that the exceptional nature of surrogate languages lies not so much in their origin, acquistion, use, or distribution, but primarily in their phonology (the particular modality of sound production employed, as well as other aspects). Moreover, because of the automatic acquisition and spontaneous conversion which is possible in many surrogate systems, it appears that a universally-available potential for surrogate communication must be recognized within the human language faculty. It is this potential, as well as the peculiarities of surrogate phonological systems, which I will give substance to in positing the existence of a discrete surrogate component within the grammar.

## 2. Akan Speech Drumaing

In this section 1 will provide an introduction to what a typical surrogate language 'looks like' by examining the drum language of Akan. Akan speech drumming has been chosen to initiate this investigation into surrogate languages because of the richness of phonological information which it encodes, and also because its descriptive documentation, provided by Nketia (1971), is generally acknowledged to be among the most thorough available (Umiker 1974:507). In the following discussion I will sketch one possible analysis of the Akan facts, and then use this as a springboard to a number of broader theoretical issues. Since the transcriptions for this surrogate language are in musical notation (as is commonly found in the literature on instrumental surrogates), part of the analysis will involve developing a means of translating musical notation into linguistic notation.

### 2.1. Background

Akan is a Kwa language of the Volta-Comoe group spoken by about two million people in Ghana. It is made up of a number of mutually intelligible dialects, among them Twi, Asante, Fante, and Akuapem (Welmers 1971; Warren 1976). Needless to say, drumming among the Akan is an intricate musical and social phenomenon, with numerous modes of drumming being recognized (see Nketia (1963a) for a complete discussion). What is of interest in this chapter is the SPEECH MDDE of drumming, which is sharply distinguished from the signal mode (as'well as various dance and musical modes) by the fact that the drumming bears a direct relation to the sound structure of the spoken text it is based on. (In the signal mode, in contrast, spoken texts may also be transmitted, but only through an arbitrary set of sound symbols.)

Speech drumming is most often performed on a pair of drums called atuppan: large bottle-shaped instruments hollowed out of a $\log$ and usually fitted with elephant ear or duyker skin heads (Nketia 1963a:5-7,12). One drum, called the 'male', produces a low pitch, while the other, called the 'female', produces a high pitch. Each drum is struck with its own stick.

### 2.2. Drummed Speech

The phonetic realizations of a number of Akan words as they appear in the surrogate language are given in (4). The linguistic forms in the lefthand column are taken from the drum texts provided in Nketia (1971) (numerals indicate page numbers in this source where the items are found) while the musical transcriptions in the righthand column represent their drummed realizations according to the principles of beat assignment detailed in the same work. Following Nketia, the spoken forms are written in the
standard orthography of Akan (Asante dialect) with tone marks and diacritics for syllabic nasals added; the orthography differs from standard phonetic transcription primarily in its grouping of the vowel harmony sets of the language (cf. Welmers 1946), but is faithful to all the elements essential for our analysis. I also follow Nketia's (1963b:25) convention of using a two-lined staff in the musical notation, the upper line representing the notes played on the 'female' drum and the lower line the notes played on the 'male' drum.
(4) Spoken
a. po 'sea' 719
b. bàtá
'fox'
720
c. àsè
'low'
719
d. Ṭfá
'take it'
e. dín 'name' 719
e. dín 'name' 719
f. due
'condolence'
723
9. 'Jéáfós' 'witch'

721
h. àsààsé 'earth'

717
i. ókón
' (type of
716 eagle)'
j. héné
'chief
k. sóró
'up, heavens'
720

1. bèrèmpòń 'nobleman' 721
m. bìim
'fright'
720


The surrogate realizations of these words consist solely of strings of drumbeats of various durations and pitches. Three elements of such beats are correlated with aspects of the phonological structure of the words they represent: the tone of the beats, the number of beats used for a given word, and the length of the beats. The mapping of each of these elements onto the linguistic representation is considered in turn below.

### 2.2.1. Tone of Beats

The most straightforward element of the surrogate-spoken language correspondence is the tone of the drum beats. Spoken Akan has a tworegister tone system contrasting high and low levels (Dolphyne 1965, 1986; Schachter and Fromkin 1968; Welmers 1973). As can be seen in (4), every time a high tone occurs in the spoken word, the surrogate has a beat played on the high-pitched drum, while every time a low tone occurs in the spoken form, the surrogate realization has a beat played on the low-pitched drum. I will make this correspondence explicit with the following tonal realization rule.
(5) Tonal Realization

Assign spoken high tones to the high-pitched drum; assign spoken low tones to the low-pitched drum.

### 2.2.2. Number of Beats

Each note in the musical transcription in (4) represents one beat on the drum. Comparing the surrogate forms with the spoken forms, it can be seen that the number of beats corresponds to the number of spoken syllables (as Nketia (1971:714-15) points out). The only case where such a correspondence may not be immediately apparent is for the sequences of two vowels, since
these could in principle be mono- or disyllabic. However, in Akan such vowel clusters are clearly disyllabic: a number of phonological processes in the language are sensitive to whether a word has one or two syllables, and words of the form CVV characteristically pattern with words of the shape CVCV and not those of the form CV. For example, disyllabic verbs reduplicate by total reduplication while monosyllabic verbs copy the first CV(N) of the stem and make the copied vowel [thigh]; CVV verbs pattern with the former (Dolphyne 1965:181,225ff.; Schachter and Fromkin 1968:155ff.). In addition, disyllabic verbs take the tone pattern low-high in the present tense and low-low in the imperative, while monosyllabic verbs are low in the present tense and high pre-pausally/low elsewhere in the imperative; once again, CVV verbs pattern with the disyllabic forms (Christaller 1933:xxx; Dolphyne 1965:221; Schachter and Fromkin 1968:223). Furthermore, CVV noun stems pattern with disyllabic nouns in their tonal behaviour in the associative construction (Nyaggah 1976). Finally, simply on distributional grounds a disyllabic structure for $W$ sequences is strongly suggested: virtually any vowel may cooccur with any other vowel in such a sequence (within the restrictions of ATR harmony), something which would not be expected if they were part of the same nucleus. 3

Assuming with Anderson (1982), Levin (1985), Lowenstamm and Kaye (1986) and others that the nucleus ( $N$ ) is the head of the syllable, the correspondence between beats in the surrogate language and syllables in the spoken language can be expressed by the following mapping rule.
(6) Beat Assignment

Assign a beat to each syllable head.

### 2.2.3. Length of Beats

Beats of three different lengths are used in Akan speech drumming: long, transcribed with a quarter note $[d]$ by Nketia (1971); short, transcribed with an eighth note [ ${ }^{h}$ ]; and extra-short, transcribed with a sixteenth note [ $A$ ]. The long beat is used in the surrogate only to represent closed syllables in the spoken language (which always have a nasal in coda position; items ( $4 \mathrm{e}, 1, \mathrm{~m}$ ) ) . The short beat is used in all other cases except when the following syllable begins with a sonorant consonant or vowel; in this environment the beat is shortened to a sixteenth note (items (4f-m) ) (Nketia 1971:717).

Abstracting away from the particulars, then, a closed syllable in the spoken language is always realized with a longer beat in the surrogate than an open syllable (where syllabic nasals are included in the latter group). In recent conceptions of phonological structure which include a skeleton or timing tier (e.g. McCarthy 1979, 1981; Levin 1985; Lowenstamm and Kaye 1986; Sagey 1986; and others), a closed syllable such as din will always have more timing units than a short open syllable such as po or a, simply because it contains more segments within its rime. In other words, the relative durations of closed vs. open syllables are directly encoded in the phonological representation. This suggests that there is a non-arbitrary relationship between the timing units of the phonological structure and the beat lengths of the surrogate. How is this relationship to be made precise, and how is the mapping from spoken to drummed timing to be formalized?. The key lies in recasting musical notation in terms of linguistic notation.

In the frameworks of Lowenstamm and Kaye (1986) and Levin (1985) the C and $V$ units of earlier conceptions of the skeleton are stripped of their inherent reference to consonants and vowels (or [tsyllabic] segments).

Thus, the elements on the timing tier (X-slots or points) are rendered contentless to the extent that they may represent the relative timing and duration of any segment. The notion that such elements are pure timing units may be extended by emptying them not only of inherent reference to consonants and vowels, but of inherent reference to phonological segments per se-- that is, such units may be considered to represent simply timing, whether of linguistic segments articulated in a spoken language or of other units (e.g. beats in a surrogate language). Each $X$-slot is then simply a minimal indivisible unit of length, with no specification as to what kind of segment that length belongs to.

With this conception of the units of the timing tier, it is possible to 'spell out' the relative durations of the three note types used to transcribe Akan speech drumming by assigning them different numbers of X slots. When removed from the two-register staff, each musical note in this transcription stands simply for the period of time or duration for which a given beat is held, or alternatively, the amount of time between beats. Length of time and only length is encoded in this notation-- there is no indication of stress or accent, and indeed this is irrelevant for Akan speech drumming. 4 Moreover, what is represented here is relative time onlywe know simply that there are three beat lengths: long, short, and extrashort, and that the long beat is twice as long as the short beat and four times as long as the extra-short beat. The actual length of each beat in real time will vary with the tempo of the drumming, which as Nketia (1971:717-18) points out is subject to the same freedom and variability as the tempo of spoken language.

The 1:2:4 ratio of the three beat lengths used in the surrogate can therefore be precisely represented with timing units as follows. If we
assign the shortest beat (the sixteenth note) the smallest timing unit-- one X-slot-- then the eighth note will be twice as long and have two slots, while the quarter note will be four times as long and have four slots: (7) $A=x$
$f=x x$
$d=x \times x \times$
In this way, only relative duration of notes/beats has been encoded. We could choose to represent the shortest note with any number of $X$-slots, of course, in which case the other two durations would simply have multiples of the number chosen, but the ratios remain constant (cf. Read (1969) for more on note lengths). 3

The table in (8) gives the surrogate forms of a number of basic syllable shapes in Akan. In the linguistic representation only skeletal slots within the rime are shown: the fact that $C V, V$, and $\underset{\sim}{N}$ syllable shapes all receive the same beat length indicates that the presence or absence of an onset timing slot is irrelevant for determining beat length. In other words, the assignment of initial timing values for syllables operates on the rime projection (see section 4.1.2. for further discussion). 6 (Following Levin (1985), the symbol $N^{\prime}$ will be used in this chapter to represent the first projection of the syllable head (the rime), while N" will be used for the maximal projection of the syllable head, i.e. $\sigma$ in traditional notation.) In the surrogate structures, the location of the beat is indicated by the occurrence of the nucleus node on the initial slot in a string corresponding to any given note. The empty slots following the N may be thought of as representing the length of time for which a given beat is allowed to continue to reverberate before the next beat. 7


As the items in ( 8 ) show, each timing unit in the phonological representation is mapped onto two such units in the surrogate structure. This mapping can be formalized as a rule which augments each rime slot by one:
(9) Beat Length Assignment (Rime.projection)

$$
\emptyset \rightarrow x \quad x \quad x \quad \ldots
$$

While (9) can account for the basic durational values of open and closed syllables, there still remains to be formalized the process of shortening which occurs before a syllable beginning with a vowel or sonorant consonant. This can be stated as the rule in (10).
(10) Pre-Sonorant Shortening


This rule serves to convert a surrogate structure with two timing units (the eighth note) into one with only a single timing unit (the sixteenth note) before syllables beginning with a sonorant segment $(V, N, N V, r V) . e$

### 2.3. Some Questions

In the preceding sections one possible formal account of the conversion of spoken Akan words into drummed words has been outlined. A number of questions immediately present themsel ves concerning both the form of the particular rules posited and the assumptions underlying their formulation. First I will consider the individual rules.

In the formulation of Beat Assignment (6), primary reference is made to the syllable nucleus. However, the same result could presumably also be achieved if beats were assigned not to individual nucleus nodes, but rather to each skeletal slot that is within the nucleus. Is there in fact any empirical difference between these two conceptions? Are both required in a theory of surrogate languages? Could it be that still a third possibility, namely assignment of beats to elements on the tonal tier, is required or preferred?

Concerning Tonal Realization (5): why is a 'rule' of this type needed at ali? The process has been formulated as one which maps a phonological entity (a tonal autosegment) onto an essentially articulatory specification (the particular drum to be struck), but is there any evidence that this is more than simply a matter of surrogate 'phonetics'? In other words, in the phonology of spoken languages tonal features represent acoustic dimensions which only receive articulatory specifications when they are translated into laryngeal gestures at the phonetic level. Can it not be assumed that e.g. 'high tone' simply represents the same acoustic categorization for
surrogates, and that this too is translated into an articulatory specification (the hitting of a particular drum) by a very low-level process?

Finally, in the formulation of the shortening process observed in Akan beat lengths (10); why is reference to the feature [sonorant] required, as opposed to any other combination of features such as [-ant, +vce]? For that matter, what is a rule of shortening doing at all in this surrogate language? Welmers (1946:17-18) observes that at the phonetic level high vowels in spoken Akan (Fante dialect) are often pronounced with somewhat shorter variants in certain environments: when low-toned and followed by a syllable beginning with $/ w, r, m, n /$, and often immediately before another vowel as well. The same is observed by Dolphyne (1965) for high vowels preceding $/ r /$ in verbs of the Asante dialect. These environments are very similar to the ones encoded in rule (10): could it be that this rule is not part of the surrogate system at all, but is in fact merely an implementational rule of the spoken language phonetics which is directly reflected in the surrogate representation?

These questions concerning individual rules in the analysis of Akan speech drumming are actually reflections of two much broader issues in a theory of surrogate language:

1) What level of phonological representation serves as input to the surrogate component? If it is indeed the surface phonetic representation, then it is quite likely that, for example, the rule of Pre-Sonorant Shortening is not surrogate-specific, and that the process of beat assignment is not operating on nucleus nodes (since according to Mohanan (1986) all hierarchical structure is dissolved at the phonetic level). If, however, surrogate conversion applies at some less shallow level, then
shortening could in fact be a rule of the surrogate phonology, and Beat Assignment could have access to syllable structure.
2) Is there indeed such a thing as surrogate 'phonology', as opposed to simply surrogate 'phonetics'? Any theoretical account of surrogate languages must recognize rules of the sort in (5) and (6) which map linguistic elements onto elements which are specific to the surrogate modality. Because their output cannot be represented entirely in terms of elements of phonological structure, such mappings can perhaps always be construed as akin to phonetic implementational rules, or perhaps even as processes which belong more properly outside of the domain of language (techniques of instrument playing, etc.). It is an open question, however, whether rules of the type exemplified by (9) and (10) are necessary in a theory of surrogate language: such rules, which map linguistic elements directly onto other linguistic elements, are necessarily 'phonological' in the sense that their output is interpretable by means of the independentlyrequired 'phonetics' of the modality.

Furthermore, questions such as those posed earlier as to why the surrogate language should have a process of shortening, or why reference to particular features is required in a formulation of that process, generally do not assume the same guise when one is dealing with spoken languages. Phonologists have traditionally been less concerned with why a given spoken language should have a rule of assimilation in the first place, for example, or why reference to the feature [vce] is required in determining preconsonantal vowel length in English and other languages, than they are with providing the most optimal characterizations of those processes. Of course, a more fundamental motivation for such processes is increasingly being sought (in terms of, for example, the setting of a limited number of
parameters made universally available by the phonological component), but such motivation never extends beyond the language faculty to some other extralinguistic system on which it could be considered to be dependent. The opposite is generally true of surrogates, though, since they are 'extralinguistic' systems which are known to be dependent on the linguistic system for many elements of their structure. Questions of surrogateexternal motivation generally figure quite prominently in connection with these systems because of certain preconceptions about what surrogate languages should and should not be able to do. If the surrogate system is seen as entirely dependent on the spoken representation for its structure, then justification must indeed be sought in the spoken language for every trait which appears in the surrogate. However, another conception of the surrogate system is, at least in principle, equally valid: it can be seen as a parallel and semi-autonomous phonological component whose primary, but not exclusive, concern is the interpretation of the spoken system. Under this view, then, one would in fact expect to find aspects of the surrogate language which do not correspond exactly to elements of the spoken language.

Particular questions such as those raised in the Akan case cannot, therefore, be properly addressed until these two larger theoretical issues are investigated. The remainder of this chapter is devoted to exploring each of these issues in depth. It will be shown, first of all, that surrogate conversion does not in fact take place at the level of the surface phonetic representation, but rather occurs at a pre-implementational level within the postlexical phonology. Second, evidence will be adduced for a significant class of surrogate rules whose effect is to map phonological elements onto other phonological elements (in addition to those rules whose outputs are modality-specific). In the course of this investigation, it will
also be demonstrated that access to syllable structure is required for beat assignment, and that the articulatory specification of tones is not necessarily simply a matter of surrogate 'phonetics'.

## 3. Developing a Model of the Surrogate Component

In this section I will determine the location and organization of the surrogate component, taking as my starting point the determination of what level(s) of phonological representation surrogate conversion operates on. The discussion is couched within a theory of lexical phonology; the particular framework $I$ assume is given in (11) in its general form, taken from Mohanan (1986: 12).
(11)

LEXICON

POSTLEXICAL MODULE


This model contains the now familiar division of phonological rules into those whose domain is the lexicon (lexical rule applications) and those whose domain is the syntax (postlexical rule applications). It also incorporates a suggestion of Pulleyblank (1986), building on insights of Ladefoged (1980), Liberman and Pierrehumbert (1984), and others, that the postlexical module should be further partitioned into a discrete submadule
of phonetic implementation. This submodule is responsible for the languageparticular specifications of "timing, degree, and coordination of articulatory gestures" (Mohanan 1986:152).

### 3.1. The Impossibility of Surface Conversion

In the last section we considered the possibility that the various beat lengths in Akan surrogate speech were a direct reflection of the phonetic timing facts of the spoken language. In order for this to be the case, the surrogate component would have to have direct access to the spoken phonetic representation. This notion may be formalized as the hypothesis in (12), conceptualized as (13).
(12) Surrogate conversion applies off phonetic representations. (13)


Timing details such as the Akan facts mentioned in section 2.3 are specified in the phonetic implementation module of the spoken language phonology; by feeding the surrogate component directly from this module, these timing properties would be made available for incorporation into the surrogate phonetic forms. In this subsection I will consider a number of properties of surrogate languages which necessitate a rejection of (12) and (13) as an
adequate conception of the link between surrogate and spoken language.

### 3.1.1. Intonational Elements

The basic problem with the model in (13) is that it predicts that all sorts of phonetic details, not just timing facts, should be available to surrogate languages, when in fact this is not the case. The most striking exception is the class of non-lexical and/or phonetic pitch elements comprising (among others) intonation, downdrift, and downstep, which I will group together under the rubric of INTONATIONAL ELEMENTS. As many researchers (Hasler 1960; Nketia 1971; Umiker 1974) have noted, surrogate languages differ as to whether they represent such non-distinctive pitch elements, the difference being correlated to whether the spoken language is tonal or non-tonal and whether an instrumental or whistle surrogate is employed. 9 The relevant generalizations are given in (14).
(14) a) Surrogates of non-tone languages always represent intonational el ements.
b) Instrumental surrogates of tone languages do not represent intonational elements; whistle surrogates of tone languages do.

Thus, Nketia (1971:728) notes explicitly that Akan speech drumming reproduces neither downdrift cthe cumulative lowering of the pitch of a high tone after a pronounced low tone) nor downstep (the lowering of the pitch of a high tone after an unpronounced, i.e. floating, low tone) (for the unitary nature of these two processes, as well as a formal account, cf. Huang (1980) and Clements (1981a)). Similarly, Ames, Gregersen, and Neugebauer (1971:25-6) take great pains to point out that Hausa speech drumming fails to represent downdrift; the same absence of phonetic pitch gradations is characteristic of the instrumental surrogates of Efik (Simmons

1955:744; 1980:11), Kele (Carrington 1953:680-1), Ewondo (Guillemin 1948), Chin (Stern (1957), Banen (Dugast 1955:737), and many others. ${ }^{10}$

The data on whistled tone languages are less extensive, but from the instrumental evidence and descriptions presented in Rialland (1981a,b) it is clear that downdrift is reproduced in the whistled surrogate of Gurma. In this language, high and mid tones are lowered after low tones (Rialland 1981b:41-3: 1983:217-18). Thus, in the spoken form of the word nújūgīú 'the knives', the mid tone is pronounced at approximately 127 Hz , while in the word likagili ' the stem', where the mid tone follows a low tone, its pitch is pronounced considerably lower, at about 110 Hz . This same (predictable, non-phonemic) downdrifting effect is observed in the whistled
 2400 Hz , while that in líkiagī̄ is whistled at approximately 1800 Hz (all pitch values, spoken and whistled, taken from spectrographic tracings in Rialland (1981a:359)).

For non-tone languages (which almost always have whistle surrogates), sources are unanimous in stating that intonation contours are represented in the surrogates: cf. Busnel and Classe (1976:76) for La Gomer an Spanish, Caughley (1976:998) for Chepang, Cowan (1976:1402) for Tepehua, Coberly (1975:61) for Tlaxcalan Spanish; spectrographic tracings illustrating the correspondence between whistled and spoken intonation are given in Caughley (1976:1015) for Chepang.

### 3.1.2. Functional Explanations

How, then, are we to account for this asymmetrical treatment of intonational elements? If we wish to maintain the model in (13), in which all phonetic contrasts are available for potential use by a surrogate, then
it must be assumed that some principle of selection is at work in the surrogate to pick out certain phonetic elements over others depending on the type of language and/or surrogate involved. Notice that such a principle cannot be based on some structural difference in the phonetic representation: after phonetic implementation, all tones will be converted to gradient values regardless of their origin as 'intonational' or lexical tones, and hence will be indistinguishable. Moreover, in current conceptions of the representation of intonation and pitch-arcent (Goldsmith 1981; Pierrehumbert 1980; Liberman and Pierrehumbert 1984; Selkirk 1984, 1985) all intonational melodies are represented autosegmentally just as in traditional 'tone' languages; the two will therefore be structurally indistinguishable even at a pre-implementational level.

A number of researchers have suggested appealing to functional considerations in attempting to explain why some surrogates represent intonational elements. Two such hypotheses merit consideration. The first relates the loss of intonational elements in tone languages to the lower functional load of sentence-level pitch phenomena in these languages. Presumably intonation plays a less significant role in a language which already has lexical tones, and hence intonation can be dispensed with in the surrogate of that language. Stated differently, perhaps the loss of intonational elements would lead to greater ambiguity in non-tone languages than in tone languages. This idea is formulated as the Tonal Disambiguation Hypothesis in (15).
(15) Tonal Disambiguation Hypothesis (TDH)

Surrogates represent all and only those tonal elements necessary to make an utterance unambiguous.

A second hypothesis centers on the observation in (14) that where a
whistled surrogate is involved (regardless of whether it is based on a tone or non-tone language), intonational elements are always represented. Perhaps the failure of instrumental systems to represent such elements is simply due to an inherent physical limitation of the modality. The phonetic representations of intonation and downdrift contours contain a multiplicity of different pitch levels; indeed, in downdrift systems there is a potentially infinite number of ever-decreasing pitch values. In whistling, the same number of pitch variations can be reproduced through the actions of the tongue and lips (cf. Pike 1943:147 and section 4.1.4.2) and therefore one would expect such elements to show up in a whistle surrogate. Instrumental systems, however, are often confined to musical instruments which have a range of only two or three distinctive pitches. It seems reasonable to assume that instrumental surrogates of tone languages would probably represent phonetic pitch variations if they could, but are simply prevented from doing so by the physical limitations of their instruments. This hypothesis has been suggested by several authors (e.g. Nketia (1971), Umiker (1974)) and is stated as the Modality Limitation Hypothesis in (16). (16) Modality Limitation Hypothesis (MLH)

Surrogates represent all and only those tonal elements which their modality will allow.

While each of the hypotheses in (15) and (16) appears quite plausible, a number of considerations indicate that neither can in fact be correct. I will consider the evidence against each of these proposals in turn.

### 3.1.3. Against the TDH

The Tonal Disambiguation Hypothesis as stated in (15) makes two claims: a) tone languages do not need intonational elements to get their essential
meaning across (i.e. they are unambiguous without them) and hence can dispense with such elements in their surrogates; and b) non-tone languages do need intonational elements to get their essential meaning across (i.e. they are ambiguous without them) and hence cannot dispense with them in their surrogates. The TDH also predicts that all phonemic contrasts of a tone language should be preserved by its surrogate, and that no surrogate should reproduce tonal elements that hinder comprehension of an utterance by obscuring phonemic contrasts. All of these claims can in fact be shown to be false.

While it is true that the phenomenon of downdrift in tone languages often carrries little or no meaning (lexical or otherwise), the same is definitely not true of downstep. As Courtenay (1971) notes, although the two phenomena are phonetically equivalent, "downdrift can be omitted with no difficulty....and there is no possibility of ambiguity being caused by such an omission. On the other hand, omission of 'non-automatic' downstep... would be an assault on the very structure of the language, often resulting in ambiquity..." (p.245). In many two-register tone languages, a downstepped high has the functional status of a third toneme and indeed was often misanalyzed in the early literature as a phonemic mid tone (cf. Stewart (1971:191-2) and Welmers (1973:84) for references to such misanalyses for Akan, Igbo, and Gã; and Winston (1960:185) for Efik). Thus, in Akan and Efik there are minimal triplets of words contrasting high, low, and downstepped high tones, as well as minimal pairs of utterances distinguished only by downstep (a downstepped high is notated as an exclamation point before a high tone).
(17) Akan
a. J̀bófó
'creator'
b. j̀bófó!
'messenger'
c. ذ̀bòfò
'hunter'
(Dolphyne 1986:35)
d. ádéń nà J́nhyé kàwá 'Why must he wear a ring?'
e. ádéńn nà únhỳ́ kàwá 'Why does he not put on a ring?'
(Stewart 1971:185) ${ }^{11}$
Efik

(Winston 1960:188)
If the representation of tonal elements in a surrogate were truly dependent on their potential to disambiguate or on some notion of functional load, the TDH would predict that the lowered high tones in these utterances should be reproduced in the surrogate. Yet in neither of these languages is the downstep tone in fact represented as a third distinct tone level ccf. Nketia (1971:728) and Simmons (1980:11-12) for explicit statements to this effect; for the various means utilized to get around such tones in the surrogate, cf. sections 4.1.1 and 4.2.3.3).

The second claim of the TDH, that intonational elements contribute crucially to the disambiguation of utterances in non-tone languages and their surrogates, can be easily refuted. Busnel and Classe (1976:76) observe that prosodic features such as intonation actually play an extremely limited functional role in the whistle surrogates of Turkish and Spanish (Aas and La Gomeran). In fact, their use is quite often either restricted or subsumed by other elements, which would not be expected if they were as important a component of non-tone language surrogates as the TDH would
suggest. Thus, although all whistled non-tone languages reproduce intonational patterns, many reduce the number of distinct contours which are allowed to occur on surrogate utterances. For example, while whistled Tepehua faithfully reproduces all seven intonational patterns found in the spoken language (Cowan 1972:695; 1976:1402), La Gomeran Spanish restricts surrogate intonations to an interrogative/ non-interrogative distinction (Busnel and Classe 1976:76), while in whistled Chepang all contours are apparently reduced to an emphatic intonation pattern (Caughley 1976:998).

A direct comparison of the treatment of question intonation in the La Gomeran Spanish and Hausa surrogate systems is particularly revealing in this regard. Downdrift in spoken Hausa may actually be considered to have a fairly significant role in the language, since by omitting it (and also raising the final high tone) a declarative sentence may be converted into a question (Welmers 1973:94). However, as downdrift is not represented in the surrogate (nor the final H-raising), interrogative particles (which may optionally also be used in the spoken language) must be drummed to indicate that a question is intended (Ames et al. 1971:28). Question intonation in spoken La Gomer an Spanish, in contrast, can be considered to play little or no functional role in the language. According to Busnel and Classe (1976:76), the tonal contour found on questions is insufficient by itself to signal a question, and is always supplemented in the spoken language with interrogative particles or constructions. In the surrogate, however, the intonation pattern of the spoken questions is invariably reproduced, but of course it too must be supplemented by the use of the interrogative particles to convey the appropriate reading. As Busnel and Cl asse note, the use of such words "could actually replace the rising intonation that in speech would normally be given to the question. But in fact, it does not." (p.76;
emphasis mine). The net result, then, is directly the opposite of what the TDH would predict: in at least one case where intonation plays a significant role in the spoken language, it is omitted in the surrogate (Hausa), whereas in at least one case where it is superfluous in the spoken language, it is retained by the surrogate (La Gomeran); as a result, each surrogate must resort to syntactic means to disambiguate the utterance.

A fourth argument against the TDH is that surrogates of tone languages often fail to represent fully even the phonemic pitch contrasts of their source language, while surrogates of non-tone languages often represent intonational elements at the expense of phonemic (segmental) contrasts. For example, in the drum language of the Jabo, the four-register tone system of the spoken language (consisting of high, high-mid, low-mid, and low; $c f$. Sapir 1931) is often reduced to no more than three contrasting levels: the low-mid and low tones are frequently not kept separate when drummed, and a high-mid drum tone is often substituted for a low-mid speech tone (this in spite of the fact that all four phonemic pitches can minimally distinguish utterances and can readily be produced on the drums used for surrogate speech) (Herzog 1945:562).

In the case of whistled non-tone languages, the articulation of tones often results in the neutralization of vowel qualities. Vowels in such surrogates are distinguished solely by their relative, pitch: [i] has highest pitch, [e] is slightly lower, [u] and [a] are still lower, while [o] is usually lowest. These pitch differences are caused by changes in the size and shape of the oral cavity when the tongue (and in some cases, the lips) assumes its configuration for each of the vowels; this is related to the patterning of the second formant in the spoken forms of these vowels (Coberly 1975:61; Busnel and Classe 1976:61). Intonational) pitch contours
in whistled languages are produced in the same way, i.e. by modifying the size and shape of the mouth through the movement of the tongue (rf. Pike (1943:147) for a description of the articulatory phonetics of whistles). Therefore, as Coberly (1975:61) and Busnel and Classe (1976:76) observe, the production of vowels and the production of intonational tones are in direct conflict in these surrogates, often resulting in obscuring of vowel qualities. In La Gomeran whistle speech, for example, the quality (=tone) of a whistled vowel is generally shifted one notch up in the descending series [i, e, $u, a, o]$ when produced on a high tone and one notch down when produced on a low tone. Yet in spite of these confusions, such pitch modulations are not eliminated from the surrogate system.

In conclusion, then, the presence of intonational elements in surrogates of non-tone languages and their absence in surrogates of tone languages simply cannot be attributed to a difference in their functional utility in these systems. The Tonal Disambiguation Hypothesis (15) must therefore be rejected.

### 3.1.4. Against the MLH

The essential claim of the Modality Limitation Hypothesis (16) is that if it is at all possible to represent some intonational element in the modality of a given surrogate, that element will be represented. According to this hypothesis, then, the reason downdrift is not represented is that the instruments used for tone language surrogates cannot accommodate the proliferation of phonetic pitch levels present in such a system. Three types of evidence can be adduced to show that this is not in fact the case.

First, a number of instrumental surrogates employ musical instruments which are capable of producing a (potentially infinite) continuum of pitch
levels, and yet these surrogates still do not reproduce downdrift. A prime example is the hourglass drum, widespread in West Africa and used for speech drumming in Hausa (where it is called kalangua). Pitch differences on this type of drum are produced by holding the drum under the arm and squeezing the cords joining the two drumheads with the armpit. The greater the tension on the cords, the higher the pitch, so that a gradient of an essentially unlimited number of pitch values may be produced (Ames et al. 1971:26; Nketia 1963:791-2; Armstrong 1955:870). Ames et al. (1971) note that these drums "can easily accommodate the pitch resources of practically all utterances... [and] could imitate not only the lexical tones but even the intonation of most Hausa utterances." (pp.25-6). Yet they most definitely do not, as noted earlier.

The same hourglass drum is played for Yoruba speech drumming (where it is called dundan) and yet its use is once again limited to reproducing only the three phonemic tones as well as the contour tones of the language, and not downdrift (Beier (1954), Arewa and Adekola (1980), Isola (1982); cf. Courtenay (1971) on the occurrence of downdrift in Yoruba). Furthermore, an hourglass drum is also found in the repertoire of Akan musical instruments, and yet it is not even used for the speech mode of drumming (Nketia 1963a:791-2). There are other examples of gradient pitch production being possible but non-occurring in talking instruments used for surrogates. Nketia (1963b:98) notes that the pitch range of Akan membranophones (skincovered drums) may be increased by varying the playing technique: by hitting the drumhead in the center (where the tension on the skin cover is the least) the lowest pitch will result, while hitting it at various increments outward will produce increasing pitch values until the highest pitch is reached at the edge (where the tension is the greatest). Nevertheless, such
pitch increments are only introduced for the (purely musical) mode of dance drumming (Nketia 1763a:798-800). Additionally, in Akan various trumpets (asesebEn) made out of elephant tusk or antelope horn are also used for surrogate speech. Nketia (1962:49) points out that these trumpets are "capable of imitating the falling intonation used in speech" but states flatly that downdrift is not in fact observed even when such instruments are employed (Nketia 1971:728).

A second argument against the MLH is that while in principle the number of phonetic pitch levels in a downdrift sytem is infinite, in practice the number is quite small. Anderson (1978) sums up the situation as follows: "since such 'terracing' accurs within the limits of the sentence or the phrase, and phrases are of finite length, there are fairly narrow practical limits to the number of levels that will actually be found in any one utterance." (pp.138-9). The number of discrete pitch levels that have been reported for a typical sentence is in fact remarkably consistent across many languages, ranging from a low of 5 reported for Hausa declarative sentences (Welmers 1973:94), through 6 (Schachter 1961:235) to 8 (Welmers 1973:82) for Akan as well as Tiv, Efik, Igbo, and Gã, up to a maximum of 9 posited for Yoruba (01mstead 1951) and Zulu (Beach 1924). 12 Furthermore, as Hyman (1996) and a number of investigators have noted for downstep systems, even where the lowering effects should in principle be unbounded and cumulative, there are often severe restrictions placed on the number of (lowered) levels that are allowed to occur. Hyman points out that no more than 2 sequential downsteppings are actually acceptable to speakers of Ngamambo (resulting in a maximum of 5 discrete pitch levels per sentence), while speakers of Yoruba vary considerably as to the degree of cumulative downstepping they will tolerate (ibid, p.133).

Utterance length is no greater in surrogates than in spoken languages (cf. Nketia (1971), Carrington (1944), and Armstrong (1955) for extensive collections of drummed texts and phrases), and therefore no more than the average of 8 or so levels found in spoken utterances would also occur in surrogates. Even this range is certainly not too great to be accommodated by instrumental means, contrary to what the MLH would imply. The tonal resources of African fixed-pitch instruments, for example, are considerably richer than the two or three level limit that is intimated by some authors for African percussion systems. But in all cases where instruments with a greater range are found, they are either not used for surrogate purposes at all, or else their full pitch range is not exploited for instrumental speech. Thus, the Akan seperewa or harp-lute which is occasionally used for surrogate speech has a. 5-7 note capability, but this is not utilized for representing downstep/downdrift (Nketia 1971:70; 1963b:97). Further examples are Bijago long drums (Wilson 1963:809), Luba wedge-shaped slit gongs (Carrington 1949:607-8), Banen hand-fluting (Dugast 1955:712), and Hausa bowed lutes (Ames et al. 1971:12), all of which have tonal ranges that exceed the number actually employed for surrogate purposes. 10

A second point is that even for instruments which do indeed have a fixed 2 or 3 tone limit, a technique known as HDCKET PLAYING is routinely employed for overcoming these limitations-- but only when the instruments are played for musical purposes. In this technique, individual instruments with fixed ranges but different registers are played sequentially, each sounding in turn the note or notes of the melody that fall within its range (Nketia 1962). The result is that a greater combined total of distinct pitches is available than could be produced by any one of the instruments individually. For example, Akan trumpet ensembles consisting of 5 to 7 instruments produce
up to 5 distinct tone levels (each trumpet has only 2 tones), while flute ensembles in northern Ghana pool together 7 notes, and it is reported that South African flute ensembles combine as many as 15 flutes (Nketia 1962:44, 49-51). The increased tonal inventories of these ensembles can certainly accommodate the range of actually-occurring levels in downdrift systems, but multiple-instrument systems are never used in this way for surrogate languages. 14

A third argument against the MLH is that other intonational elements in tone languages which do not invalve a potentially unbounded number of pitch levels (and hence are well within the limits of the instrumental modalities involved) are not reproduced in instrumental surrogates either. The first of these is, of course, downstep, which (as noted in section 3.1.3) often simply adds a third surface-contrastive level to the language. It would be quite plausible for a language such as Akan to ignore downdrift in its surrogate while still representing downstep by using a drummed mid tone. In fact, Nketia (1963b:97ff.) reports that the most typical drum ensembles in Akan contain three drums producing high, mid, and low tones, which would appear ideal for the three-way contrast of high, downstepped high, and low in this language. Once again, these are not exploited for surrogate language purposes.

Furthermore, there are a number of other intonational phenomena found in tone languages which involve only limited tonal resources but which are nevertheless ignored in instrumental surrogates. The entire question of how or even whether intonation is manifested in tone languages has rarely been thoroughly addressed in the literature (beyond the phenomenon of downdrift/downstep). Nevertheless, while many tone languages do truly seem to lack intonational phenomena, a number of investigators have identified a
cluster of intonational elements which characteristically appear in tone languages (Bolinger 1978:494-7; Lehiste 1970:100; Welmers 1973:99ff.). These may be grouped into three broad categories, the last of which is unique to tone languages: 1) assignment of sentence-end tones correlated with clause type (typically, lowered tone for declaratives/wh-questions, high or rise for yes-no questions); 2) assignment of high or mid tone at sentence-internal pauses; and 3) more complex modification or obscuring of lexical tone contrasts at the end of a pause-group cbased on Bolinger (1978), where 27 tone languages are surveyed).

None of these specific intonational elements is in fact represented in instrumental surrogates when they occur in the spoken language. In spoken Hausa questions, for example, the final $H$ tone of the sentence is raised in pitch, as noted earlier. This raising is well within the means of the hourglass drum, yet it is not represented (as stated expicitly by Ames et al. 1971:28). Similarly in Sizang and Kamhau Chin, lexical tones are modified before pauses, typically being replaced by low tones (Stern 1963:232-3; Henderson 1965:31). This change could readily be represented by the slit-gong drums used for surrogate speech in these languages, since they are otherwise able to represent low tones, but it is in fact not represented (Stern 1957:137). Finally, in Kickapoo, three basic sentence-final pitch changes are found: lowering for declaratives, high rising on the final vowel for interrogatives, and high level or high falling for emphatics Coorhis 1974:9), yet these are not carried over to the surrogate (Taylor 1975:360).13

From this discussion it is clear that instrumental modalities are in most cases quite capable of reproducing intonational elements, but simply do not; the MLH (16) must therefore be rejected. To conclude this subsection,
then, I have shown that an appeal to functional considerations cannot explain the appearance of intonational elements in some surrogates but not others, regardless of whether properties of disambiguation or modality limitations are considered. ${ }^{16}$ As a consequence, it cannot be maintained that surrogate conversion operates on phonetic representations, and (12)(13) must be abandoned, at least as far as instrumental surrogates are concerned. 17

### 3.2. Evidence for Postlexical Conversion

The failure of instrumental surrogates to incorporate elements such as downstep into their signals even when their presence would appear to be very helpful or simple to acconmodate suggests that such information is simply not available to these surrogates. In other words, surrogate conversion appears to be operating on a level of representation where lexical tones, but not intonational tones, are present. Intonational elements are lacking from the representation at the underlying level, throughout the lexical phonology, and perhaps even partway into the postlexical phonology; therefore these are all potential conversion sites. How deep in the phonology does instrumental conversion actually take place? Could it in fact be as deep as the underlying level? This would be an obvious place to start, especially given some authors' remarks to the effect that only "essential" tones are represented (e.g. Carrington 1953:680-1). However, a number of different kinds of evidence point to the conclusion that conversion cannot be at the underlying level, and must in fact be at least as late as the postlexical level. Since it has already been established that whistle surrogates reproduce intonational effects, the discussion of this evidence will be centered on instrumental surrogates.

### 3.2.1. Postlexical Phonological Rules

Instrumental surrogates unfailingly reproduce the effects of phonological rules which apply between words, i.e. rules of the postlexical module in (11). Foremost among these are processes which alter the lexical tones of words when they come to stand adjacent to other words or in certain syntactic configurations. For example, Nketia (1971:725-7) provides a detailed description of seven different tonal changes in Akan which take
place when words occur in specific constructions, all of which are reproduced in speech drumming. ${ }^{20}$ Efik bell language represents the effects of various tone rules undergone by nouns when preceded by adjectives (Simmons 1980:1-4), Manjaco drumming reproduces the tone raising of nouns in the genitive construction (Wilson 1963:815), while the effects of tonal transfer resulting from vowel deletion between words are reproduced in Idoma speech drumming and trumpeting (Armstrong 1955:868). Similarly, Kamhau drumming represents the effects of tone sandhi between words (Stern 1957:497).

Also reproduced in surrogates are the outputs of rules of vowel epenthesis and coalescence/assimilation which take place between words, already noted above for Idoma. Other examples include the fact that epenthetic vowels inserted to break up consonant clusters arising across word boundaries receive their own beats in the surrogate languages of Manjaco (Wilson 1963:815), Ewondo (Guillemin 1948:577-8), and Banen (Dugast 1955: 738), while the effects of vowel deletion and assimilation between words are carried over to Efik surrogate speech (Simmons 1980:12-13).

Finally, Akan speech drumming reflects resyllabification that applies between words. In a phrase such as meyan atuspan a 'when I drum', the underlined voweltnasaltvowel sequences are drummed as $[\mathcal{A} \delta$, reflecting transfer of the word-final coda nasal into onset position of the following (word-initial) syllable. The sequence is not realized as $[d \boldsymbol{d} \boldsymbol{d}$, the pattern these two syllables would have if resyllabification were not reflected in the surrogate (Nketia 1971:717).

### 3.2.2. Pauses

A second piece of evidence for conversion at the postlexical level is
that instrumental surrogates always reproduce the pauses found in speech, whether between words or at the juncture of larger constituents. This is noted explicitly by Nketia (1971:704) and Rattray (1922:371) for Akan drumming, Herzog (1945:561) for Jabo drumming, Taylor (1975:360) for Kickapoo fluting, Clarke (1934:420) for Tumba drumning, Wilson (1961:168) for Balanta, and Stern (1957:498) for Kamhau and Sizang drumming. While they may not concur on the exact nature or formulation of the process of pause insertion, researchers such as Mohanan (1982, 1986), Selkirk (1984), and Kaisse (1985) are all in agreement that such a process must apply after words are strung together in the syntax (i.e. in the postlexical module in a framework of lexical phonology).

### 3.2.3. Tonal Interpretation of Metrical Structures

A third argument for postlexical surrogate conversion comes from the fact that the fluted surrogate of Kickapoo reproduces tones. From the descriptions presented in Voorhis (1971, 1974) and Gathercole (1983), it is clear that the tones in this language are not lexical, but in fact pattern analogously to the pitch-accent system of languages such as Kimatuumbi, as analyzed by Pulleyblank (1983). According to Pulleyblank (1983, 1986), the tonal contours of what are traditionally known as 'pitch-accent' languages (as well as 'intonation' languages, as opposed to 'tone' languages) are the result of postlexical assignment of tones to metrical structures (excluding cases of pre-linked tones, as in Tonga). The fact that the Kickapoo instrumental surrogate reproduces such tones is in accord with the other evidence we have seen that the outputs of postlexical phonological processes are available to the surrogate component.

### 3.2.4. Sentence-Peripheral Modifications

A final argument for postlexical conversion concerns the fact that many surrogate languages treat sentence-peripheral and sentence-internal phonological elements differently. For example, in Hausa speech drumming a low tone which occurs on a long syllable that is not atterance-final is rendered with a simultaneous slap of the hand and hit of the stick on the drum (usually hitting and slapping are used by themselves) (Ames et al. 1971:28). In addition, various tonal modifications are made in the drumming depending on whether a tone occurs in initial, medial, or final position within the sentence (ibid., pp.28-9). This indicates that the surrogate system must have access to the sentential location of a given tone in assigning its realization. Many surrogates add special markers to indicate utterance-initial or utterance-final position: Idoma trumpet speech greatly lengthens final vowels (Armstrong 1955:873), Kele drum speech prefixes a special tonal pattern in utterance-initial position (Carrington 1949:631), while Kickapoo flute speech lengthens final vowels and adds a distinctive tonal pattern (Voorhis 1971:1438; Taylor 1975:360). If it is assumed that surrogate conversion is limited to operating on the representation of individual words (which are only later assembled into longer strings by the syntax), there would be no way of accounting for these phenomena. However, with the assumption that conversion is postlexical-- i.e. that entire sentences, and not single words, are submitted to the surrogate component-these types of phenomena are readily accommodated.
3.3. Instrumental and Whistle Modules

I have established (section 3.2) that conversion to an instrumental surrogate must be prior to the assignment of downdrift/downstep and other
intonational elements but no earlier than the postlexical level. I have also established (section 3.1.1) that conversion to a whistle surrogate, in contrast, cannot be any earlier than the assignment of downdrift/downstep and other intonation. The fact that both types of surrogate do not require access to any pre-syntactic level may be construed as evidence that the surrogate component itself is confined entirely to the postlexical module. In this section 1 will provide further definition to the internal structure of the surrogate component by positing two independent modules within it, one responsible for whistle languages, the other for instrumental languages. My task at this point is to determine the precise relationship of each to the levels of postlexical phonological representation.

### 3.3.1. Whistle Surrogates

The table in (18) presents a summary of the postlexical phenomena we have been examining and the way they are distributed between instrumental and whistle languages. The term 'pitch-accent assignment' is being used here as a cover term for both the assignment of intonational melodies (cf. Pierrehumbert (1980), Selkirk (1984, 1985)) and the tonal interpretation of metrical structures (Pulleyblank 1983). In addition, grouped along with downdrift/downstep in (d) are the phenomena of 'tonal intonation' such as pre-pause or utterance-final sandhi noted by Lehiste (1970), Welmers (1973), and Bolinger (1978) for tone languages (discussed previously in section 3.1.4).
a. Pitch-accent assignment + (Kickapo) + (Tepehua)
b. Postlexical phonological rules + (Manjaco) + (La Gomera)
c. Pause insertion + (Jabo) + (Mazateco)
d. Downdrift/downstep - (Akan) + (Gurma)

Examples of languages whose surrogates specifically exhibit or lack the property in question are indicated in parentheses in (18). The instrumental examples have already been discussed in section 3.2; I will now examine the evidence from whistle surrogates.

For (18a), numerous examples of the occurrence of intonational melodies in whistle languages have already been cited; cf. section 3.1.1. Postlexical phonological rules (18b) are abundantly instantiated in whistle speech (derived from both tone and non-tone languages). For example, Cowan (1948: 234) notes that Mazateco whistling reproduces all "syntactically significant glides" such as those occurring on nominals when preceded by an adjective (cf. Pike 1948: 100). Similarly, Classe (1957a:977) points out that whistled La Gomeran Spanish reproduces the post-vocalic spirantization of voiced stops occurring across word boundaries. Finally, in the whistle surrogate of Turkish as well as Aas and La Gomeran Spanish, a vowel is inserted before utterance-initial consonants (a in La Gomeran Spanish, o in Aas Spanish and Turkish), indicating that the surrogate must have access to the string-position of a word (as is the case for instrumental languages).

As far as pauses are concerned, it is clear from the descriptions of the articulated whistles of Turkish, Spanish, and Chepang in Busnel and Classe (1976), Busnel, Moles, and Gilbert (1962), Lenneberg (1970), Busnel (1970b), and Caughley (1976) that all aspects of timing, including pauses, are
virtually identical between the spoken and surrogate forms. Similarly, pauses in the utterances of Mazateco and Chin whistled speech occur at the same locations as they do in their spoken equivalents (Cowan 1948; Stern 1957:138).

The representation of downdrift in whistle speech has already been noted for Gurma (cf. section 3.1.1). The occurrence of the other tone language intonational phenomena in whistle surrogates is a bit more difficult to ascertain: spoken Mazateco, for instance, apparently has no intonational contrasts imposed upon its complex system of level and contour tones (Pike 1948:95-164). However, it appears that in Sizang and Kamhau Chin, the prepause and utterance-final sandhi effects (falling within Bolinger's typology of tone language intonation) are preserved in whistle speech and only omitted in the drum language (Stern 1957:137).

### 3.3.2. Postlexical Levels

From the table in (18), then, it is clear that whistle surrogates reproduce all the postlexical phonological phenomena we have examined, whereas instrumental surrogates reproduce all but downdrift/ downstep (keeping in mind that the latter category covers a number of different tonal phenomena). Does this asymmetry correspond to an independently-motivated property of the organization of the postlexical phonological module? In other words, is there a distinct level of representation which includes all of (18a-c) but excludes (18d), and which could therefore serve as input to instrumental but not whistle languages? In fact there is.

The postlexical module has generally been viewed as an essentially undifferentiated postsyntactic component of the grammar. Recently, however, a much richer conception of the organization of this module has been
emerging. Liberman and Pierrehumbert's (1984) original proposal that there are two parts to the postlexical phonology has been followed by the more elaborated and articulated models of Selkirk (1984, 1986), Kaisse (1985), Pulleyblank (1986), and Mohanan (1986). These researchers have focussed on a number of different sentence-level phonological phenomena, working with different sets of assumptions and not always in the same sorts of frameworks. Selkirk, for example, does not specifically endorse a model of lexical phonology. Nevertheless, the work of all four researchers converge in the recognition of a number of different postlexical levels and rule clusters. The divisions which must be recognized, and their relative ordering, are consistent across each of their individual frameworks. In the overall model which I have arrived at in the synthesis of their frameworks, at least four distinct postlexical levels of representation can be identified. I have summarized these, placing them within the lexical phonology framework given earlier in (11), on the lefthand side of (19). The frameworks of each of the four authors are given on the righthand side of (19) for comparison. I have assigned each of these four levels a number, since they go by different names or (more frequently) have remain unnamed, depending on which author's work is consulted. I should also point out that I am using the term 'level' here in a slightly different way from its standard usage in lexical phonology: it refers in this case to the level of representation which is the output of a given block of rules or processes, rather than to that block of rules itself.

LEXICON


Several explanations are in order concerning the correspondences between the four individual models and the comprehensive framework I ultimately arrive at. First, Pulleyblank (1986) motivates the placement of downdrift/downstep assignment in what he calls the phonetic implementation module, which corresponds to Mohanan's (1986) postsyntactic module; in (19) this means anywhere after Level 3. In the frameworks of Clements (1981a) and Huang (1980), the calculation of the lowering effects in downdrift/ downstep systems is viewed as a two-step constituency-based process, only a portion of which is directly implementational: tonal feet are first erected over a sequence of tones, each foot being headed by a low tone (whether linked or floating); phonetic pitch levels are then calculated off this hierarchical structure. I have assigned the creation of this hierarchical structure to the earlier of the two subdivisions of the postsyntactic module (which corresponds to Selkirk's (1986) "phonological subcomponent") since as noted earlier hierarchical structure is destroyed within the phonetic implementation module per se (Mohanan 1986). For now it is important to recognize only that this belongs to the Postsyntactic component.

Second, Pulleyblank (1983,1986) places the tonal interpretation of metrical structures within the postlexical component up to and possibly including the phonetic implementation module, which in terms of the levels in (19) is anywhere after Level 1. I have narrowed its range to between Levels 1 and 2 for the following reason (although the exact location within the 'Syntax' module is not in fact crucial for my analysis). It is not Clear that the assigment of tonal melodies in, say, Kimatuumbi is formally distinct from the assignment of pitch-accents in intonation languages (both involve the linking of tonal autosegments to metrically specified positions); cf. Pierrehumbert (1980), Pulleyblank (1983). Since Mohanan
(1986) and Selkirk (1984, 1986) concur in placing 'intonation' proper (e.g. for a language like English) between Levels 1 and 2, I have simply adopted this as the paradigm location of all pitch-accent assignment.

Third, Selkirk (1986) notes that pause insertion (her 'silent demibeat addition') may have a domain extending between Levels 2 and 4, with perhaps its primary functions coming into play after Level 3. Mohanan (1986) and Kaisse (1985) place it between Levels 2 and 3, however, and this position (which is not inconsistent with Selkirk's) is the one adopted here. It should also be pointed out that Kaisse's "levels" refer to rule groups or components rather than levels of representation; additionally, some of her rules of external sandhi (pre-Level 3) would be placed by Selkirk (1986) in the phonological subcomponent (post-Level 3).

Fourth, what were originally grouped together as postlexical phonological rules in a number of early models of lexical phonology (e.g. Mohanan (1982)) now have a number of different locations in the grammar: those sensitive to syntactic information and/or insensitive to the location of pauses occur between Levels 2 and 3; those which are sensitive to the location of pauses occur between Levels 3 and 4; while those which specify allophonic or phonetic detail occur after Level 3 and in many cases after Level 4. Since the postlexical rules discussed earlier are primarily of the first type (tone rules applying in various syntactic configurations, epenthesis which is dependent only on the allowable syllable shapes of the language), I have grouped these prior to Level 3.

Finally, no explicit position on the location of assignment of intonational elements for pure tone languages has been adopted by any of the researchers in question. I have placed them in the Postsyntactic module because: 1) They are part of a cluster of intonational properties which (as
identified by Bolinger 1978) also includes downdrift; since downdrift belongs firmly in the postsyntactic module (Pulleyblank 1986), I have grouped all of these phenomena in the same location; and 2) as described by Bolinger (1978) and others, the types of intonational phenomena found in tone languages refer exclusively to sentence type and/or pause location, and never to the more detailed type of syntactic information required in such 'typical' intonation languages as English (Mohanan 1986:147; Selkirk 1985); this is consistent with placing such rules in the module where syntactic information is no longer available, namely after Level 3.

### 3.3.3. Conversion Sites

Comparing (18) with (19), it can be seen that all of the phenomena which are reproduced by instrumental surrogates are assigned prior to Level 3, while all of those which instrumental surrogates do not reproduce (but which whistle surrogates do) are assigned after Level 3 (namely the phenomena subsumed under the rubric of downdrift/downstep in (18)). This indicates that the representation at Level 3 must serve as the input to instrumental surrogate conversion, while conversion to whistle surrogates must take place after Level 3. This is illustrated by the model in (20). Notice, then, that the division between instrumental and whistle systems falls at the boundary between the two principal modules within the postlexical component, namely what Mohanan (1986) calls the 'Syntax' and the 'Postsyntactic'. The autonomy of these two modules is independently motivated on the basis of spoken language phonology, but the fact that this fundamental division of the postlexical component is recognized by surrogate systems argues very strongly for the existence of an independent level of representation mediating between them (i.e. Level 3 in (20), corresponding to what Mohanan
(1986) labels the 'syntactico-phonological' representation and made up of what he terms 'phonological phrases').
(20)

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Further evidence for the placement of the Instrumental Module prior to the Postsyntactic component can be found in the treatment of certain
epenthetic vowels in Hausa speech drumming. In contrast to the cases cited in section 3.2 .1 , in which epenthetic vowels uniformly receive their own beats in the surrogate, Hausa speech drumming ignores inserted vowels. However, the segments in question are purely transitional vocoids which appear between certain consonants. According to Ames et al. (1971:27), "Anaptyctic vowels, i.e. vowel 'embryos' wholly predictable from a particular articulation within a consonant cluster, e.g. -rk- pronounced [ $\left.r^{1} k\right]$ or $\left[r^{2} k\right]$ or $-r H^{-}\left[r^{\omega_{w}}\right]$ are ignored in the syllable count." These vowels have the hallmarks of what Levin (1987) classifies as 'excrescent' segments, a class of inserted vowels which she proposes are systematically distinguished from true or canonical 'epenthetic" vowels. Such segments, also sometimes called euphonic, organic, or inorganic vowels, are found in numerous languages and are frequently transcribed with a small raised vowel symbol to indicate their somewhat nebulous status: Levin cites examples in Piro, Hua, Mokilese, Sakao, and Hixkaryana. An excrescent vowel exhibits all or most of the following properties: a) its quality is variable, generally determined by phonetic coarticulation effects (either languageparticular or universal), and frequently tends toward schwa; significantly, it does not necessarily correspond to any of the underlying vowel qualities of the language; b) its insertion is triggered not by stray (i.e. unsyllabified) consonants but rather by the need to mediate a transition between "adjacent articulations requiring some degree of constriction in the oral tract"; and c) it is not referred to by any of the phonological rules of the language (Levin 1987:194). In contrast, canonical epenthetic vowels generally have a nonfluctuating quality which is part of the underlying inventory of the language, their insertion is conditioned by unsyllabified consonants, and they may be referenced by phonological rules.

According to Levin, excrescent vowels are inserted in the phonetic component of the grammar; in terms of the model in (20), this would mean at least after Level 3, and most likely after Level 4, since the coarticulatory nature of these vowels strongly sugests that they are part of the process of Phonetic Implementation. In the model of the surogate component developed in this section, the Instrumental Module does not have access to any processes occurring after Level 3. Since the excrescent vowels of spoken Hausa are not present in the representation that is fed to the surrogate, it follows automatically that these vowels should not show up in Hausa speech drumming. This example therefore provides strong confirmation for the location of the Instrumental Module arrived at on the basis of independent considerations.

At this point the precise location of the Whistle Module presented in (20) needs to be addressed. From (18) it is apparent that this module must have access to the information introduced as late as Level 4, namely downdrift/downstep, etc. However, it also appears that whistle surrogates employ the timing details and gestural realignments introduced after Level 4 in the phonetic implementation module of the spoken language. For example, in an extensive instrumental study of whistled Turkish, Lenneberg (1970:1044) found a near-perfect match in syllable duration between spoken and whistled words; Classe (1963:990) found virtually identical syllable length measurements in surrogate and non-surrogate speech for La Gomeran Spanish. Similar effects are observable in the spectrograms and/or spectrographic tracings of whistled and spoken Aas Spanish (Busnel, Moles, and Gilbert 1962:904-5), Chepang (Caughley 1976:1016-17), and Gurma (Rialland 1981a), among others. ${ }^{19}$ In addition, X-ray cinematography of, for example, whistled Turkish (Leroy 1970a) and La Gomer an Spanish (Busnel and Classe 1976) shows a very close match between the articulatory sequencing
used in whistled and spoken language-- in other words, speakers are simply attempting to pronounce their language as they ordinarily would while whistling at the same time (Classe 1957a:969).

Although these phenomena could be accounted for by having whistle surrogate conversion apply directly off the phonetic representation, two things argue for having the Level 4 representation first passed to the Whistle Module and then fed back into the phonetic implementation module, as indicated in (20). First, as $I$ will show in the next section, whistle languages often perform systematic modifications on segmental phonological features, such as converting the value [-continuant] into [+continuant] for certain segments. These altered values are articulated as they would normally be for a segment of spoken language with the same feature value. This can be accounted for by having only the surrogate-specific changes performed in the Whistle Module, with the result then simply carried out by the spoken language implementation module. Secondly, the implementation of tones in whistle speech is based on the same phonological features used for spoken language, but those which specify the articulation of the organs of the oral cavity rather than the larynx. For example, Pike (1943:147) notes that a high whistle tone is made by placing the tongue in the configuration for the vowel [i], while for a low tone the tongue assumes an [u]-like configuration. Other articulatory gestures are also used, such as those found in spoken [5], [ $\check{y}]$, labialization, or retroflexion. In other words, in the Whistle Module the independently-required oral cavity features such as [high], [back], [round], etc. are being mapped onto the phonological entities of high tone, low tone, etc. Such features then receive their usual articulatory implementations in the spoken language phonetics, only in this case they result in variations in the whistle pitch. If the Whistle

Module is not fed back through the spoken language phonetics, therefore, we lose the ability to exploit the implementation component already in place there for the realization of these features.

### 3.4. Segments (Or Lack Thereof)

The model of the surrogate component I have presented in (20) can explain the asymmetries between instrumental and whistle surrogate languages in their treatment of intonational elements. However, some refinement is needed, since as it stands this model cannot yet account for one other major asymmetry in surrogate systems, given in (21).
(21) Surrogates of tone languages never reproduce segments (consonants or vowels) while surrogates of non-tone languages always do. This generalization was first observed by Hasler (1960) for whistle languages and has also been noted by Busnel and Classe (1976:82) and Nketia (1971:714) for whistle and instrumental systems respectively. 20

The absence of segments in instrumental surrogates is perhaps to be expected, since most musical instruments are suited to representing only elements such as pitch, length, intensity, etc. Their absence from whistled (tone) languages, though, is perplexing: consonants and vowels are articulated in all of the whistles of non-tone languages reported in the literature, so why should they fail to be realized in the whistled languages of Mazateco, Ibo, Wahgi, Piraha, Chin, and the more than 30 other whistled tone languages reported in Cowan (1976)? According to the model in (20), there is in fact nothing to prevent such segments from being articulated when the surrogate representation returns to the spoken language phonetic implementation module.

### 3.4.1. Functional Explanations

Once again, a number of functional explanations for this asymmetry have been suggested in (or can be inferred from) the descriptive literature on surrogate languages. In section 3.1 .2 we saw the pitfalls of ascribing properties of surrogate language structure to superficially-appealing functional considerations, and the same is true in this case. I will consider in turn a number of these explanations, and show that each must be rejected.

Building on the observations of Coberly (1975) and Busnel and Classe (1976) (noted in section 3.1.3) that the articulation of tones in whistles may tend to neutralize some segmental contrasts (particularly vowel qualities) of a language, it might be hypothesized that segments and tones are simply articulatorily incompatible in whistled language. This is easily refuted, however, when one considers that primarily vowels are adversely affected by whistled tonal articulation (and hence the absence of consonants would remain unexplained), and moreover tones and segments are articulated simultaneously in surrogates of non-tone languages, since they reproduce intonational tones.

In many tone languages, pitch contrasts carry a high functional load (in terms of 'lexical' meaning). Faced with such oft-cited tours de force as the 12 segmentally identical utterances of Mazateco with 12 distinct tonal readings (Pike 1948:23), or the 30 such utterances in Jukun (Welmers 1973:97-8), one might be tempted to hypothesize that in such languages consonants and vowels are in effect 'not needed' to get across the meaning of an utterance, and therefore can readily be dispensed with when converted to a whistle surrogate. If this were the case, however, one would expect whistled utterances in such surrogates to be unambiguous, and this is far
from true. Classe (1957b:120) and Busnel and Classe (1976:82-3) point out that whistled tone languages are considerably more ambiguous than the whistles of non-tone languages specifically because of their $105 s$ of segments, while Cowan (1948:1389) observes that the substantial ambiguity inherent in Mazateco whistle speech is quelled only by limiting whistled conversations to topics familiar to the participants, and using stock phrases to open a discourse and signal the context.

Since some information must always be lost when conversion to a surrogate takes place, it has been suggested that surrogates simply employ a strategy that will inimize ambiguity, rather than eliminate it altogether. The line of reasoning is that the loss of tones would perhaps lead to greater confusion in these languages than the loss of segments. This notion is formulated as the Ambiguity Minimization Hypothesis in (22).
(22) Ambiguity Minimization Hypothesis (AMH)

In choosing which elements of the spoken representation to preserve, a surrogate will select those whose loss would lead to greater ambiguity. This is essentially the position adopted by Everett (1985), who notes in his description of Pirahã whistle speech that the consonant system of the spoken language is highly impoverished and rampant with free variation and fluctuant articulations (his "sloppy phoneme effect") and consequently bears a low functional load in the language compared with prosodic elements. While the AMH sounds quite plausible, three types of evidence indicate that it is untenable.

First of all, the consonant system of Pirahã is in fact quite exceptional among the world's languages both in its size (one of the smallest ever reported) and its variability. In most tone languages which have whistle surrogates the inventories are considerably more developed, and
the loss of segments in such systems would actually lead to greater ambiguity than the loss of tones.

In Mazateco, for example, the consonant and vowel system is substantially richer than that of Pirahã (as Everett himself notes), and yet segments are still dropped in the whistle surrogate. This cannot be attributed to the more extensive tonal inventory of Mazateco 'taking over' the duty of segments, either, as a simple computation will reveal. While it is true that a given syllable in Mazateco may bear any of four contrastive level tones or 10 contour combinations of these (compared to only high or low in Pirahã), the segmental makeup of that syllable (maximal shape CCCVVV) may have any one of 81 different consonants or consonant clusters and 36 different vowels or vowel clusters (Pike and Pike 1947). This means that a segmentally-specified monosyllabic word will be potentially ambiguous between 14 different tonal readings, while a tonally-specified monosyllabic word will be potentially ambiguous betwen 2,602 different segmental readings (taking into account all phonotactic restrictions and excluding rarelyoccurring sequences). 21 The AMH is obviously being violated by the dropping of segments in this surrogate.

Similar statistics can be adduced for African languages, in particular those whose tonal and segmental inventories are not even as extensive as Mazateco's. Efik, for example, has 12 consonant phonemes, 7 vowels, and 2 level tones (which may also combine to give rising and falling contours as well as downstepped high) (Welmers 1973): compare this with Pirahã's 7 consonants, 3 vowels, and 2 tones (Everett and Everett 1984). Simmons (1980:9-10) calculates that in Efik the tonal pattern of a typical surrogate utterance such as oson ubok oson inua is in fact ambiguous between more than 1,025,690,08B different segmental readings. This figure is arrived at by
partitioning the tonal melody into its constituent words, totalling the number of other words in the language of the same major category (noun, verb, adjective, etc.) which have the same tone pattern, and multiplying across. 22 In contrast, Essien (1977) found that the segmental string ekpat ubok anwan ai okpon in the same language is ambiguous between only 6 different tonal readings. ${ }^{23}$ Of course, in both this and the Mazateco case, it is not the exact values of these figures which is important, but rather the clear discrepancy between tonal and segmental ambiguity which they reveal.

Finally, attestation of the relatively greater importance of segments than tones in carrying meaning may be had in the simple observation that practical orthographies of African tone languages often get by with no tonemarking whatsoever. Examples include Akan, Efik, Hausa, and Yoruba (Tucker 1964, 1971; Welmers 1973). Furthermore, even the indigenous syllabaries developed by speakers of Vai, Loma, and Mende for writing their own languages dispense with writing tone (Dalby 1967:4). 24 Reading such or thographies or writing systems involves supplying the tones missing from the segmental specifications; although in some cases this may be difficult (cf. Courtenay 1971, Essien 1977). However, the problems encountered are nothing compared to the near impossibility of supplying segments if (for some absurd reason) only tones were written in the orthography.

A second argument against the AMH is that it is not so clear that the role of tone in some 'tone' languages (whose surrogates reproduce tone but not segments) is any more important than the role of segments or intonation in non-tone languages. As is well known, the distinction between tone and non-tone languages is often not a sharp one, and tone may play a variety of functions in different languages (cf. McCawley (1978) and Welmers (1973) for
some discussion). The function of distinguishing single lexical items, often thought of as a hallmark of the use of tone in 'tone' languages, is in fact quite poorly developed in Akan, Hausa, and many Bantu languages. According to Welmers (1973:117), minimal pairs distinguished solely by tone occur with surprising infrequency in these languages, leading Stewart (1971:183) to remark that Akan could in fact be considered to be only a "rather marginal sort of tone language". In Yoruba, in contrast, tone plays. a considerably more important role in minimally distinguishing utterances (Courtenay 1971; Welmers 1973) and yet the surrogates of all of these languages are oblivious to this difference, reproducing tones but not segments in each case.

On the other hand, in La Gomeran Spanish consonants make up less than half of the phonetic material and are subject to considerable free variation and variability in articulation, especially among the group [r, $1, n, \delta]$ (Classe 1957a:972-3). In fact, Classe observes that in many cases the vowels and stress alone are sufficient to determine the identity of a word. In short, La Gomeran Spanish appears to exhibit the "sloppy phoneme effect", and therefore one would expect consonants to be dispensed with in the surrogate. Yet this is most definitely not the case.

Finally, the basic idea that surrogates pick out only the truly essential phonological elements of their source language is fundamentally flawed in two respects. First, if a surrogate language were in fact attempting to maximize the contrastive features of its spoken language while eliminating those that are useless, one would expect a much lower degree of ambiguity in the signals than is actually found (even taking into account the considerable strain imposed upon the communicative channel by the use of an alternate sound source). The fact is that surrogates are far from being
efficient information transmitters. The literature is rife with accounts of the extent of surrogate ambiguity, and more to the point, the elaborate steps that must be undertaken to eliminate it. What is most interesting is that in all cases nonphonological means are employed to overcome it. For example, in Akan the size of the vocabulary and number of syntactic constructions used in surrogate utterances are drastically reduced. In addition, a technique known as ENPHRASING is employed, in which a lexical item that is ambiguous by itself is placed in a sentential context coften quite lengthy and roundabout) which will make its meaning clear (and which would not otherwise be needed in the spoken language; Nketia 1971). In many surrogates pragmatic considerations (social setting, discourse markers) are manipulated to control ambiguity. It is never the case that phonological elements which could help disambiguate the utterance are added to the signal (e.g. consonants in a whistled tone language). Thus, although surrogates strive to eliminate ambiguity, its elimination is not an overriding determinant in the spoken-to-surrogate conversion process. Rather, it appears that elements such as consonants in tone languages, though much needed, are prevented from being expressed by a more fundamental constraint within the overall organization of the surrogate system.

Second, it is simply not possible to attribute the presence of any given linguistic element in a surrogate uniquely to its utility in conveying the meaning of the utterance. A prime example of this is the phenomenon of 'useless' articulations found in whistled non-tone languages. Researchers working on these surrogate systems have repeatedly remarked on the fact that certain segmental articulations are retained even when they have no appreciable acoustic effect, that is, even when they could not possibly be considered to convey any meaning. Their presence is verifiable by $X-r a y$
cinematography and observation of the articulatory movements of whistlers. Examples from La Gomeran whistle speech include ihe inaudible articulation of $r$ when occurring in the clusters $r t$ and $n r$ (Classe (1957a:980), lowering of the velum, which fails to alter the quality of the signal in this surrogate (Busnel and Classe 1976:70), and sporadic laryngeal activity which is inaudible at the distances that whistle communication is used for (Classe 1957a: 978). It is also reported that whistlers of Turkish and Spanish contract their lips around their fingers (inserted into the mouth) when producing bilabial and rounded segments, even though complete closure and rounding are impossible and no acoustic effect whatsoever results (Lenneberg 1970:1045; Classe 1957a:978). 25 All things considered, then, the AMH (22) must be rejected as an explanation for the absence of segments in whistled tone languages.

### 3.4.2. A Structural Explanation

Notice that the problem of segmental absence cannot be explained simply by setting up a totally separate whistle module for tone languages which is lacking implementation rules for segments (as is the Instrumental Module). Two things argue against such an approach. First of all, this would involve building an undesirable amount of redundancy and duplication into the grammar, on two levels. The same vocal apparatus that is used for spoken language is used for whistled language, and is used identically for whistled tone languages and whistled non-tone languages. Thus, the various ways of creating a primary stricture in the oral cavity, the airstream mechanisms used, and the use of the fingers in producing a whistle cut across the distinction between tone and non-tone languages. As (23) shows, for every whistle type used for surrogate purposes, there can be found both a tone and
a non-tone language which employs it.
(23)
Whistle Type Tone Languages Non-Tone Languages

1) Bilabial

| a. Egressive | Mazateco <br> Kele <br> Ibo | Tepehua <br> Chepang |
| :---: | :--- | :---: |
| b. Ingressive | Pirahã | Tepehua |
| 2) Dental |  |  |


| a. Nondigital Sizang | Turkish <br> Chepang <br> Spanish (Tlaxcalan) <br> b. Digital Sizang | Spanish <br> Turkish |
| :--- | :--- | :--- |

If we were to set up two separate whistle modules, the same specifications for whistle type would have to be duplicated in each (cf. section 4.1.4.2 for more on the exact feature specification required). Additionally, as noted in section 3.1.3, the implementation of tone and segment production in whistles is based on the same phonological features used for spoken language (with perhaps a few additional nonlinguistic specifications for finger position, etc.). If the whistle module is not fed back through the spoken language phonetics in the case of tone languages (in order to avoid implementation of segments), we lose the ability to exploit the implementation component already in place there for the realization of tones in whistle speech (specified in terms of tongue-body features).

A second and more important argument against setting up a separate whistle module for tone languages is that there is no way of distinguishing tone and non-tone languages at the level of representation where whistle surrogate conversion must take place. Recall from section 3.3.1 that whistle surrogates of all languages must have access to information introduced as late as the postsyntactic module. At this level,
representations in the two types of languages will be alike in the crucial respect that vowels will be tone-bearing in each case (i.e. associated to tonal autosegments); hence they cannot be treated differently at this late stage.

However, there is one important difference to be noted: in one case the tones will have originated in the lexicon, while in the other they will have originated in the postlexicon. Thus, there does exist a structural difference between tone and non-tone languages, but only at or before Level 1 in the postlexical component (prior to the assignment of pitch accents). This level is within the domain of the surrogate component (as schematized in (20)); I will therefore posit a Selection Module located at Level 1 in the surrogate component, whose function is to read the representation at this level and alter it depending on the presence or absence of tones. The effect of this alteration is to select tones over segments when both are present, otherwise to select segments.

The basis for this selection is a geometrical property of the phonological representation. The essence of the selection operation is that one or the other of segments or tones must be sacrificed when surrogate conversion takes place, and tones are given priority over segments in all cases. This priority is not, as I have emphasized repeatedly in the previous discussion, a reflection of its functional load in the language or any limitations of surrogate modalities. Rather, such priority follows directly from the place of tone within a hierarchical representation of features. In order to see this, we need to trace the history of the autosegmental representation of tone.

In early versions of autosegmental phonology such as Goldsmith (1976), tone, along with perhaps nasality, was the only feature assigned to its own
autosegmental tier (at least at the pre-phonetic level). In this framework the difference between tone-bearing and non-tone-bearing vowels (in a hypothetical tone language and non-tone language respectively) prior to the assignment of intonational tones would be represented as in (24).
(24) a. ${ }^{1}$
b. i
H
i

With this type of representation, the structural priority of tones over segments could be straightforwardly characterized: one need only say that autosegmentalized features take precedence over segmental features. With the introduction of a skeletal tier as in McCarthy (1979, 1981) as well as the recognition that a wider range of features could behave autosegmentally (e.g. [ATR] in vowel harmony systems), this structural distinction was no longer available. The representation provided by the theory for the segments in (24) was now as shown in (25) (assuming both languages have ATR harmony).
(25) a. i b. i


Precisely this situation arises in Akan, in fact, since the language has both tone and [ATR] harmony (for an autosegmental analysis of the latter, cf. Clements (1981b)). In such representations, it is not sufficient to appeal to placement on an autosegmental tier to distinguish tone from, say, [ATR], since neither tier containing these features is more 'autosegmental" than the other. There is in fact no clear structural characterization of traditionally 'suprasegmental' features (like tone) as opposed to
traditionally 'segmental' features. Consequently, no principled explanation can be offered for why a surrogate of the language in (25a) should choose to represent tone over [ATR] Cor any of the other vowel features for that matter). 26

Recently a more highly articulated theory of the organization of phonological features has emerged, exemplified by the hierarchical models of Clements (1985) and Archangeli and Pulleyblank (1986) (among others). In these frameworks, the notion of the quintessentially prosodic nature of a feature such as tone (which provided the original motivation for the development of autosegmental theory, and which could be characterized so elegantly in early frameworks) is once again available. (26) gives the hierarchical structure of the same segments in the hypothetical languages charted in (24)-(25), as they would be represented in the feature hierarchy of Archangeli and Pulleyblank (1986) (this particular model of feature geometry has been chosen because it is the only such framework to address in detail the location of tonal features within the hierarchy). For the sake of this example I assume that the tone language (26a) has three level tones, i.e. the use of both tonal features [upper] and [raised] is required (cf. Pulleyblank 1986).
(26) a. 1
b. $i$

Macro Node/Skeleton
Tonal Node
Root Node
Supral aryngeal Node
Place Node
Secondary Place Node

+ATR

In (26a) the tonal features are no longer structurally equivalent to all other features; they are separated from the root node and grouped under their own class node linked directly to the skeleton. All other segmental features, in contrast, are dominated by class nodes lower down in the hierarchy. This asymmetry in the representation formally encodes the independence of tone from segments in its behaviour in spoken languages (Archangeli and Pulleyblank 1986:54-56). This asymmetry can also be invoked to explain the selection of tones by surrogate languages.

In (26) the node that is retained by the surrogate for each language type has been blacked in. In each case it is a node which is linked directly to the skeleton. In (26b), (a non-tone language at Level 1), there is only one such node-- the Root node-- while in (26a) (a tone language), there are two such nodes-- the Root and Tonal. I will define a PRIMARY NDDE as a class node which is linked directly to the skeleton (i.e. a class node which forms a minimal path with the macro node in Archangeli and Pulleyblank's (1986) terminology), and a PRIMARY TIER as a tier defined by primary nodes. The two primary nodes in (a) are structurally distinct in two ways: 1) the Tonal node dominates fewer features than the Root node; and 2) the Tonal node is a terminal class node whereas the Root node is a nonterminal class node. Two considerations indicate that it is only the terminal/nonterminal distinction which needs to be accessed by the surrogate Selection Module.

First, consider the representation that the vowel in (26a) would have in a tone language where the features [hi], [bk], and [rnd] are all supplied by default rules postlexically (i.e. after Level 1):
(27)

```
i
+rupper
Macro Node/Skeleton
Tonal Node
Root Node
Supralaryngeal Node
Place Node
Secondary Place Node
```

In this case the Root node dominates fewer features than the Tonal node, but it is still the Tonal node which is selected by the surrogate. Clearly the relative number of features is irrelevant. Secondly and more significantly, the distinction between terminal vs. nonterminal class nodes is independently required within phonological theory for cases of node selection in spoken languages. Shaw (1987) shows that examples of the nonconservation of melodic structure in Nisgha and Ewe reduplication involve an enforced choice between various nodes of the feature hierarchy. This choice is in all cases based on the headedness of the nodes involved, where headedness is a structural property defined in part as the difference between a terminal and a nonterminal class node:
(28) Melodic Headedness II (Shaw 1987:295)

Where branching in the melodic representation does not define a precedence relation, headedness between two nodes, $N_{2}$ and $N_{2}$, in a branching relation is defined in terms of:
a. systemic markedness theory: where universal markedness theory characterizes a possible language inventory as having $N_{i}$ but not $\mathrm{N}_{2}, \mathrm{~N}_{1}$ constitutes the head.
b. systemic dominance relations: where $N_{1}$ is a nonterminal node and
$N_{2}$ is a terminal node, $N_{1}$ constitutes the head.
The 'head" may be thought of informally as that node in the feature hierarchy which "functions as more salient or criterial than the other (s)" (Shaw 1987:293).

I therefore propose that the principle of surrogate selection is based on this geometrical distinction, as stated in (29).
(29) Principle of Surrogate Selection (PSS)

In a representation which includes more than one primary tier, select the one defined by terminal class nodes.

It is interesting in this regard that surrogate languages appear to reverse the priority found in spoken languages. That is, in the cases of node selection examined in Shaw (1987), only head nodes are conserved when a choice must be made. According to her criteria, the Tonal node is clearly the nonhead constituent at the level of primary nodes (since it is terminal and need not be lexically defined in a language), and this is confirmed by the fact that reduplication in tone languages often copies only the segmental portion of the melody (Shaw 1987:305). Thus, it would seen that in surrogates only nonhead nodes are conserved when both are present in the representation (or perhaps, that the Tonal node acquires the status of 'head" in the surrogate system). See Chapter 4 for further discussion of this reversal.

The notion of 'selection' in (29) could be viewed in one of two ways: 1) as a kind of projection which makes only tiers which have been selected visible; or 2) as an actual deletion of tiers which have not been selected. This distinction is not crucial for my analysis and therefore $I$ will leave this issue open for now. Notice that entire tiers rather than individual nodes must be selected, since the fact that a given segment in a language
lacks a particular node does not necessarily mean that that tier is not defined in the phonological representation. The crucial issue is whether a given node is present within the underlying inventory of the language as a whole rather than on any particular segment; $c f$. the notion of 'systemic markedness' in (28).

### 3.5. Summary

The completed model of the surrogate component developed in this section is given in (30). 27
(30)

LEXICON


In the preceding discussion it has been shown that, on the basis of a wide range of spoken language phenomena studied by a number of researchers, at least four distinct levels of representation can be recognized within the postlexical phonology; this particular organization of the postlexical component gains further support when we turn to examine surrogate language systems. In particular, Mohanan's (1986) division into a 'Syntactic' module and a 'Postsyntactic' module is exploited within the surrogate component as the basis for a fundamental distinction between instrumental and whistle systems: the output of the 'Syntactic' module serves as input to the Instrumental Module but not to the Whistle Module. This is reflected in the differential treatment of intonational elements (located in the 'Postsyntactic' module) by these two types of surrogates. The fact that both downdrift and downstep pattern together in this regard lends validity to a number of recent theoretical treatments of these phenomena, in which they are rendered essentially indistinct from a formal standpoint in spite of widely differing functional status and different structural configurations of the triggering low tones (linked vs. floating).

Furthermore, the fact that at least some of the information encoded by downdrift/downstep systems must be made available to the Whistle Module prior to the level of phonetic implementation supports the two-step, constituency-based approaches of Clements (1981a) and Huang (1980). In these approaches, there is a pre-implementational stage at which hierarchical structure is erected; this is subsequently interepreted in the spoken language phonetics (converted ultimately into varying laryngeal gestures), but it is also available to the Whistle Module for implementation in surrogate-specific ways, namely mapping onto oral cavity gestures. A single-
step, purely implementational approach to the calculation of downdrift/downstep effects such as those presented in Anderson (1978) and Liberman and Pierrehumbert (1984) cannot readily accommodate the modalityindependent aspects of pitch lowering required by surrogate systems. In these latter approaches, local sequences of tones are scanned in the phonetics and implemented directly; since no hierarchical structure is erected, such approaches are unable to capture the fact that the same types of pitch lowering occur regardless of whether these are realized ultimately as laryngeal or oral gestures.

In this section it has also been shown that the treatment of segments in the surrogates of tone languages points very strongly to the existence and integrity of the root node in a hierarchical conception of feature organization. In these surrogates, the root node is not being mapped, whereas everything else is. The principle in (29) invokes a rationale for why this should be the case, one which relies crucially on the geometrical notions of terminal class node and adjacency to the skeleton. Specifically, it appears that surrogate languages do not tolerate the presence of more than one primary tier (directly skeleton-adjacent) in the representation, and consequently eliminate the one which is not composed of terminal class nodes.

## 4. The Autonosy of the Surrogate Component

The basic organization of the surrogate component having been established, 1 will proceed in this section to flesh out the content of each of its modules. It will be shown that the surrogate system is not entirely parasitic in its relationship to linguistic structure, restricted to transferring elements from one modality to another, but is in fact more autonomous, in that it can actually manipulate the phonological representation in ways of its own. I have already referred to a number of rules in the preceding section which exemplify both types of relationship; in the following discussion I will provide a more detailed typology of these two kinds of processes. Those rules which map linguistic elements onto elements specific to the surrogate modality I will call TRANSFER RULES. Those rules which map elements of phonological structure onto other elements of phonological structure (these being subsequently interpreted by transfer rules or the phonetic implementation rules of spoken language) I will call (SURROGATE) PHONOLOGICAL RULES proper.

### 4.1. Transfer Rules

Considerably more types of transfer rules can be found in instrumental surrogates than in whistle surrogates simply because there are many more aspects of the modality which are not shared with spoken language (the use of external resonators, instrumental playing techniques, etc.). In this subsection 1 will reconsider two instrumental transfer rules already discussed in connection with Akan speech drumming-- beat assignment and tonal realization-- as well as examine a number of other types in both instrumental and whistle systems.

### 4.1.1. Beat Assignment

In section 2.2 .2 beat assignment was characterized as the mapping of a drum strike onto a syllable nucleus. Two issues remain to be discussed in connection with this rule: a) In which module(s) of the surrogate component is it located? and b) Is reference to syllable structure both sufficient and necessary for a proper characterization of this process?

Depending on the type of instrument used, what I have been referring to as a beat will in fact have a number of different articulatory realizations. It may of course be implemented as the strike of some object (usually a hand or stick) upon some surface: this is true not only for membranophones such as Akan atumpan or Hausa hourglass drums, but also for idiophones such as Kele and Chin slit-log gongs, Banen xylophones, and Efik metal bells, all used for surrogate speech. For talking chordophones such as the Akan harplute or Olombo two-stringed lute (Carrington 1949), the beat will correspond to the pluck of a string, while for aerophones such as Idoma trumpets, Mossi two-holed whistle-flutes, or Banen and Kickapoo hand-fluting, it will be realized as a change in finger position and perhaps also breath flow.

While the notion of beat would therefore seem to be closely tied to instrumental surrogates, it is in fact also found in whistle surrogates, but only for whistled tone languages. In Mazateco whistle speech, for example, the tone of each syllable is whistled as a separate beat or pulse (what Cowan (1948) refers to as a whistle 'punch'), these being separated from each other by very brief silent transitions (cf. the spectrograms of Mazateco whistled utterances in Busnel and Classe 1976:33). The same phenomenon can be observed in Gurma whistling, where individual syllables are seen on the spectrographic tracings as uninterrupted stretches of pitch separated from each other by very short gaps (Rialland 1981a). 20 Finally,

Everett (1988:220) notes that "syllable divisions are clearly marked by individual pulses" in Pirahã whistle speech.. Whistled non-tone languages, in contrast, are always conveyed by a continuous pitch stream (which may of course be broken by the articulation of consonants that also cause interruption of the airflow in spoken language) rather than a series of detached notes (Classe 1957b:118).

Since beat assignment is therefore sensitive to the distinction between tone and non-tone languages, it might appear that it should be placed in the Selection Module of the surrogate component where such a distinction is structurally available. However, as noted previously, epenthetic (nonexcrescent) vowels inserted postlexically (i.e. after Level 1) uniformly receive beats in surrogate languages. Therefore Beat Assignment cannot occur in the Selection Module, but must instead be localized in each of the Whistle and Instrumental Modules. How, then, are tone and non-tone languages to be distinguished for this process in the Whistle Module? In fact, due to the PSS (29), tone languages will always have only one primary tier in their surrogate representations after Level 1 (the tonal tier) while non-tone languages will always have two (tonal and segmental). Thus; the proper characterization of beat assignment is that it only occurs when the surrogate representation has a single primary tier.

In order to determine which elements of the phonological representation must be accessed for beat assignment, I have assembled the beat realizations in various surrogate languages of all possible combinations of elements on the nucleus, skeletal, and tonal tiers. These are given in (31), along with specific examples in (32). Where two elements are indicated on the tonal tier in (31) these are to be understood as two different tones. 20
(31)

Phonological Structure:

Number of elements on: nucleus tier 1 skeletal tier tonal tier


1
1 2


| 1 | 1 | 2 | 2 |
| :--- | :--- | :--- | :--- |
| 2 | 2 | 2 | 2 |
| 1 | 2 | 1 | 2 |

Surrogate Realization:
One Beat
a. b.
all Efik
Mazateco
c.
d.
e.
$f$
Balanta
Hausa
*
*
Hausa Luba
Luba
Two Beats
9. h.
i. $\quad j$.
$k=$
1.

* Ewondo

Jabo ${ }^{30}$
Manjaco
Balanta
Akan
Akan
Kele
Jabo
Jabo
(32)

Surrogate
mord
Beat Realizational
Source

| 1. Akan | bèá | 'place' | L Hoz | Nketia (1971:719) |
| :--- | :--- | :--- | :--- | :--- |
|  | fúfú́ó 'white' | H H H | Nketia (1971:719) |  |
| 2. Balanta rí́tè ? | H: L | Wilson (1963:813) |  |  |
|  | mánjoेó ? | HLH |  |  |

3. Efik
4. Ewondo
átâ
'burns'
H H
Simmons (1980:20)
5. Hausa
àk 'foot?s
LLH
Nekes (1912:76,82)
6. Hausa
k'Stfè 'metal'
sà '(3rd pl. H-L:
Ames et al. (1971:35) future)'
7. Kele
8. Luba
yéétó
'metal'
LH H
L: H
L: L
9. Manjaco ùcáák ? $?$

LHH
Wilson (1963:812)
9. Mazateco

'firewood'
M H-MP4
Cowan (1948: 1392)

| '=high tone | T=single short beat |
| :--- | :--- |
| =low tone | T: =single long beat |
| =lower-mid | $T$ T=two short beats |



Notice that all patterns of beat assignment in (31) are attested except (e), (f), and (g). Of these, (f) and (g) represent assignment of a beat number which does not correspond to the number of elements on any of the three phonological tiers (nucleus, skeletal, tonal). This indicates that at least no sore information than that encoded on these tiers is required for the proper assignment of beats. Pattern (e), the only other unattested cell, corresponds to the number of beats that would be assigned if only elements on the tonal tier were being scanned. This indicates that the
tonal tier cannot serve as the sole input to beat assignment. Although one might have initially hypothesized that the surrogate is simply 'reading off' the tonal autosegments like a musical score, two further pieces of evidence confirm that this cannot in fact be the case.

Consider first a sequence of syllables with several consecutive high tones: CÚCÚCÚCÚCV́. Assuming the OCP, this will be represented autosegmentally by a single high-toned autosegment linked to all of the vowels. If beat assignment were scanning only the tonal tier, such a sequence should be realized as a single beat in the surrogate. This is never the case, however: in Akan, for example, this would be drummed as 5 individual high-toned beats. The Akan system also provides a second argument against beat assignment to tonal autosegments cone which, incidentally, is not dependent on assuming the OCP). as According to Nketia (1971:729), downstep sequences in Akan are often drummed simply by omitting the floating low tone that triggers downstep; ${ }^{36}$ the sequence óréséné ák'! ' when he passed here on his way' is realized in the surrogate as if it were óréséné ák'́ , that is, as [HHHHHH]. Looking at the autosegmental representation of this word (33), it is clear that if beats were being assigned to all and only tonal autosegments, the drummed realization should be *[H L H], incorrectly including the low tone (as well as having too few high-toned beats).


If it is assumed that beat assignment is not based on the tonal tier, however, the fact that floating tones are ignored can be straight forwardly accounted for. Given the well-motivated principle of spoken language phonology that elements which are unassociated to the skeleton remain
unpronounced (cf. Halle and Vergnaud 1982;68), it follows automatically that floating tones should 'drop out' of the representation in this case (with the minimal assumption that such a principle is operative in the surrogate component, and where 'pronounced' means given an articulatory implementation, whether spoken or instrumental). In spoken languages as well as whistle surrogates, of course, floating low tones may affect the pronunciation of linked tones (without themselves being pronounced) by being: incorporated into the hierarchical structure erected for downdrift (cf. Section 3.3.2). This possibility never arises in instrumental surrogates because conversion occurs prior to the creation of such hierarchical structure.

If the tonal tier is not being accessed in beat assignment, then which of the remaining two tiers is? (34) presents three hypotheses and their counterexamples in this regard.
(34) Access to:
a) nucleus tier only
b) skeletal tier only
c) nucleus or skeletal tier

Counterexamples (from 31):
h, i, j
$b, c, d, h$
h

None of the hypotheses is in fact without exceptions. Of the three, however, access to either the nucleus or skeletal tiers (34c) is counterexemplified by only one language-to-beat mapping, namely the realization of a contour tone on a short vowel (31h). It is significant that this exception involves a structure which is also marked within spoken language: many tone languages do not allow contour tones on short vowels at all, and they are frequently subject to simplifications or modifications even when they do occur. Moreover, the exceptional behaviour of such structures in surrogates can in fact be accounted for if we consider the
process that provides tones with their articulatory realization.
In most surrogate tone languages a distinct tone cannot be realized without also adding a distinct beat (e.g. striking the drum). In some modalities, however-- whistling, and the hourglass drum-- tonal glides can be produced without adding a second beat for the additional tone. Notice in (31) that in all cases where the modality will permit it (Hausa hourglass drum (d) and Mazateco whistling (b)), tone contours are in fact realized with a single beat when a single nucleus node is present. Even in some cases where the modality requires an additional drum strike (Efik (b), Luba (d)), that additional strike is eliminated by not realizing one of the tones of the contour (see section 4.2.3). In the pattern exemplified by Ewondo and Jabo in ( $h$ ), then, it appears that the articulatory realization of tones is simply being allowed to override the constraint exerted by the single beat/nucleus, a constraint which is otherwise rigidly adhered to. I therefore hypothesize that only nucleus or skeletal information may be accessed in beat assignment, and state this more formally in (35).
(35) Beat Assignment (Whistle and Instrumental Modules)

When a single primary tier is available in the surrogate representation, assign a beat to N or its skeletal projection. Reference to a single primary tier in (35) insures that beat assignment will only apply to languages with tones present at or before Level 1 (i.e. tone languages), as discussed earlier. I assume that the two options given in (35) (N or its skeletal projection) are values of a single parameter which must be set for each surrogate; I further assume that $\mathbf{N}$ is the unmarked setting simply because it is used in the majority of cases exemplified in (31). 37 Notice, then, that the fact that Beat Assignment is not modalitydependent (i.e. it cuts across' the distinction between instrumental and
whistle systems, and across many different instrumental realizations) indicates that it is considerably more than a matter of surrogate 'phonetics'.

### 4.1.2. Skeletal Projection

If a surrogate language chooses the option in (35) of assigning beats to skeletal positions, these must be slots within the nucleus. This is because even though the timing slots of coda consonants may be accessed by a surrogate to determine beat length (e.g. in Akan, Gurma, and Hausa all closed syllables receive a long beat), these slots are never assigned a beat of their own. The fact that onset slots are never recognized in a surrogate even for length purposes, on the other hand, was accounted for in section 2 as a process of rime projection on the skeletal tier which is independent of beat assignment. In determining the length of its beats, it appears that surrogates of tone languages once again have two options in this regard: they may select either the skeletal projection of the nucleus (e.g. Balanta uses long beats for long vowels but not for closed syllables) or the skeletal projection of the rime (e.g. Hausa uses long beats for both long vowels and closed syllables).

In non-tone languages however, all timing slots within the maximal projection of the syllable ( $N^{\prime \prime}$ ) are utilized, including those in onset position. In Tepehua speech whistling, for example, onset clusters are articulated as they normally would be in spoken language (Cowan 1976), while in Turkish and La Gomeran Spanish whistle speech, affricates in onset position cause a slightly lengthened gap in the whistle stream when they are pronounced (Classe 1957a:978; Leroy 1970a:1149). These examples indicate that the surrogate system must take into account the presence of onset slots
and their associated segments. This difference in the use of the skeleton for tone and non-tone languages is formalized in (36).
(36) Skeletal Projection (Selection Module)

When two primary tiers are present in the phonological representation, select the skeletal projection of $N$ or $N$ '; otherwise, select the skeletal projection of $\mathrm{N}^{\prime \prime}$.

This projection operation has been placed in the Selection Module (where only tone languages have two primary tiers) since it is sensitive to the distinction between tone and non-tone languages and does not depend crucially on the output of any postlexical operations after Level 1 (as does Beat Assignment).

### 4.1.3. Tonal Realization

We saw in the preceding discussion that in a few cases the articulatory realization of tones is able to override beat assignment, while in most other cases beat assignment takes priority and may even dictate that some tones not be realized. What determines this difference? The answer appears to lie in the distinction between articulatory and acoustic correlates of phonological features in surrogate languages.

In spoken language the phonological features used to characterize tones (for example, [upper] and [raised] in the system of Pulleyblank (1986; based on Yip (1980))) represent acoustic dimensions, partitioning the pitch range into a number of discrete categories. In phonetic terms, of course, all such features ultimately receive an articulatory realization when they are translated into various laryngeal gestures regulating the fundamental frequency. In terms of phonological categorization, however, the acoustic dimension is primary (cf. Anderson (1978) for further discussion).

In instrumental languages, on the other hand, it appears that the articulatory specification of a particular tonal feature (like the assignment of beats) may be more than a matter of simple 'phonetic realization'. In most systems, it is true, the particular articulatory realization of tones in terms of hand assignment, location of strike, playing technique, etc. is not under active control of the surrogate, but merely follows from the physical arrangement or mechanics of the instruments involved. In these systems tones can be considered to specify the same acoustic categorization as in spoken language, with the particular articulatory realization being supplied by the extralinguistic aspects of the modality. For example, in Tumba speech drumming, high and low tones may both be struck with either the right or the left hand and the choice is not significant in the surrogate system. Any pattern is acceptable so long as the correct tones are sounded, and different individuals do in fact use different sequences (Clarke 1934:419). 3e Similarly, in Hausa speech drumming the representation of tones is constrained by an articulatory playing technique which has as its effect a purely 'phonetic' upsweeping effect. On the hourglass drum it is apparently easier to sustain a high tone over a series of consecutive beats by exerting increased tension on the cords of the drum towards the end of such a sequence (Ames et al. 1971:29). The result is that a string of several phonemic high tones in a row will often actually be realized on steadily increasing pitches. 3 s

In contrast, in some instrumental surrogates the articulatory realization of a tone does not appear to be left merely to the constraints of the instruments involved. In the speech drumming of languages such as Balanta, Bi jago, and Manjaco, specific hands are rigidly prescribed for each beat, and the message is not considered acceptable unless the correct hands
are used (Wilson 1963:811). The same is also reported of Ewondo (Nekes 1912; Stern 1957). In Jabo speech drumming a complex set of articulatory specifications are enforced for each speech tone: the two [-upper] tones of the spoken language (the lower register) are required to be beaten on the left-hand side of the drummer, preferably by the left hand, while the two [+upper] tones must be beaten on the right-hand side (even though the opposite arrangement would be physically possible) (Herzog 1945). In addition, individual tonal features are assigned specific finger configurations: [-upper] tones must be drummed with a cupped hand, [+upper, -raised] tones are assigned a beat by the middle phalanges of the finger, while the fingertips are prescribed for the [+upper, traised] tones. In Akan speech drumming it appears that whether the dominant or recessive hand is used to beat a given tone is significant, and in fact determines the location of the drums in relation to the drummer. According to Rattray (1922:382), low speech tones must be beaten with the dominant hand, so that if the drummer happens to be left-handed, the usual positions of the drums (low-toned drum on the right side, high-toned drum on the left side) must be reversed.

Finally, the primacy of the articulatory realization of a linguistic tone in surrogate speech over and against its acoustic realization is dramatically illustrated by the phenomenon of tone reversal observed by Herzog (1945:568) for Jabo speech drumming. In the slit-log gong used for this surrogate language, high tones are beaten on the lip of the instrument closer to the player, low tones on the lip farther from the player. Herzog notes that in one particular case the instrument had to be turned around because of excessive wearing on one side; drummers continued, however, to assign high tones to the closer lip and low tones to the farther lip. Since
the position of the instrument was now reversed, this meant that most spoken high tones corresponded to drummed low tones while most spoken low tones corresponded to drummed high tones. The situation was apparently tolerated because the articulatory specification of the tones (which side of the instrument was struck) remained constant, even though their acoustic realization was in fact the opposite of what it should have been.

Returning to the table in (31), it can be seen that most of those cases where the realization of tones can override the number of beats assigned to the nucleus involve languages for which the assignment of articulatory correlates of tones appears to be primary, e.g. Jabo, Balanta and Manjaco (assuming the default assignment of beats to N in (35)), and possibly Ewondo. This seems to indicate that even at the level of transfer rules, a difference must be recognized between essentially 'phonetic' and essentialy 'phonological' specifications: the same physical event (e.g. use of the right or left hand) is significant and specified in one surrogate (Balanta), and may interact with other principles of surrogate organization (Beat Assignment), while it is noncontrastive and variable in another surrogate (Tumba).

### 4.1.4. Whistle Transfer Rules

Whistle transfer rules may be divided into two types: those that specify features not found in spoken language phonologies at all (analogous to hand assignment in drum languages), which I will call EXTRALINGUISTIC TRANSFER RULES, and those which map elements of the linguistic representation onto phonological features that are found in spoken language but are not used to articulate the particular linguistic entity concerned (e.g. use of tongue body features to articulate tones). These will be designated LINGUISTIC

## TRANSFER RULES.

### 4.1.4.1. Voiceless Transfer

A number of different extralinguistic transfer rules must be recognized for whistle languages: those that specify the use of pulmonic ingressive airstream, the various placements of fingers within the mouth and on the tongue, and the specification of absence of airflow to or from the lungs. Of these, only the latter is of immediate interest to us because of its interaction with a number of the phonological rules proper to be discussed in the next section.

In spoken languages, air is allowed to flow continuously through the oral cavity from the lungs, subject to blockage (in the form of segments) only by the organs of the vocal tract. In whistle languages, on the other hand, pulmonic airflow is actively regulated on a segmental level through the action of the thorax muscles and diaphragm (Busnel and Classe 1976:64). Since in all whistle languages the vacal folds are held continuously open (except for glottalized segments, to be discussed in section 4.2.1), any voicing contrasts in the spoken language cannot be maintained in the surrogate through the action of the larynx. Instead, (spoken) voiceless segments are translated uni formly into an absence of pulmonic airflow in whistle speech. This is observable as a break in the curve on spectrographic tracings of whistled utterances. Although such breaks may also result from interruptions of the airflow in the oral cavity or at the glottis (as pointed out by Classe (1957a:970)), a number of considerations indicate that it is in fact the feature [-vce] (and not [-cont] or [+constricted glottis]) which is being mapped onto this breath interruption.

First, voiceless fricatives are always produced with such an interruption in whistled speech even though they are not made with complete
closure in either the oral cavity or the glottis, whereas voiced fricatives typically have a continuous pitch stream (for examples in specific surrogates see Busnel and Classe (1976:68, 72) for La Gomeran Spanish, Leroy (1970a:1151) for Turkish, Cowan (1976) for Tepehua, and Coberly (1975:64-5) for Tlaxcalan Spanish). Secondly, even when complete closure of bilabial stops is prevented (by the insertion of fingers into the mouth) or suppressed (in the case of Tepehua bilabial whistling), such segments are produced with an interruption of the airflow, but only when they are voiceless (Busnel and Classe 1976:64; Cowan 1976:1403). Finally, voiceless vowels (which involve no oral or glottal constriction) occur utterancefinally in spoken Tepehua: in the surrogate the airflow (and consequently the pitch stream) of the whistle is suspended for the production of these segments (Cowan 1976:1403). This mapping of voicelessness onto pulmonic airflow interruption may be characterized by the following rule (where the feature [pulmonic airflow] is usually redundantly specified as [+] in spoken languages).
(37) Voiceless Transfer (Whistle Module)
[-vce] ---> [-pulmonic airflow]
I assume that the feature [-pulmonic airflow] is implemented as the movement of the thoracic muscles and diaphragm so as to prevent air from leaving the lungs.
4.1.4.2. Linguistic Transfer Rules

In spoken language the articulations responsible for the primary sound source and the production of pitch contrasts cannot be separated: both are functions of the fundamental frequency, implemented through the actions of the larynx. In whistle languages, though, both of these functions are taken over by the tongue and lips and are divided between two articulatory
specifications. These specifications are assigned by the linguistic transfer rules of the surrogate, which utilize the distinctive features of spoken language phonology to designate 1) the location and configuration of the primary stricture within the oral cavity, which produces the fundamental pitch stream of the whistle when air is passed through it; and 2) the gestures which must be carried out by the tongue and/or lips to produce pitch modulations. The articulatory correlates for each of these are summarized in (38) and (39), along with the distinctive feature specifications required to describe the gestures involved.
(38) Primary Whistle Strictures

| Whistle | Stricture | Articulatory | Feature |
| :--- | :--- | :--- | :--- |
| Type | Location | Configuration | Specification |

a) Bilabial $\begin{aligned} & \text { between lips, and } \begin{array}{l}\text { rounded and } \\ \text { between lips and } \\ \text { upper incisors }\end{array} \\ & \text { protruding } \\ & \text { lips }\end{aligned}$
Sources: Pike (1943:147); Cowan (1976:1401); Busnel
b) Dental between tongue $\begin{array}{lll}\text { and teeth }\end{array} \quad \begin{aligned} & \text { apico-dental } \\ & \text { to apico- } \\ & \text { postalveolar; } \\ & \text { spread lips }\end{aligned} \quad\left[\begin{array}{l}\text { [-rnd] }]\end{array}\right.$

Sources: Coberly (1975:E2); Busnel and Classe (1976:48); Cat ford (1977:157)
(39) Pitch Modulations (L=lower pitch; H=higher pitch)

| Articulatory Organs/ | Linguistic Analogue | Feature |
| :--- | :--- | :--- |
| Configurations | Specification |  |

1. Lips (nondigital dental whistles only)
a. L: rounded lips
b. H: unrounded lips

| labialized | [+rnd] |
| :--- | :--- |
| non-labialized | $[-r n d]$ |

Sources: Pike (1943: 147)
2. Tongue body, non-grooved
a. L: high back tongue position
[u], velarization [+hi, +bk]
b. $H$ : high front tongue position
[i], palatalization
[+hi, -bk]

Sources: Pike (1943:147), Busnel and Classe (1976:47)
3. Grooved tongue body, tip neutral
stridency
a. L: central tongue position
[ك], shibilance
$[+5 t r,+a n t,+c o r]$
b. H: forward tongue position
[s], sibilance
[+str, -ant, +cor]

Sources: Pike (1943:147)
4. Grooved tongue body, tip active
a. L: tip curled sharply upward
b. H: tip lowered or neutral
stridency
[s], retroflexion [+str,-distr]
[s], non-retroflexed
[+str, $+d i s t r]$

Sources: Fike (1943:147); Coberly (1975:62)
Notice that all of the articulatory movements and configurations can be satisfactorily characterized in terms of the distinctive features which are independently required for the articulation of ordinary segments in spoken language. This is not surprising, since as Pike (1943: 146) notes, they essentially correspond to the articulations used for various fricatives in spoken languages. Whistle strictures are classifed by Cat ford (1970:323) as one of several "universal human articulatory stricture type[s]" along with stop, fricative, approximant, etc. They differ in that a slightly greater degree of constriction is employed so that a shrill pitch (instead of simply
random turbulence) is created when air is forced through the constriction. This difference is presumably related to a different implementational value for the feature [+continuant].

The function of the linguistic transfer rules is simply to map the feature specifications in (38) and (39) onto the representations of the spoken language. Primary stricture specifications are imposed on the articulation of all segments, while pitch modulations are mapped only onto tonal autosegments (taking into account hierarchical structure which encodes downdrift/downstep, when present).

### 4.2. Phonological Rules

In this section I will document the occurrence of surrogate rules which directly manipulate elements of phonological structure on their own, in ways which parallel (but do not replicate) those found in their respective spoken languages. I begin with articulated whistles, in which the necessity for recognizing such rules is especially clear.

### 4.2.1. Articulated Whistles

In most, if not all, articulated whistle languages (i.e. those based on non-tone languages), the pronunciation of certain consonants is systematically altered. This alteration must involve the manipulation of linguistic features, since the output of the Whistle Module is read by the phonetic implementation submodule just as any spoken phonological string would be. However, the specific alterations which are carried out differ considerably from surrogate to surrogate, although they are consistent across speakers within a given surrogate. This indicates that they cannot be attributed to the automatic, universal, and individual articulatory
strategies which are known to be adopted by the vocal apparatus in compensating for 'unnatural' production demands (as in the articulation of bite-block vowels; cf. Lubker (1979); Lindblom, Lubker, and Gay (1979)).

Of course, some such compensatory strategies have been noted for Whistled speech: for example, Coberly (1975), basing her observations in part on characteristics shared by spontaneous whistled English and established whistle languages such as Tlaxcalan Spanish, observes a tendency for bilabial sounds to be articulated with some velarization (perhaps, as she suggests, to make up for the loss of labial constriction attendant in many whistle systems). It also appears that all coronal sounds may be articulated somewhat farther forward in the mouth. Undoubtedly other strategies occur as well. However, the vast majority of articulatory modifications that have been reported in the literature are not of this type: they do not occur automatically in every surrogate, and the specific environments and segments affected are not the same for processes that do occur in more than one. This indicates that such processes constitute a codified, surrogate-specific system. Moreover, a number of such processes, though differing in detail, do recur across more than one surrogate: this suggests that a limited set of processes is made available within the Whistle Madule for each surrogate to draw upon in its own ways. I will consider each of these processes in turn, noting the variations that are manifested in various whistle languages.

### 4.2.1.1. Glottalization

In a number of whistled languages certain consonants are articulated with simultaneous glottal closure. In La Gomeran Spanish whistle speech, for example, all voiceless stops as well as $s$ are pronounced with constricted glottis (Coberly 1975:64-6); in Kickapon, glottal closure is
added to (or perhaps substituted for) all stops (Voorhis 1971:1435), while in Tepehua whistle speech nasals may be optionally glottalized (Cowan 1976: 1403). Glottalization has also been reported for the whistle surrogates of Aas Spanish (Busnel, Moles, and Gilbert 1962:885-6) and Turkish (Busnel 1970b:1058). It must be emphasized that in the spoken form of none of these languages are the segments in question glottalized at either the underlying or surface level. 40 Moreover, it is quite clear that the feature [+constricted glottis] which is added to the articulation of these consonants in the surrogate is implemented phonetically in exactly the same way as it would if it were part of the spoken phonological string: Busnel, Moles, and Gilbert (1962) found in X-ray film studies of whistlers that glottalization consists of raising the larynx while the vocal folds are closed, exactly the same as in the articulation of ejective segments in spoken languages (Ladefoged 1971:25).

### 4.2.1.2. Denasalization

In Turkish whistle speech the feature [nasal] is not used at all-- Xray cinematography reveals that the velum remains raised throughout the production of an entire whistled utterance, and oral and nasal stops are not distinguishable in the acoustic signal (Leroy 1970a:1137, 1148). In the Whistle surrogate of La Gomer an Spanish, as well, the velum may optionally not be lowered for nasal stops (Classe 1957a: 978 ), while in Tepehua $n$ is optionally denasalized. This is in direct contrast to the surrogates of Tlaxcalan Spanish (Wilken 1980:883) and Chepang (Caughley 1976) as well as the majority of occurrences of nasal consonants in Tepehua (Cowan 1976:1404), where the nasalization on nasal stops is quite acoustically distinct. 41

### 4.2.1.3. Palatalization

According to Classe (1963:989) and Busnel and Classe (1976:71), all alveolar consonants in La Gomeran Spanish are palatalized in the whistle (i.e. they become [-ant, tcor, thi]). Although this may be a function of the immobilization of the anterior portion of the tongue for the production of the dental whistle stricture, palatalization has also been reported as a feature of consonant articulation in the bilabial whistle of Tepehua, in which the tongue is not employed for the whistle stricture (Cowan 1952; Umiker 1974). Moreover, it has nat been noted for any of the other dental whistles (Turkish, Aas and Tlaxcalan Spanish, and Chepang, although the latter does articulate segments which are palatalized in the spoken language).

### 4.2.1.4. Continuantization

In a number of surrogates, consonants which are articulated with a complete oral cavity closure in the spoken language lack such a closure in the whistled form. This involves a change of the continuancy of the segment ([-cont] --) [+cont]) and in all cases is not due to a supposed physical impossibility of making the closure (as is the case for bilabials in whistles in which fingers are inserted into the mouth). This is because other [-cont] segments at the same place of articulation are not altered, or else the process is optional (i.e. complete closure is still physically possible). Thus, in Turkish whistle speech the liquids $l, r$ are articulated with no contact of the tongue on the alveolar ridge (r is a tap in the spoken language); contrast this with whistled Tlaxcalan Spanish, in which the alveolar lateral, tap, and trill are all distinct and articulated as they normally would be in the spoken language. 42 In Tepehua whistle speech bilabial stops and nasals are optionally articulated without complete lip
closure (Cowan 1976:1403). In the whistle language of La Gomeran Spanish, n is usually articulated as a continuant; some speakers, however, maintain the [-cont] specification of $n$ wile making $p$ [+cont], thereby preserving the distinction between these two segments that is eliminated by the surrogatespecific palatalization of $n$ (Busnel and Classe 1976:71).

### 4.2.1.5. Devoicing

All segments in articulated whistles are phonetically voiceless since they do not involve any vibration of the vocal folds. However, in a number of cases segments which are voiced in the spoken language behave like spoken voiceless segments when whistled, in that they cause an interruption of airflow even when there is no glottal or oral closure. This may be accounted for by positing a rule of devoicing which affects such segments prior to the application of the rule of Voiceless Transfer (37); recall that the latter rule will result in their being articulated with [-pulmonic airflow] (along with the other voiceless segments of the spoken language). For example, in Tepehua whistle speech all nasals, liquids, and $w$ are devoiced; the result is that $y$ is the only non-vowel in the inventory which does not cause a break in the airflow of the whistle (whether through [-cont], [+constricted glottis], or [-pulmonic airflow] specifications) (Cowan 1976: 1403, 1405). In Turkish whistle speech all fricatives are devoiced, and cause preceding liquids in a cluster to devoice (and hence break the whistle) (Leroy 1970a:1151, 1155). Devoicing of sonorants is also reported for La Gomeran and Tlaxcalan Spanish; furthermore, in these surrogates voiced bilabials (only stops in La Gomeran, both stops and fricatives in Tlaxcalan) are also devoiced, so that these segments interrupt the whistle even though there is no labial closure (Busnel and Classe 1976:70-1; Cl asse 1957a: 978; Coberly 1975:64-6). In Chepang, however, sonorants which are
voiceless in the spoken language are kept distinct from voiced sonorants in the whistle. Unlike the examples mentioned above, in this whistle language voiced sonorants do not cause an interruption in the airflow; this may be explained as the absence of a rule of (sonorant) devoicing in this surrogate (notice that, were whistled Chepang to have such a rule, its effect would be to neutralize spoken voiced and voiceless sonorant consonants).

### 4.2.1.6. Deletion and Epenthesis

Several whistle surrogates include rules which delete consonants when they are not intervocalic or add epenthetic vowels to make them intervocalic (in intervocalic position consonants tend to be more distinct, owing to the upward and downward transitions they induce on the whistle pitch of vowels). Consonants are dropped utterance-initially in Kickapoo (Voorhis 1971:1437-8) while in the same position La Gomeran, Aas, and Turkish add epenthetic vowels (as noted in section 3.3.1); final consonants (except alveolar sonorants) are often dropped in La Gomeran. In addition, La Gomeran whistle speech simplifies many clusters of the spoken language (in contrast to, e.g. Tepehua; cf. Cowan 1976:1403): Cr clusters are reduced to $C$ (even though Busnel and $\mathrm{Cl} a s s e$ (1976) note that "it would be quite possible to articulate them in succession" (pp.73-4)), while past-vacalic 5 (realized as [h] in the spoken language) is deleted before consonants in the surrogate (ibid., p.72).43

### 4.2.1.7. Gemination

A very interesting rule is reported by Coberly (1975) for the whistle speech of Tlaxcalan Spanish. Voiceless stops are uni formly articulated with a significantly longer duration than all the other segments in the inventory, in particular voiced stops and fricatives. Since voiced stops in this-- and all other-- whistled languages are articulated with no vocal fold
vibration, the result is that the voiced-voiceless contrast for stops in the spoken language is converted into a short-long contrast in the whistle language (it is significant in this regard that Tlaxcalan whistle speech does not utilize glottalization to help distinguish voiced and voiceless stops as does e.g. La Gomeran whistle speech). This rule is formulated in (40).
(40) Tlaxcalan Gemination (Whistle Module)

$$
\begin{aligned}
& \bullet \rightarrow \times 1 \\
& {\left[\begin{array}{c}
1 \\
-\operatorname{con} t \\
-v c e
\end{array}\right] }
\end{aligned}
$$

This gemination is confined to the surrogate language and is not a distinctive aspect of the pronunciation of spoken Tlaxcalan Spanish at either the phonemic or phonetic level, according to Coberly (and confirmed by the descriptions of Tlaxcalan and Mexican Spanish in the Latin American dialect surveys of Resnick (1975) and Canfield (1981)). The greater intrinsic duration of voiceless stops over voiced stops is a well known phonetic fact (Lehiste 1970). It cannot be the case, though, that Tlaxcalan whistle speech is merely reproducing this timing detail, because crucially no other whistle surrogate does the same thing (we would expect it to show up in all such surrogates if it was the automatic reflection of a phonetic pracess). Moreover, intrinsic duration differences such as that noted for spoken voiceless stops are, by definition, non-contrastive in the language in question and usually verifiable only instrumentally. The length distinction in Tlaxcalan whistle speech, on the other hand, is readily apparent to the unaided ear and serves as the sole distinguishing feature between stops which were originally voiced and voiceless in the spoken language. In other words, the surrogate is not reflecting a phonetic timing
fact, but rather has selected one particular property of voiceless stops from the acoustic signal and translated or codified this into a binary distinction (long vs. short) at the surrogate phonological level.

### 4.2.2. Whistled Tone Languages: Syllabic Restructuring

In whistled tone languages a process which I will call SYLLABIC RESTRUCTURING is often found. The effect of this process is to collapse the nucleus nodes of two adjacent syllables, so that a sequence which would usually receive two short beats (one for each syllable) is actually articulated as a single lengthened tone or glide. Typically such processes are optional, often occurring only in 'fast (whistled) speech'. I will consider two examples, from Mazateco and Gurma.

### 4.2.2.1. Kazateco

The forms in (41), taken from Cowan (1948), illustrate the process of syllabic restructuring in Mazateco whistle speech. In the transcriptions, 1=high tone, 2=higher mid, 3=1ower mid, 4=1ow; in the whistle forms I follow Cowan's notational conventions: tones joined by a hyphen (e.g. 1-3) represent a contour tone; a colon following a simple or contour tone represents a lengthened beat; commas between tones indicate that they are whistled as separate beats. (Morpheme-by-morpheme glosses are not available for all items.)

| Spoken |  | Whistled |  |
| :---: | :---: | :---: | :---: |
|  |  | Slow | Fast |
| a. |  | 3,3,1 | 3,3-1: |
| 'at Kohmi' |  |  |  |
| b. | hme ${ }^{\text {min }}$ = | 1,3 | 1-3: |
| 'what?' |  |  |  |
|  | hme ${ }^{2} \mathrm{kPoa}{ }^{4} \mathrm{~s} \mathrm{it}^{2}$ | 1,4,2 | 1-4:,2 |
| d. | $\mathrm{E}_{\text {hi }}{ }^{1} \mathrm{nko}{ }^{1}$ | 1,1 | 1: |

As these items show, the beats of two adjacent syllables may optionally be fused into a single long beat. It should be noted that contour tones which occur on single syllables in the spoken language are always whistled with a short beat: compare ho' thit ${ }^{2-s}$ 'how many?', whistled as [1, 1-3], with (41b) above, and $n i^{2} y_{a i}{ }^{2}-7 n i^{9}$ (word-by-word gloss not provided), whistled as [2, 1-4, 3], with (c) above. Moreover, Cowan states explicitly that the coalescence of tones on adjacent syllables which results from syllabic restructuring "never occurs in speech, regardless of speed" (1976:1391). Since, as noted earlier, beats are assigned in the surrogate to each syllable head, the creation of a long beat out of two short ones is straight forwardly formulated as the combining of two adjacent nucleus nodes: (42) Mazateco Syllabic Restructuring (Whistle Module)


## (optional)

The cutput of this rule is a single nucleus node (yielding one beat) dominating two timing slots (yielding a long beat). This rule could also be formulated to manipulate the beats assigned on the basis of nucleus nodes if these were encoded in metrical terms. Whatever the specific formalization, though, this process provides clear evidence (in addition to that given in section 4.1.1) of the necessity for accessing syllable structure in the assignment of beats. If beat assignment were simply scanning the tonal tier or the timing tier, there would be no straight forward way to account for the three-way distinction between: a) a tone 1 and a tone 3 accurring on separate syllables in the spoken form and each receiving its own beat in whistle speech; b) the same tones occurring on separate syllables but receiving a single long beat; and $c$ ) the same tones occurring on a single syllable and receiving a single short beat; i.e. [1,3] vs. [1-3:] vs. [1-3].

### 4.2.2.2. Gurma

A second example of syllabic restructuring is found in the whistle speech of Gurma, where the facts are a bit more complex. The relevant forms are given in (43), based on Rialland (1981a). In the transcriptions, '=high tone, $\=1 \mathrm{ow},-=m i d ;$ in the whistled forms, each tone letter represents a single short beat, and a colon following a letter indicates a long beat. 44
(43) UR Spoken Surface MhistIed
a. /lí-kàg-lí [líkagìí HL:M or HLLM
'the stem'

'the knives'
c. /ò-púgn-ì/ [opúgínì]

LH:L or LHHL
'he increased'
d. /o-kóabg-dá [okoábígídá] LH:HH or LHHHH
'it shortens'
e. /o-dàgn-di/ [òdagindí]

L L L: H
'he makes equal"
In spoken Gurma, an epenthetic vowel, transcribed as $;$ but ranging in quality between $[i],[u]$, and $[\vartheta]$, is inserted to break up impermissable clusters: Gurma allows only open syllables and syllables closed by nasals (Rialland 1981a:357). These epenthetic vowels always take on the tone of the preceding syllable. In the whistle surrogate, such vowels may be treated in two different ways: 45 1) they may be given their own beat (indicated in the final column in (42)); or, more commonly, 2) they may be realized as a lengthening of the beat of the preceding syllable. Option (2), however, is only possible when two conditions are met by the vowel: it
must occur in an open syllable, and it cannot be preceded by another syllable containing an epenthetic vowel.

At first glance, then, it might appear that the whistle surrogate is simply assigning beats and determining their lengths on the basis of a representation that does not include the epenthetic vowels. In (43a), for example, the single long beat would correspond to the closed syllable kag, while the failure of epenthetic vowels to 'lengthen' preceding epenthetic syllables would follow automatically, since neither would in fact be present.

There are a number of problems with such an analysis, however. First, epenthetic vowels in certain positions are always assigned a beat and never omitted in the surrogate: for example, *[L H: H] is not a possible realization of (43d), nor is *[L L: H] possible for (43e), which are the patterns one would expect if epenthetic vowels uniformly did not 'count'. Secondly, such an analysis would require saying either that surrogate conversion applies at the underlying level (where epenthetic vowels are not present), or that post-nuclear consonants do not trigger epenthesis until the phonetic implementation module. Neither of these positions is tenable. The first (conversion at the underlying level) would require Gurma to be considered an exception to the overwhelming body of evidence that surrogates do not have access to underlying representations and in fact customarily do assign beats to epenthetic vowels (whether inserted lexically or postlexically); moreover, as pointed out previously, Gurma whistling reproduces downdrift and hence cannot be looking entirely at the underlying representation. Furthermore, access to both the underlying form and the phonetic form would in fact be required for beat assignment under such an account, in order to explain the optionality of 'ignoring' the epenthetic
vowels.
The second position (that post-nuclear consonants do not trigger insertion of epenthetic vowels until very late in the derivation) would imply that these vowels are in fact excrescent rather than truly epenthetic (see the discussion in section 3.3.3), i.e. that they are introduced in Phonetic Implementation. However, other than their variable quality, they do not appear to share the properties of excrescence mentioned earlier; in particular, their insertion is triggered by unsyllabifiable consonants. Moreover, in order to prevent such triggering early in the derivation, very complex consonant clusters would have to be considered syllabifiable within the lexical, but not the postlexical, phonology. This is the reverse of the pattern found in most languages, where more complex clusters are frequently created in the postlexical phonology; moreover, the constraint on open syllables appears to be pervasive at all levels of the phonology of Gurma. Alternatively, one could assume that post-nuclear consonants remain unsyllabified throughout the lexical phonology but fail to trigger epenthesis immediately; only at the late phonetic level would insertion actually take place. This would entail violation of a number of principles which have been proposed in the literature, including Kiparsky's (1982; 1985) structure preservation and McCarthy's (1979) constraint that the output of all phonological (i.e. lexical) rules be syllabifiable.4c

This seems to indicate that it is not necessarily the 'inserted' character of these vowels (i.e. their absence from URs) which explains their treatmenmt by the surrogate, but perhaps simply an inherent featural or structural property of the epenthetic segments. In the frameworks of Archangeli (1984a), Levin (1985), and Archangeli and Pulleyblank (1986) (building on earlier analyses such as Halle and Vergnaud (1980) and Harris
(1980)), epenthetic vowels are analyzed as empty skeletal slots (specified only as syllable nuclei) which receive their feature specifications through redundancy rules. Insertion of the empty slot is triggered immediately by an unsyllabified consonant, but in the unmarked case, redundancy rules do not apply until very late in the derivation. A much simpler approach, then, to the ones considerd above is to assume that Gurma whistle speech includes an optional rule of syllabic restructuring, with this rule accessing this particular structural property of epenthetic vowels (their lack of feature specifications). This rule is formulated in (44).
(44) Gurma Syllabic Restructuring (Whistle Module)


> (optional)
(The symbol $X$ is used to indicate a nucleus slot with no feature specifications. Inclusion of the non-branching $N^{\prime}$ (rime) in the formulation insures that the rule will not apply if the second vowel occurs in a closed syllable.) If this analysis is correct, it provides a fairly precise way of determining exactly how late in the derivation the redundancy rules apply (to fill in the empty slot). Since the rule in (44) applies after Level 4 (it is located in the Whistle Module), this indicates that the redundancy rules in this case must be held off until the Phonetic Implementation component.

In many languages, however, redundancy rules may be triggered fairly early in a derivation, depending on whether there are other phonological rules which refer to default values; cf. the Redundancy Rule Ordering Constraint of Archangeli and Pulleyblank (1986). This is a somewhat controversial aspect of the theory of underspecification in question, and
without a detailed analysis of the phonology of Gurma, it is difficult to say whether epenthetic vowels in this language could actually remain featureless as long as would be required by the formulation in (44). Even if their features had to be filled in, however, it would still be possible to access such vowels independently of others without having to resort to the objectionable analyses mentioned previously. In particular, one could make reference to their quality ([i]/variable) and/or the fact that they are always linked to the tone of the preceding syllable. The fact that all cases of whistle tone lengthening given by Rialland involve epenthetic vowels may simply be due to the limited distribution of non-epenthetic /i/ in the relevant environments. From the paradigms given in Beckett (1974); there do not in fact appear to be any polysyllabir noun or verb stems in which the second vowel has the same feature specifications and tone as an epenthetir vowel and occurs underlyingly. If this is true, then one could simply specify the vowel [i] (doubly linked to a tone) in the rule of syllabic restructuring. Whatever formulation of this rule or particular theory of epenthetic (and/or excrescent) segments is adopted, though, the central claim of this section remains the same: namely, the whistle language of Gurma manifests a surrogate-specific process which is formulable in linguistic terms.

### 4.2.3. Instrumental Surrogates

A number of different phonological rules occur in instrumental surrogates, many involving tonal changes. The status of such rules as 'phonological' as opposed to 'transfer' is clear: because the surrogate must independently contain rules for the instrumental implementation of tones, these can also be used to implement the output of the tone-changing rules.

In this subsection $I$ will briefly consider some of the types of tonal rules found in instrumental languages.

### 4.2.3.1. Replacement/Insertion

Many instrumental surrogates have rules of tonal replacement or insertion which add or substitute one tone value for another in specific environments, totally independently of the spoken system. In each case the particular rule does not form part of the spoken language phonology (although a similar type of rule may, perhaps differing in the tone substituted or the environment). In Banen speech drumming and hand-fluting, for example, the tone of a syllable in sentence-penultimate position (immediately preceding the clause-final particle e) is consistently rendered with a high tone regardless of the tone it has in the spoken language (Dugast 1955:740); thus, the spoken form émotè è (no gloss given) is realized in the surrogate as émot́́ è and bol't è is rendered as bolé è. Another example is found in the speech drumming of Sizang and Kamhau Chin (Stern 1957:137). In the spoken languages, pre-pausal syllables usually end on a low tone; in the surrogate, however, the tone of such syllables is usually replaced with a high tone. Finally, a fairly complex system of tonal replacement is found in Hausa speech drumming, as described by Ames et al. (1971:28-9). Utterance-final tones as well as all falling contours of the spoken language remain unaffected. In utterance-initial position in the surrogate language, however, a mid tone may be substituted for a spoken high tone, while either a mid tone or a rising contour usually replaces a spoken low tone. The same substitutions may also be made for a tone occurring within a sentence so long as a preceding low tone has not been altered. As can be seen, this system often results in considerable deviation from the tone patterns of the spoken language.

Further evidence that these constitute surrogate-specific rules comes from the fact that if they were rules of the source (spoken) languages, the surrogate could not have access to their output in any case, owing to the location of the Instrumental Module. Many of the tonal replacement/insertion processes found in instrumental surrogates, such as the Sizang and Kamhau cases mentioned above, make reference to pause location. If the rule belonged to the spoken language, it would have to be located in the Postsyntactic component, after the application of pause insertion and construction of phonological phrases. Since (for reasons given earlier) the Instrumental Module does not have access to the Postsyntactic component, it follows that these processes of tone replacement/insertion must actually be taking place in the surrogate component.

### 4.2.3.2. Contour Sipplification

A second type of phonological rule found in instrumental surrogates is contour simplification (or 'absorption', to use Hyman and Schuh's (1974) terminology), in which a rising or falling tone is reduced to one of its component level tones. As was noted in section 4.1.1, this often occurs when there is a discrepancy between the number of beats assigned to the nucleus (one) and the number of tones which that nucleus bears (two in the case of a contour). In Efik, rising and falling contours occur freely on short vowels in the spoken language and are not subject to any process of simplification (Welmers 1973:59-60; Cook 1969:141-7). In the bell language of Efik, however, a falling tone is often simplified to high before a low tone and to low after a high tone (Simmons 1980:11-12).47 In Luba, as we noted previously, a falling tone is simplified to low: ấss 'eyes' becomes mè:ś in the surrogate (Burssens 1936:475). Although the spoken language does have a process of contour simplification, it is completely different
from the surragate rule, since it is restricted to absorptive environments (the second member of a contour is lost before a like tone) and therefore would not even be applicable in the case cited above (Schadeberg 1977:197). Contour simplification is also reported as a frequent occurrence in Banen surrogate speech (Dugast 1955:738).

### 4.2.3.3. Tonal Reconstruction

One extremely interesting type of rule which is found in a number of surrogates consists of the reassociation of a floating low tone that would otherwise trigger downstep. Since this has the effect of allowing that low tone to be pronounced, while in some cases restoring a pre-downstep creation tone sequence, I will call such rules TONAL RECDNSTRUCTION. An example is the instrumental speech of Efik, in which a sequence such as át'a úfok '[fire] burns house' is realized in the surrogate as ata $\langle f \boldsymbol{f} k$ (Simmons 1980: 11, 18). This indicates that the floating low tone between the first and second syllables has been linked up to the vowel to its right. This is formulated as the reconstruction rule in (45) whose operation is illustrated in (46).
(45) Efik Tonal Reconstruction (Instrumental Module)

(46)


It might appear that in this case the surrogate is simply reading elements off the tonal tier without carrying out any restructuring of its own. However, it has been demonstrated previously that there are strong arguments for not considering beat assignment to have access to the tonal tier (since this will lead to incorrect results in the case of multiply-
linked tonal autosegments as well as the omission of floating tones). Moreover, the validity of an approach which utilizes a surrogate-specific rule of tonal reconstruction is confirmed by a case in Akan speech drumming. By positing a rule of the type in (45) to account for the realization of floating tones in surrogates, we in fact predict that there should be instances where the surrogate form does not correspond in full to any tonal sequence within the spoken language representation, and this is exactly what is found in Akan. Downstep sequences in the spoken language may be realized in a number of different ways in the surrogate (Nketia 1971:728-9): flaating tones may be omitted entirely (as described in section 4.1.1), or a floating low may relink and displace the tone on the syllable to its right, e.g. b'́ky'eré 'come and show' is drummed as békyeré. However, in some instances a third type of realization is possible. This is illustrated in (47). (47) Spoken Drumed

Prior to downstep creation*0 After downstep creation

'we have lifted it and taken it away'
b. yЄ̀aưkúrú àba yèkúkúrú áb'á yEàkúkúrù àbá
'we have lifted it and brought it back'
As these items show, the tone sequence of the drummed phrase corresponds to neither the spoken sequence prior to downstep creation nor the sequence (minus floating tones) after downstep creation.4s In other words, not only is the surrogate replacing the floating low tone on its original syllable prior to downstep creation, but it is spreading it one syllable to the left. This is formalized as the reconstruction rule in (48). $=0$
(48) Akan Tonal Reconstruction (Instrumental Module)


This rule therefore provides very strong evidence for the autonomy of the surrogate component, since it creates a tonal sequence which is not an exact replica of the spoken phonological string at any level of representation.

### 4.2.4. Summary

A number of generalizations emerge from this survey of phonological processes in surrogate languages. First, all of the rules examined here are readily formulable in terms of the distinctive features and other phonological elements of spoken language phonology, but crucially are not rules of the phonologies (or phonetics) of the spoken languages the surrogates are based on. Moreover, the cross-surrogate variations exhibited by such rules clearly indicate that not all aspects of these processes can be attributed to a uniform articulatory compensating mechanism.

Second, the rules found in any given sur rogate constitute a sequential derivation which takes as its underlying form the pre-surface phonetic string of the spoken language. As a result, segments which are noncontrastive at the underlying level in the spoken language can be distinguished at the surrogate underlying level and acted upon differentially during the course of the derivation. To give just a few illustrations from La Gomeran Spanish whistle speech: Voiced stops and their spirantized counterparts are not contrastive in the spoken language, i.e. the feature [+cont] is not available underlyingly for voiced obstruents. Thus, no rule of the spoken language phonology could refer to a stopfricative distinction for such segments. However, La Gomeran Spanish does
have a postlexical rule of spirantization which applies to voiced stops; thus, at the phonetic level which serves as input to the surragate (Level 4 in (30)), voiced stops and their fricative counterparts are distinguishable by their values for [cont]. Accordingly, the surrogate takes the members of a series such as $p-b-\beta$ and treats each segment as one member of a 3-way opposition, applying different rules to each: $\rho$ is glottalized, $b$ is devoiced, while $\beta$ remains unaffected. Furthermore, all of these changes must precede the loss of the feature [vce] that occurs when the specification [+spread glottis] is mapped across all non-glottalized segments. Similarly, continuantization of coronal nasals in this surrogate must precede the palatalization that will eliminate the place of articulation contrast between them.

Third, we saw in the case of Tlaxcalan whistle speech that phonetic characteristics of the spoken utterance can be picked out by the surrogate for conventionalization in the form of a phonological rule, thereby helping to preserve the contrasts of the language that are wiped out by other rules or the limitations of the modality. This is in fact entirely parallel to the process of 'phonologization' of phonetic rules observed in spoken languages, in which a process may be transferred from the phonetic to the phonological rule component, often accompanied by the loss of a contrast elsewhere in the language (cf. Hyman 1976).

Finally, it may be noted more generally that many of the phonological rules examined in this section introduce segments, feature combinations, ur phonological contrasts which are not attested at the underlying level for the spoken languages involved: for example, glottalized stops in La Gomeran Spanish and glottalized nasals in Tepehua, a length contrast in Tlaxcalan Spanish, Turkish lateral and rhotic approximants, and mid and rising tones
in Hausa (among many others). In fact, this property of surrogate phonological rules is entirely predicted, given the model of the surrogate component presented in (30). In spoken languages, rules of the postlexical component are typically free to create novel segment types, introduce clusters which violate lexical phonotactic restrictions, and so forth, since such rules are not bound by any sort of principle of structure preservation (as are most lexical rules) (cf. Kiparsky 1982; 1985). It was shown in section 3 that there is independent evidence for considering the surrogate component to be confined to the postlexical phonology. Given this location within the grammar, then, it follows automatically that the phonological rules of surrogates and the postlexical rules of spoken phonology should behave alike in this respect.

Furthermore, many of the phonological rules described in this section display other properties which also follow from the postlexical location of the surrogate component. Several of the surrogate rules examined previously are variable or optional in nature, and may be tied to the rate of surrogate speech production. These include La Gomeran Spanish denasalization and the continuantization of $\Omega$, Mazateco syllabic restructuring, and Tepehua nasal glottalization and bilabial continuantization. Optionality has been noted as a general property of postlexical rules in spoken phonology (Kaisse and Shaw 1985:6). Similarly, surrogate rules often have across-the-board application. Like postlexical spoken rules (cf. Pulleyblank 1986; Mohanan 1986), they frequently apply to all segments which meet their structural description, without exceptions or reference to morphological information. Examples include Tepehua sonorant devoicing, which applies wholesale to all fricatives in whistle speech, and Kickapoo glottalization, which applies to all stops in the surrogate.

## 5. Concluding Remarks

### 5.1. Akan Revisited

We began this investigation into the organization of surrogate language phonology by considering one particular case, Akan speech drumming. The challenges posed by a formal analysis of this system for a conception of what surrogate languages can and cannot do led to the development of a larger theoretical framework, encompassing an extensive and diverse set of surrogate systems. The result of this is the model of the surrogate component summarized here in (49). With the benefit of this framework, let us now return to re-examine briefly some of the questions initially posed in the analysis of the Akan system.

With regard to Beat Assignment (6): in section 4.1.1 our initial postulation of the relevance of syllable structure for this process was confirmed, although it was also shown that access to the skeletal tier must be allowed in some cases. Regarding the formulation of the rule of Tonal Realization in (5): we saw in section 4.1 .3 that for the majority of surrogates the articulatory realization of tones is indeed only a low-level phonetic phenomenon, whereas in other instrumental languages (Akan included), it may be worthwhile to consider the articulatory specification of tonal features to play a more fundamental role within the surrogate system.

Finally, concerning the rule of Pre-Sonorant Shortening (10): it was shown in section 3 that surrogate conversion does not apply off surface phonetic representations. Hence the timing facts of the Akan surrogate language cannot be a direct reflection of this level of the spoken language. It is still possible, of course, that the surrogate may be reflecting an

intermediate timing representation constructed within the spoken system (pre-Phonetic Implementation, though still 'phonetic': perhaps directly before Level 3). However, it was demonstrated in section 4.2 that surrogate languages are not entirely derivative and dependent on the spoken representation for their structures, but may in fact introduce modifications of their own and may even imitate phonetic details of the spoken form in so doing. Furthermore, the environments of the phonetic shortening process described for spoken Akan by Welmers (1946) and Dolphyne (19E5) (noted in Section 2.3) are not, in fact, identical to those found in the surrogate: in the spoken language only high vowels are affected, and sometimes only if they are low-toned, whereas according to Nketia (1971) the surrogate shortening process applies across the board regardless of the quality or tone of the vowel involved. Thus, the validity of an approach which posits a rule such as (10), which mimics but does not replicate the spoken phonetic form of Akan utterances, is strengthened; whether this is in fact the correct rule formulation, however, must remain a question for future research.

### 5.2. Non-Speech Sounds

It has been a long-standing puzzle of phonetics why some common and articulatorily 'natural' sounds-- most notably whistles-- are never used contrastively within any language. As Ladefoged (quoted in Fromkin (1985)) points out, functional explanations ('ease of articulation") are inadequate here: whistles are clearly no more or less difficult to articulate in connected speech than many actually-occurring speech sounds such as clicks (with their often astounding array of effluxes) or other multiply-articulated consonants. Yet no language contrasts voiced and whistled vowels the way some languages
contrast, say, voiced and laryngealized vowels, and no language contrasts whistled and non-whistled consonants. This cannot be because the articulation of whistles involves an entirely unrelated set of articulatory features from spoken language: as we showed in section 4.1.4, the articulation of whistles (both primary stricture specifications and pitch modulations) may be satisfactorily specified in terms of the distinctive features of spoken language. This is confirmed by the fact that in a number of spoken languages certain segments within the inventory often acquire a secondary whistled quality: Shona has a set of 'whistling fricatives' (described by Ladefoged (1971:60) as labial-(laminal) alveolars), while Mazateco is reported to have a retroflex fricative which may be pronounced with a whistle-like quality (Cowan 1948). In all of these cases, though, the whistle quality is not pure, but has a strong fricative component, and is essentially an 'accidental' result of combining a number of independent articulatory specifications (labialization, retroflexion, etc.) already present in the language. Crucially, there is no contrasting set of non-whistled consonants at the same place of articulation in these languages.

Within the present framework, the answer to this puzzle is almost deceptively simple. Since whistle articulation is'stranded' in the postlexical phonology (by virtue of being confined to the surrogate component), it is not available to any language for use in its underlying inventory. The fact that the feature specifications for whistles may not be introduced contrastively in any spoken language therefore follows automatically. The same holds for a number of other articulatory features, such as pulmonic ingressive airstream, which are not used contrastively in any spoken language but which must be specified for some whistle languages (see Chapters 3 and 4 for further discussion of the occurrence of pulmonic ingressive airstream in alternate
languages). As such, it would appear that the theory of surrogate language presented in this chapter offers the potential to illuminate, and integrate, a number of deep-seated and primary aspects of human language.

### 5.3. Summary

Generative grammar as a whole, and lexical phonology in particular, has been pursuing a rigorous program of modularization in its characterization of the organization of the knowledge of spoken language. In this chapter the validity of this pursuit has been extended to the case of surrogate languages. It has been shown that only by recognizing a number of essentially independent modules within the surrogate component, each of which acts upon the phonological representation in limited and precise ways, is it possible to explain a number of fundamental asymmetries in surrogate systems: asymmetries, on the one hand, between instrumental and whistle surrogates with regard to the representation of intonational elements, and on the other hand between surrogates of tone and non-tone languages with regard to the representation of segments. Several functional explanations for these asymmetries were shown to be incorrect; in the process, independent support has been provided for a number of constructs within current phonological theory. Most notable among these are the richer conceptions of the postlexical component emerging in the work of Mohanan (1986), Selkirk (1984, 1986), and others, as well as the hierarchical models of feature geometry presented in Clements (1985) and elaborated upon in Archangeli and Pulleyblank (1986) and Shaw (1987). In addition, evidence bearing on the theoretical treatment of downdrift/downstep as well as on the recognition of an independent level of syllable structure has been presented.

More generally, the idea that many aspects of phonology belong to a
distinct cognitive domain which is essentially modality-independent has been substantiated in this study. Recent work such as Anderson (1981) as well as the burgeoning literature on sign language phonology has shown that the rules and representations of the phonological component cannot in general be regarded as dependent on the particular articulatory apparatus with which they are ultimately realized. This notion is supported by surrogate languages, since (as I have demonstrated) many such systems incorporate phonological rules and structures whose forms are not modality-dependent. An additional twist has been given to this line of reasoning, though: in this chapter it has also been shown that significant portions of surrogate phonological systems are independent not only of their particular modalities, but also of their own source language (spoken) phonolagies as well.

## APPENDIX

The following is a list of the principal surrogate languages surveyed in this chapter, along with their genetic affiliations, geographic locations, and primary sources. Genetic affiliations and locations are taken from individual sources, as well as from Westermann and Bryan (1952), Welmers (1971), and Voegelin and Voegelin (1977). I=instrumental surrogate, W=whistle surrogate, $T=$ tone language, $N=n o n-t o n e ~ l a n g u a g e ~(f o r ~$ clarification of these terms, cf. note 9.

| Language | Genetic Affiliation |  | Geographic Location | Sources |
| :---: | :---: | :---: | :---: | :---: |
| Akan | I, T | Kwa | Ghana | Nketia (1971) <br> Rattray (1922) |
| Balanta | I, T | West Atlantic | Portuguese Guinea | Wilson (1961, 1963) |
| Banen | I, T | Bantu | Cameroon | Dugast (1955) |
| Bi jago | I, T | West Atlantic | Roxa, Bijago Islands | Wilson (1963) |
| Chepang | W, N | Tibeto-Bur man | Nepal | $\begin{aligned} & \text { Caughley (1976) } \\ & \text { Pike (1970) } \end{aligned}$ |
| Efik | I, T | Cross River | Nigeria | Simmons (1955, 1980) |
| Enga | W, T | East New Guinea Highlands | New Guinea | Laycock (1975) |
| English | W, N | Germanic | U.S.A. (Colorado) | Coberly (1975) |
| Ewondo | $I_{g} \mathrm{~T}$ | Bantu | Cameroon | Guillemin (1948) <br> Nekes (1912) |
| Gurma | W, T | Gur | Burkina Faso | Rialland (1981a,b) |
| Hausa | I, ${ }^{\text {T }}$ | Chadic | Nigeria | Ames et al. (1971) |
| Ibo | I, T | Kwa | Nigeria | Carrington (1949) |
| Idoma | I, T | Kwa | Nigeria | Armstrong (1955) |
| Jabo | I, T | Kwa | Liberia | Herzog (1945) |
| Kamhau (Tiddim) | $\mathrm{I} / \mathrm{W}, \mathrm{~T}$ | Tibeto-Burman | Burma | Stern (1957) |
| Kele | I, T | Bantu | Congo | Carrington (1944, 1953) |
| Kickapoo | I,N | Algonquian | Mexico, Okl ahoma | ```Ritzenthaler and Peterson (1954) Taylor (1975) Voorhis (1971)``` |


| Language | Genetic Affiliation |  | Geographic Location | Sources |
| :---: | :---: | :---: | :---: | :---: |
| Luba | I, T | Bantu | Congo | Burssens (1936) |
| Manjaco | I, T | West Atlantic | Portuguese Guinea | Wilson (1963) |
| Mazateco | $W, T$ | Popolocan | Mexico | Cowan (1948) |
| Pirahã | $W, T$ | Macro-Chibchan | Brazil | Everett (1985) |
| Sizang | I/W, T | Tibeto-Burman | Burma | Stern (1957) |
| Spanish Aas (Be | $\begin{aligned} & W, N \\ & \text { arnais) } \end{aligned}$ | Romance | French Pyrenees | Busnel and Classe (1976) Busnel, Moles, and Gilbert (1362) Busnel, Moles, and Vallancien (1962) |
| La Gomer | an |  | Canary Islands | ```Busnel and Classe (1976) Classe (1957a,b, 1963) Coberly (1975)``` |
| Tlaxcal |  |  | Mexico | Coberly (1975) Wilken (1980) |
| Tepehua | W, N | Totonocan | Mexico | Cowan (1952, 1972, 1976) |
| Tumba | I, T | Bantu | Congo | Clarke (1934) |
| Turkish | $W, N$ | Altaic | Turkey | Busnel (1970a) <br> Busnel and Classe (1976) |
| Wahgi | $W_{\text {, }}$ T | East New Guinea Highlands | New Guinea | Laycock (1975) |
| Yoruba | I, $T$ | Kwa | Nigeria | Arewa \& Adekola (1980) <br> Beier (1954) <br> Isola (1982) |
| Zanniat | I, $T$ | Tibeto-Burman | Burma | Stern (1957) |

NOTES
*Thanks to John McCarthy for pointing this out to me.
2This diagram has been somewhat simplified, since in the case of whistle languages the vocal apparatus is still utilized, but in ways which diverge quite radically from its normal use in spoken language.

3Nketia (1971) points out that sequences of the form CrV also receive two beats, e.g. rèr̀̀́, 'calling' is drummed as $[d \oint \oint$. Such sequences are, however, clearly also disyllabic in the spoken language. According to Dolphyne (1965:229-30) and Schachter and Fromkin (1968:104) these forms are derived from CUrV sequences and often have slow speech forms with a vowel between the C and $r$. Furthermore, on the surface the liquid in such clusters is clearly syllabic since it may bear a distinctive tone (for more on C+liquid clusters, cf. Welmers (1973) and Kaye and Lowenstamm (1985)).

4According to Nketia (1971), "Representation of normal stress by accentuation does not seem to be done consistently in Akan surrogate languages" (p.718). Stress in spoken Akan generally falls on the first high-toned syllable in a word, or in some cases on a low-toned syllable immediately preceding that syllable (cf. Christaller (1933:xxviii, 1964:16) for more details).

SIn setting up this correspondence between linguistic and musical form I am assuming that not only are the relative durations of the three beat types significant, but also the precise ratios between them. Dne could of course adopt the viewpoint that the particular beat values are not to be taken literally and only a difference between relatively long, relatively short, and relatively extra-short is important. This may indeed prove to be a more worthwhile approach in the long run. For now, though, I take it to be significant that Nketia, an eminent musicologist as well as linguist, native
speaker of Akan, and drummer, chose to represent the beats with the particular values that he did. It must be pointed out, as well, that by encoding beat ratios we are not translating relative time into real time, but only specifying relative time more precisely (since as noted above it is the choice of number of slots for the shortest beat which determines the absolute values).

GThis same effect could be achieved by adopting the weight unit approach of Hyman (1985) or the mora system of McCarthy and Prince (1986), in which the weightlessness of onsets is accounted for by depriving them of their own timing unit. However, this would also necessitate depriving coda consonants in closed syllables of their own weight unit/mora, since in Akan they never carry a distinctive tone and such syllables clearly pattern with monosyllabic (i.e. single weight unit) forms in all of the phonological processes mentioned above. As such, we would be forced to give up any correlation between the number of timing units in the linguistic form and the number of timing units in the surrogate form (since closed syllables would only be differentiated at the melodic level from open syllables). Consequently, beat length could only be determined by counting the number of segments attached to each weight unit/mora. This would undermine the very motivation for utilizing a weight unit/mora approach, since nothing in principle would then prevent the counting of onset consonants.

7As Nketia (1971:717) states: "Generally the long syllable is distinguished from the short syllable when both occur at the end of the rhythmic group. In the case of the long syllable the drum head is allowed to go on vibrating, whereas for the short syllable the drummer may stop the vellum with his free hand or rest the drum stick on it after the beat."
-The formulation in (10) incorrectly predicts shortening before glide-
initial syllables. According to Nketia (1971) shortening only occurs before vowel-, nasal-, or liquid-initial syllables, never before glide-initial syllables. At present, it is not immediately apparent how this restriction may be formulated; clearly a more detailed investigation of spoken Akan syllable structure as well as the exact realization of such sequences in speech drumming is required. For now, the formulation in (10) is sufficient to draw attention to a number of broader theoretical issues in the analysis of surrogate language.

9A word on terminology is in order here. The term 'whistle' has been used in the literature on surrogate languages for a number of widely differing methods of sound production, including all of the following: techniques in which the primary resonator is within the oral cavity and no external implements are used (although fingers may be inserted into the mouth), and pitch modulations are achieved through the action of the tongue and/or lips (e.g. La Gomeran Spanish dental whistle, Mazateco bilabial whistle); sound production in which the primary resonator is external to the oral cavity but formed by the hands, in which pitch modulations are effected through the action of the fingers (Kickapoo and Banen hand-fluting); and sound production in which the primary resonator is external to the oral cavity and formed by an external implement, in which pitch modulations are achieved through the action of the fingers and/or lips (instrumental whistles, i.e. one- or two-holed flutes, in many West African surrogate systems (Eboue 1935; Labouret 1923), possibly the Mazateco coffee leaf whistle (Busnel and Classe 1976:52)). In this chapter I follow Taylor (1975:358) in classifying only the first method as 'whistling' (=internal resonating cavity); all other techniques are considered to be 'instrumental' (=external resonating cavity or implement). 'Tone language' is being used to
refer to any language which has tones present in the lexical phonology, 'non-tone language' to refer to any language in which tones are not introduced until the postlexical phonology. (cf. sections 3.2.3, 3.3.2, and 3.4 for further discussion).

10In the descriptions of many of these surrogates there is no explicit reference to downdrift/downstep; indeed, most were written prior to the recognition that such a phenomenon is a predictable feature in the languages where it occurs (or that it is even present in them). However, its treatment and occurrence can be inferred. For example, Simmons refers to the "mid tone" of Efik when in fact this is always either a downstepped or downdrifted high (cf. Winston 1960), while Carrington (1953) refers to "essential tones" of Kele which are reproduced vs. "speech tones" which are not, the latter covering pitch variations due to the position of a word in the sentence and the sentence type. For the remaining cases, authors state that only two or three basic tones are reproduced when decriptions of the languages in other sources indicate the presence of downdrift/downstep (for Ewondo: Redden 1979:10; for Chin (Kamhau): Henderson 1965:30-1; for Banen and other Basa languages: Guthrie 1953:29 ("tone slip")).
${ }^{11}$ Downdrift (Stewart's "automatic downstep") has been suppressed from these transcriptions.

12 These figures are gathered both from sources which recognize that such pitch levels are not contrastive (Welmers, Schachter) as well as those which have misanalyzed these phonetic levels as numerous different phonemic pitches (Olmstead, Beach); figures for the latter group include nonphonemic glides as well (cf. Courtenay 1971:241).
${ }^{13}$ Examples of instruments with greater ranges that never (or only rarely) are used for surrogate languages are the widespread African thumb
piano with a range of 5-7+ notes (Nketia 1963b:97) (which is only reported as a talking instrument among the Idoma; Armstrong 1955), and xylophones, which in Akan have $14-18$ different keys and a $2 \frac{1}{2}-3$ octave range (Nketia 1963b:97) but are not used there as talking instruments (for Banen, where they are, only contrastive tones are represented (Dugast 1955:712)).
${ }^{14}$ Lest it be thought that this is because surrogate speech is a strictly 'solo' activity that is never accomplished as a group effort, three things deserve mention: a) Speech drumming is frequently played in the context of a larger drum ensemble. However, the additional instruments typically provide only musical accompaniment and do not lend their additional tones to representing the spoken utterance (cf. Nketia (1971:702-3) for Akan and Yoruba, Ames et al. (1971:29) for Hausa, and Lush (1935:462-4) for Luganda); b) Two or more drums are often found speech drumming simultaneously. In all such cases, though, the additional tones of the extra drum or drums are not used to expand the representation of the spoken range, but only to echo the message played by a principal drum (as in Bijago; cf. Wilson 1963:809) or to add a refrain on top of the primary message (as in Mbole: Carrington (1957)). Here the different registers are explaited simply to avoid confusion between the different signals; c) In the Hausa surrogate language, speech tones of an individual utterance are often doled out to more than one instrument. However, in this case the additional instrument (a small hourglass drum) is used not to sound out finer phonetic pitch levels, but merely to take over all or most of the phonemic high tones of the spoken utterance (Ames et al. 1971:28-9).
${ }^{2}$ Voorhis (1971:1438) suggests that the high-low tone pattern found on all final vowels in surrogate utterances may in fact be a representation of the spoken emphatic intonation. However, Taylor (1975) concludes that a
more plausible explanation is that this is simply a surrogate-specific flag for the end of a fluted message.
${ }^{16}$ Although I reject these functional considerations as the sole explanation for the observed properties of surrogate languages, the formal explanations which I ultimately propose in their stead are not incompatible with a number of other functional properties such as perceptual salience or aspects of information theory (as pointed out to me by John McCarthy). Moreover, it is not inconceivable that from a historical standpoint, functional considerations may have played an important role in shaping surrogate languages in ways which are synchronically encoded in strictly formal terms.

17 This conciusion is confirmed when we consider the fact that there may not even be such a thing as a 'phonetic representation', that is, an independent, conceptually well-formed level of linguistic structure which could serve as input to the surrogate. It is not actually clear that there is any representation of the output of the phonetics-- except the speech signal itself. For some discussion, see Mohanan (1986).
${ }^{10}$ The specific constructions are noun+noun (genitive), noun+adjective (adjunct), imperative verb+nominal, serial imperative verbs, negative verb forms+various particles (demonstrative, etc.), verb+object, and within a subordinate clause. Many of these rules are also detailed in Christaller (1933, 1964), Dolphyne (1965), and Schachter and Fromkin (1968).

2OWhile individual syllables whistled in isolation exhibit this close correspondence of timing, spectrograms of longer utterances in Turkish and Aas Spanish presented in Busnel, Moles, and Gilbert (1962:904-5) and Busnel (1970b: 1071, 108B) show that whistled phrases are considerably longer and more drawn out than their spoken equivalents. This is probably a reflection
of their use in long-distance message transmission and calling. In addition, as Lubker (1979:292) observes, connected speech produced with a bite-block (a device placed between the teeth to prevent complete closure of the mouth) is slower and more laboured than normal speech. The physical impediment of a bite-block is very similar to that created by placing the fingers between the teeth for whistling (used in the Aas and Turkish surrogates), and it may be that the same effects are coming into play. 20A number of exceptions to this generalization have also been noted in the literature; however, all involve surrogates which are either poorly documented or whose status as true abridging systems (i.e. actually based on the spoken language) is questionable. For example, Cowan (1976) reports the existence of a whistle surrogate of Gadsup, a tone language of New Guinea, which reproduces both tones and segmental material. Knowledge of this system was not firsthand, however, and no further documentation of this surrogate has since surfaced. Second, Snyders (1969) reports a drum language from the Solomon Islands based on a non-tone language, in which vowel qualities are apparently converted into drum tones. However, the language itself is never identified, and Laycock (1975) disputes Snyders claim that there is in fact any significant correlation between vowel quality and drummed tone in this system. Third, the surrogate system of Duala (a tone language of Cameroon) is reported to assign different vowel qualities to different strike locations on the drum (Nekes 1912). However, there are conflicting accounts as to whether this system is in fact an abridging (i.e. non-arbitrary) surrogate (cf. Stern 1957 for some discussion). Finally, Jabo speech drumming is reported to represent various consonants described as "heavy", "emphatic", or with "anacrusis" (Herzog 1945). From the descriptions of the spoken language in Sapir (1931),
though, it is not clear whether these are actual features of consonant articulation or rather tonal alternations conditioned (synchronically or diachronically) by the consonants. Obviously all of these languages (spoken and surrogate) require further detailed investigation before they can be considered genuine counterexamples. Everett (1988:220) also reports that in Pirahis "consonants are always represented by breaks in whistle speech" . However, this is clearly an instance of whistle beats corresponding to each spoken syllable; see section 4.1 .1 for more on beat assignment in surrogates of tone languages. Everett's point is that syllables separated by consonants may not undergo an optional process which slurs together the tones of adjacent syllables in fast whistle speech (in contrast to syllables that do not begin with consonants). In section 4.2 .2 I consider a similar phenomenon in Mazateco and Gurma whistle speech and formalize this as a process of syllabic restructuring. The Piraha facts simply indicate that syllabic restructuring in this language cannot take place across intervening consonants (unlike in Mazateco and Gurma).
$210 f$ course, many of the logically possible (and linguistically sanctioned) combinations of consonants with vowels may not actually be utilized by the language in forming its lexical items, but the same is true of combinations of segments with tones. Moreover, it is doubt ful that, even taking into account actually occurring lexical items, the extent of tonal ambiguity would ever approach that of segmental ambiguity.

22 If one does not partition the tone melody in the same way or restrict tallies to words of the same class, many more combinations are of course possible, as noted by Simmons.

22Essien in fact considers only semantically plausible tonal combinations, whereas Simmons considers all logically possible combinations
within a given syntactic frame. To make the figures more comparable, I have tallied the number of segmental homophones for each of the words of Essien's sentence as listed in Goldie's (1964) Efik dictionary and multiplied across to give the number of logically possible combinations. The result is that there are 6,912 possible tonal permutations of this sequence (ekpat $\epsilon \times$ abok $16 \times$ antan $6 \times$ i $3 \times$ okpon 4). This is considerably more than Essien's figure of 6 , but still far less than the amount of segmental ambiguity. Since tone is not marked in Goldie's dictionary, some of these words may in fact be true (that is, tonal) homophones, in which case my figure might even be too large.

24The failure of these syllabaries to represent tone cannot be attributed simply to the influence of Roman-based orthographic traditions. Although the development of these systems was to some extent tied to the presence of Western writing forms in these cultures, their elaboration also drew upon rich autochthonous traditions of pictograms, as well as Arabic script. Furthermore, a number of the native syllabaries do represent phonological elements which have no counterparts in standard alphabetic or syllabic systems: the Bassa, Manding, and Kpelle systems have indeed developed a (limited) set of tonal diacritics, and a number of the Mande language systems have developed ways of representing consonant mutation (Dalby 1967, 1968, 1969).

25A similar phenomenon is reported from electromyographic studies of bite-block articulation, which show that when the jaw is propped open speakers nevertheless continue to contract the mandibular elevating muscles, thereby "attempting to raise the jaw even though it is not possible for them to do 50" (Lubker 1979:287-8).

20One could, of course, simply stipulate that tone features are always
chosen over others, but such an approach explains nothing, since any other feature could be so designated.

27The Instrumental Module must be allowed to feed back into the spoken language system in the case of somatic instrumental systems such as Kickapoo hand-fluting; this is to permit the segments in such systems (if they are not eliminated by the PSS) to be articulated. This recursion has not been indicated in (30).

2eExceptions to this one-to-one correspondence between syllables and whistle pulses are dealt with in section 4.2.2.
${ }^{29}$ In assigning the syllable structures in (31), I have assumed-- in the absence of explicit analysis in the available references-- that were a language contrasts long and short vowels and allows no (or very restricted) vowel sequences other than two identical vowels, these identical vowels are tautosyllabic, i.e. dominated by a single nucleus node (cf. Levin 1985). This assumption has been made for Balanta, Hausa, Kele, Luba, and Manjaco. Although this assumption may prove to be false in some cases, it is a working hypothesis that I had to adopt in order to make some sense out of data from the very large number of surrogates whose spoken languages have received little or no analysis within nonlinear phonology. Obviously this is a point for further research.

30No relevant Jabo examples are available; however, the beat assignments indicated are noted explicitly by Herzog (1945).
${ }^{31}$ In some cases, authors do not provide complete transcriptions of surrogate utterances, only statements of beat realizations such as "long vowels are realized with a single long beat" (e.g. Burssens (1936) for Luba); in these cases, an example word containing the relevant structure has been selected from a surrogate text provided in the source and supplied with
the beat realization described by the author. Furthermore, it has not been possible to determine the glosses of all items because some authors fail to provide a word-by-word translation of surrogate phrases (even though they may provide a drum transcription, e.g. Wilson (1963)).

32 The effects of Pre-Sonorant Shortening (10) are not indicated in this transcription.

3aThis word is sometimes transcribed with a long vowel in Redden (1979), a descriptive grammar of the spoken language. However, it is clear from the explanation of the (non-autosegmental) treatment of contour tones given in this work (p.8) as well as from various paradigms presented (e.g. on pp.97, 121) that this is merely a device used to avoid having to set up phonemic contour tones, and does not actually reflect a difference in vowel length.
${ }^{34} \operatorname{Transcribed}$ with tone numerals as $X_{i s k_{i}}{ }^{\prime-s}$ in Cowan (1948); the gloss is from Pike (1948:101).
msome work has raised the possibility that the OCP (which insures that this representation has only a single tonal autosegment for each group of consecutive like tones) may not in fact be operative in some tone languages (cf. Odden 1986). However, in Akan at least it is demonstrable that the OCP is operative (ibid, p.374), and this in any case appears to be the unmarked option for most languages.
scfor other ways in which the downstep tone is represented, see section 4.2.3.3.
mit would in fact be possible to formalize a more abstract entity of 'beat' through the use of metrical structure, either grid-based or arboreal, and then have this implemented in surrogate-specific ways in each module. seThese often tend towards an alternating right-left pattern, though. 39It is interesting that this is in a sense a reversal of the downdrift
system found in the spoken language, but with the crucial difference that there are no intervening low tones involved here.

40 Tepehua is in fact the only language in this group which uses glottalization phonemically, and it is restricted to an ejective series of stops; these are also glottalized in the whistle.
${ }^{41}$ In whistled Aas Spanish the nasalized vowels of the spoken language are apparently produced with lowered velum but this is said to have no acoustic effect, as is the case for nasal consonants in whistled La Gomeran Spanish in which the velum is lowered (Busnel and Classe 1976:70-1).

42Leroy (1970a) states that the acoustic distinction between $I$ and $r$ in whistled Turkish is nevertheless preserved in the surrogate; presumably this is because 1 is still [+lateral], though in this case a lateral approximant. It could also be that the difference between the two is maintained by a difference in tongue height, since Leroy notes that the palatal glide $y$ is always merged with one or the other liquid in the surrogate.
${ }^{43}$ If it were present we would expect a lengthened gap before the following vowel; Busnel and Classe are explicit on this point, however, stating that /pastel/, realized as [pahtel] in the spoken language, is whistled as if it were [patel].

44The effects of downdrift, a rule of H -raising (which raises a high tone before a low), and a rule of H -spread (which links a H tone to a following L-toned syllable to create a falling contour) are not indicated in these transcriptions; cf. Rialland (1991b, 1983) for further details.

45Dptionality may not be attested for all items in the corpus (Rialland 1981a), but it is a characteristic feature of certain syllable sequences.

46Another possibility (suggested by Rialland (1981a)) is that the surrogate only gives distinct tones their own beat: in other words, since
the epenthetic vowel always shares the tone of the preceding syllable, it also shares its beat. This is equivalent to saying that beat assignment scans the tonal tier, which as we saw previously is not a viable approach in other surrogates for a number of reasons. In Gurma as well there are arguments against such an account: it cannot explain why the epenthetic vowel in forms such as (43e) does always get its own (long) beat, while some mechanism would also be required to explain the optional whistle pronunciations of other forms where 'epenthetic' tones can get their own beat.

4TNo examples are given where both contexts are met, viz. H H-L L. 4eThe morpheme-by-morpheme breakdown of these forms (which is not provided in Nketia (1971)) is as follows: yt- '(1st person plural)' (Schachter and Fromkin 1968: 120); -a- " (Past Perfective Aspect)' (ibid., P.126); kukuru'to lift up' (Christaller 1933:269); (L-)H-H-H '(Past Perfect tonal melody)' (Dolphyne 1965: 284); d- '(Consecutive Aspect)' (Schachter and Fromkin 1968:137ff); ko 'go', ba 'come' (ibid., pp:150ff) (both of the latter receive high tone by PRule G6, ibid., p.224).
${ }^{49}$ Downstep creation is the result of a general rule of Akan postlexical phonology which spreads a word-final high tone onto a low-toned prefix in a following word (Schachter and Fromkin 1968:224, rule F57 "Prefix High-Tone Agreement"; also mentioned in Schachter (1969:352), Stewart (1971:187), and Dolphyne (1986:36-7)).
soThis may in fact be two separate processes: a rule of tonal reconstruction, followed by a rule of tone spreading.

Chapter Three: LUDLING sYstems IN Theoretical perspective: Three Case Studies

## 0. Introduction

Ludlings may be divided into three broad categories: templatic, infixing, and reversing. In this chapter I will analyze representatives of each of these types, exploring their implications for linguistic theory in relation to both ordinary language and alternate language. In section 1 I examine the phonology and morphology of katajjait (sg. katajjaq) or throat games, an extraordinary form of vocal behaviour found among the Canadian Inuit. Customarily regarded as a form of music, these katajjait reveal themselves under careful analysis to be a particularly well-developed form of templatic ludling. The katajjait will, in a sense, serve as a bridge from surrogate languages to more familiarly linguistic ludlings, since part of their analysis involves the same translation of musical notation into linguistic notation that was employed in the analysis of Akan surrogate speech in the last chapter. In section 2 I turn to an example of an infixing ludling in Tigrinya. Several important insights into the nature of tiered and planar representations will emerge from this study, most notably a proposal that nodes higher in the feature hierarchy are the unmarked choice for spreading, as well as a reaffirmation and refinement of the role of the Morphemic Tier Hypothesis in ordinary and ludling morphology. Finally, in section 3 I provide a detailed theoretical treatment of reversing ludlings of all types. The discussion is centered around the


#### Abstract

ramifications of these systems for the status of the Crossing Constraint within the grammar. I argue that the Crossing Constraint, which forbids the crossing of association lines, is actually composed of several different parameter settings, and that processes of reversal are to be analyzed as the result of introducing crossed association lines into the representation. Within ordinary languages, the 'no crossing' setting is in effect (and therefore reversal is rarely found in this domain), whereas in certain ludlings, the marked 'crossing' setting may be utilized. I will show that by allowing association lines to cross in ways which are tightly restricted by a hierarchy of parameters, it is possible to develop an explanatory account of the full typology of reversal processes found in ludings.


## 1. Katajjait and Enpty Morphology

Katajjait are played by two women standing at close range to each other, often at a distance of six inches or less (Charron 1978). Each game consists of short repeated units, traditionally known as motifs, which are strung together into longer phrases by each partner and syncopated to produce complex interwoven sound patterns. A given motif consists of spans of voiced and voiceless, inspirated and expirated sounds and a tonal contour; these are layered over a short string of segmental material comprised most often of a few words or vocables (nonsense syllables) and mapped onto a timing or rhythmic structure. The overall acoustic effect is an astounding blend of droning and intricate 'guttural' sounds.1

Each katajjaq is in some sense an endurance test, since it terminates when one partner has been overcome by exhaustion-- either physical (choking, lack of breath), psychological (a fit of laughter), or creative (inability to follow the other partner's pattern or introduce one's own) (Beaudry

1978b). Throat games often have a specific subject derived from the words in their text, which may form an extended narrative or simply consist of repeated lexical items such as toponyms or animal names (Charron 1978:247). More often, however, they do not have a 'narrative' in any sense: in this case, they may be imitative of animal sounds (such as the cries of geese, eider ducks, walruses, mosquitoes, panting dogs) (Montpetit and Veillet 1977, Nattiez 1982) or other sounds, such as frying seal flippers; or they may simply be abstract manipulations of sound for their own aesthetic effect.

There appear to be three main dialects or regional varieties of throat games within the general region of the eastern and central Canadian Arctic where this phenomenon occurs. One is centered in Northern Quebec (Peninsule d'Ungava) and southern Baffin Island, including the communities of Cape Dorset, Ivujivik, Payne Bay, Povungnituk, and the Belcher Islands. In this region throat games are referred to as katajjait (sg., katajjaq). A second region is in northern Baffin Island and adjacent areas of the Northwest Territories amongst the Igloolik Inuit, including the communities of Pond Inlet and Igloolik; here the games are referred to as pirkusirtak (Nattiez 1983a:459). Finally, a third dialect area is found on the western side of Hudson Bay among the Caribou and Netsilik Inuit, including the communities of Gjoa Haven, Pelly Bay, and Spence Bay, where the game is called nipaquhiit (Nattiez 1983a: 459). The dialects differ in such things as the internal patterning of the game and the types of sounds used (e.g. the pirkusirtuk seem to lack most of the distinctive vocal and breath qualities of the others (Nattiez 1983a)), the structure of the text (e.g. the games of the Netsilik Inuit often employ an extended text of identifiable meaning), as well as many other nonlinguistic factors such as the use of
resonators to amplify the sound (e.g. in Povungnituk parka hoods are used to direct the sound between the partners, while in Gjoa Haven a bread pan is held at one side of the face for the same effect (Cavanagh 1976); in other regions other kinds of cooking pots and oil drum lids are used, or resonators may be completely absent).

In this section attention will be focused on the katajjait dialect of the game, as described in the work of the Groupe de Recherches en Semiologie Musicale of the University of Montreal. ${ }^{2}$ Drawing on the detailed descriptions of Nattiez (1993a) and Beaudry (1978a), I will argue for three things in the analysis which follows:
a) Katajjait can and should be considered a primarily linguistic rather than musical system (contrary to their traditional classification);
b) The complex voicing, breath, and timing patterns found in katajjait motifs can be given a simple and straightforward account by appealing both to metrical and morphological constituent structure;
c) The type of morphology exemplified by katajjait, which will be called 'empty' morphology (after McCarthy 1985), is not unique to this system (as might at first appear), but rather must be independently recognized in lingustic systems in the domain of ludlings and other alternate languages.

The organization of the discussion is as follows. In section 1.1 three types of evidence will be brought forward to support the claim that kataj.jait have more in common with language than music: the distinctive features and phonetic contrasts utilized in the katajjait, the organization of these features into larger units, and the open-endedness of the system. In section 1.2 a specific mode of representing the structure of a kataj.jaq motif utilizing the framework of autosegmental phonology will be introduced,
based on the method of translating musical notation into linguistic notation presented in Chapter 2. Then in section 1.3 a number of generalizations concerning the distribution of voiceless and inspirated sequences within the motif (as well as the skeletal patterns of motifs) will be laid out, constituting the primary body of data to be accounted for. A phonological analysis of the internal organization of katajjait motifs based on metrical structure will be explored in section 1.4. It will be shown that a formal account of the voicing and breath patterns of the katajjait provides some independent support for a number of notions implicit in an arboreal theory of prominence, most notably those of constituency and headedness. Several empirical and conceptual problems with this account will be pointed out as well, leading to rejection of a strictly phonological approach. In section 1.5 it will be shown that a morphological component must also be recognized in the generation of katajjait motif structures (operating in conjunction with the phonological elements). Finally, section 1.6 will examine how the morphological system posited for the katajjait meshes with other natural language morphologies.

### 1.1. Language or Music?

The Inuit traditionally regard the katajjait as a special language spoken by the Tunnituarruit or flying heads, mythical beings which are halfwoman, half-bird; ${ }^{3}$ it is also considered to be the language by which the dead communicate (especially as manifested in the form of the aurora borealis), understandable only by women (Saladin d'Anglure 1978). Within the scholarly literature, however, katajjait have been recognized primarily as a form of music, perhaps resulting partially from the fact that all of the pioneering research on these games has been carried out by persons
trained as musicologists. Even within the musicological literature, though, there is some confusion as to precisely how this phenomenon is to be classified. For example, Cavanagh (1976), in speaking of the Netsilik Inuit, states: "...the women's throat games are not considered a genre of 'singing' in this area. Furthermore, since 'singing' is the closest Netsilik concept to "music", perhaps the games should not fall into the realm of ethnomusicological study at all. However, as a unique variety of abstract expression in sound, they merit our attention."(p.43). An objective examination of the katajjait from a linguistic perspective reveals that perhaps the traditional Inuit conception of these games as a form of language has a greater validity.

### 1.1.1. Distinctive Features

The types of phonetic distinctions utilized in the katajjait, particularly those involving voicing, airstream mechanism, and tone, have been puzzling to researchers studying these games from a musicological perspective because they are generally not found in the musics of other cultures. However, these features cease to be exceptional once the katajjait are considered to be a form of language, since the contrasts involved are commonplace, or at least well-attested, in the languages of the world.

### 1.1.1.1. Voicing

The discovery by Beaudry (1978a) and Charron (1978) that katajjait employ voiceless segments was considered unprecedented as a musical phenomenon; within the world's languages, however, voiceless segments are ubiquitous. [tvoice] is of course a member of the universal set of distinctive features upon which languages draw to form their contrasts. In
the katajjait, though, voicelessness typically occurs during the articulation of vowel sounds.4 The possibility of having voiceless vowels in a language, though not as common as voiced vowels (or voiceless obstruents), is in fact reported "from every major world area" (Greenberg 1969:156). In many of these languages voicelessness on vowels is predictable from the stress pattern, position of a segment in a word, or position of a word in a phrase. In these cases it behaves in a sense like a suprasegmental feature, and this manifestation of voicelessness is especially close to its behaviour in katajjait motifs, as will be shown subsequently. By considering katajjait to be a form of language we in fact expect the feature [-voice] to be employed as a matter of course, rather than regard it as anomolous.

### 1.1.1.2. Airstreap Mechanis.

An even more startling discovery than the use of voiceless sounds in the katajjait was the orcurrence of inspirated segments, that is, sounds produced while inhaling air to the lungs (Charron 1978:252). Pulmonic ingressive airstream, ${ }^{=}$though virtually unattested in musical systems, is in fact reported from a wide variety of paralinguistic systems throughout the world. True, it is not used contrastively within any language per se (Smalley 1967, Ladefoged 1971, Catford 1977). However, it seems quite clear that a linguistic feature controlling the direction of the pulmonic airstream must be independently recognized for languages, since it is available for conscious manipulation by speakers and does occur as both a segmental and suprasegmental feature in inter jections, speech disguise systems, and ritual languages.

For example, we find pulmonic ingressive airstream used as a prosodic feature over entire utterances in a number of special linguistic registers,
most notably in speech disguise systems. One such example is the SwissGerman custom of Fensterle reported in Dieth (1950) and Cat ford (1977), mentioned in Chapter 1. Another is a type of speech disguise found in the Hanunoo language (in the Philippines) known as pahasgut (Conklin 1959). Laughren (1984:87) also reports the occurrence of pulmonic ingressive airstream in a women's speech style used among the Warlpiri in Australia. Finally, pulmonic ingressive airstream is used as an actual distinctive feature at the segmental level in Damin, the ritual form of the Lardil language spoken on Mornington Island, Australia which was described in Chapter 1. Hale (1973) describes how the segmental inventory of this language has been expanded to include not only the the regular consonant phonemes of Lardil but also a series of nasalized clicks, ejectives, and most notably, a pulmonic ingressive lateral fricative, [ ${ }^{2}$ ]. This latter segment occurs as a regular consonant within the words of Damin, as in [\$<i] 'fish'.

It is probably the case that the occurrence of pulmonic ingressive segments within linguistic systems is even more widespread than this limited survey would indicate. In contrast, the only report of pulmonic ingressive airstream utilized within a 'musical' system is the rekkukara of the Ainu. As described by Nattiez (1983b), however, this vocal behaviour found among the aboriginal inhabitants of Japan (and the neighboring Sakhalin peninsula) is identical to the katajjait of the Canadian Arctic in most crucial respects. The rekkukara is executed by two women facing each other at close proximity; it, too, involves voiced and voiceless sounds (as well as inspirated and expirated ones) and the same minimal tonal contrasts; and it has the same overall pattern of organization. Thus, the rekkukara does not provide any independent support for the recognition of pulmonic ingressive
airstream in musical systems, since it is no more a clearly 'musical' (and less "linguistic") system than the katajjait itself.c

For the remainder of this chapter the linguistic feature controlling pulmonic airstream direction will be designated as [expirated]. Segments within ordinary languages are considered to be redundantly specified as [+expirated] (pulmonic egressive) by universal default rule (unless they are glottalic). The value [-expirated], on the other hand, is available for use paralinguistically and in special accessory speech forms (ritual languages, speech disguises, language games, etc.), with the katajjait (and rekkukara) falling into the latter category.

### 1.1.1.3. Tone

Another striking fact about the katajjait is that, unlike ordinary musical systems which usually employ absolute, fixed pitch values, the pitch values of a katajjaq are entirely relative (excluding the small subset of melodic katajjait, in which pitrh modulations are absolute and invariant; cf. Nattiez (1983a:465)). This is pointed out quite explicitly by Charron (1978), who states that "...the traditional parameters of fixed pitch or fixed intervals do not occur with significant regularity..." and "...the actual frequency range of several contours may differ in any game song, although the relative relationships of each contour remain constant." (p.248; cf. esperially Figures 2 and 3). It is, of course, a hallmark of the use of tone in linguistic systems that only the relative value of the pitch is essential (see for example Anderson 1978:141).

Further confirmation that the tones of the katajjait fall within the boundaries of language comes from the number of tone levels which must be recognized. No more than three or four distinct levels occur in the katajjait (Nattiez 1983b). The most common motif patterns employ three or
fewer, chosen from among high (H), mid (M), and low (L), although a few katajjait from the Belcher Islands may utilize four levels Charron 1978:250). This is in striking conformity to the universal inventory of (phonologically distinctive) tone levels utilized in the world's languages. Anderson (1978:145) observes that "[s]ystems of two and three distinct level tones are abundantly attested from all the major groups of tone languages in the world (American, Asian, and African)". A number of languages using four contrastive tone levels are also found, but languages with more than four are extremely rare.

In summary, then, it is apparent that the katajjait fall well within the range of phonological parameters used by the world's languages, and are anomolous in their distinctive features only when regarded as a musical system. Furthermore, none of the phonetic distinctions utilized in the katajjait-- voiceless vowels, pulmonic ingressive airstream, or tone-- occur as contrastive features in the Inuktitut language on which the vocal games are based. Thus, one cannot consider the occurrence of these elements in the katajjait as the result of transfer from the spoken language, the way, for example, a language with distinctive ejectives would carry these segments over into the text of a song. The only conclusion is that, at least on a phonological basis, the katajjait represent an independent linguistic system.

### 1.1.2. Units of Organization

A second piece of evidence bearing on the classification of katajjait concerns their structural units above the phonological feature and segment. Each katajjaq has two fundamental levels of organization. One consists of the motifs: short, semi-discrete units made up of the combination of
voicing, breath, tone, vocable, and rhythmic/timing patterns. These motifs are in turn repeated and alternated over time to form the larger units or phrases of the katajjag as a whole. This closely parallels the dual organizational structure of languages, i.e. the basic (albeit imprecise) division between 'words' and word-level phenomena (roughly, morphology), and phrases and sentence-level phenomena (roughly, syntax). Of course, neither of these units is uncontroversial within linguistics or has an agreed-upon definition, and this is particularly true for the unit of 'word'. However, a number of researchers have suggested some general characteristics of words, and while these are neither sufficient nor necesssary conditions for the identification of a distinct unit, it is striking that they are true of the katajjait unit of 'motif' as well.

Bloomfield (1933:178) has characterized the word informally as the "minimal free form" and Sapir (1921:35) and Greenberg (1954) identify it atheoretically as a "non-interruptible unit" (Greenberg 1954:28). Although neither of these characteristics is definitive, it appears to be the case that motifs are also the minimal indivisible units of a katajjaq. Individual motifs are often vocalized in isolation as a 'warm-up' before a katajjaq is commenced, but single motifs cannot be further decomposed. Beaudry (197Ba: 266) reports that if one or more of the individual components of a motif (vocable, rhythm, tone, etc.) is separated from the others, the motif is rendered unidentifiable to the throat singers who use it in forming a katajjaq.

More powerful evidence of a parallel between 'word' and 'motif' concerns a number of phonological universals relating to the sequencing of voiceless vowels and level tones within a word which also hold of katajjait motifs. For example, voicelessness in the katajjait most often occurs at
the terminal edges of motifs, and Greenberg (1969) demonstrates that there is a cross-linguistic preference for voiceless vowels to occur in word-final position. More formally, the following implicational universal concerning linguistic systems holds utterly of katajjait motifs and higher phrasal units.
(1) If a language does not regularly have high stress on the word-final syllabics, then, if it has voiceless vowels in word-initial, it has them in word-medial; if in word-medial, then in word-final; if in word-final, then in the final of some longer unit or units such as an intonational contour, sentence, or utterance (Greenberg 1969:165).

That is, no language allows voiceless vowels to occur at the beginning or earlier portion of a word without also allowing them to occur at a later portion of a word, and no language permits voiceless vowels to occur within words without also allowing (words with) voiceless vowels to occur at the end of a higher organizational unit. The same is true of the katajjait: voiceless vowels occur motif-initially (as in N11, B18), but they also occur motif-medially (B8), and of course motif-finally (B9) (numbers and letters refer to the list of motifs given in the Appendix; cf. Section 1.2), as well as at the end of phrases within a katajjaq (Nattiez 1983a).

Similarly, Maddieson (1978), in an extensive survey of tone languages, arrives at a number of universals concering the sequencing of tone levels within the word or morpheme; these universals are also obeyed by the katajjait motifs. Two of these constraints are given in (2) and (3).
(2) Languages which permit a sequence of unlike tones on a word or morpheme also permit like tones on a word or morpheme (Maddieson 1978:343).
(3) A language which permits successive shifts of tone level in opposite directions within a word permits words with only one shift of tone level
(Maddieson 1978:345).
This is certainly true for the katajjait as well: we find motifs with opposite-shiftings such as LHM (example N4) or MLH (N14), but also unidirectional shifts such as HL (N18) and LH (N11), as well as motifs with like tones throughout, e.g. L (N17).

### 1.1.3. Open-Endedness

It is a characteristic of human language that it is an open-ended system: a potentially infinite number of sentences can be generated by combining a finite number of smaller units. The katajjait have exactly the same property: when performing katajjait, throat singers do not simply repeat memorized patterns, but combine and vary the basic elements which make up a katajjaq as the game proceeds. Compare the statements of Nattiez (19B3a): "[W]e never encounter two absolutely identical katajjait. What is truly remarkable is that this constant diversity results from the combination of such a small number of basic elements." (p.468). Of course, a number of musical systems are spontaneously open-ended, for example those which utilize improvization. This indicates that open-endedness is a necessary, though not sufficient, criterion for a linguistic system and the katajjait meet this criterion. It cannot be denied that the katajjait have many characteristics of musical systems, for example, their extensive use of repetition and symmetry. 7 But it is not being claimed here that katajjait are identical to language in all respects. Rather, the claim is that many fundamental and apparently unusual aspects of katajjait organization receive a plausible explanation when viewed in terms of principles of linguistic organization.

### 1.2. Motif Structure

In this section a system for representing the structure of a katajjait motif utilizing linguistic notation will be presented. Katajjait have traditionally been transcribed using a form of musical notation (cf. Nattiez 1983a, Beaudry 1978a). Researchers working on these systems, however, have repeatedly pointed out the inadequacies of standard musical transcription for representing katajjait structure; this has necessitated the development of a number of unique transcriptional devices not normally required for writing music. ${ }^{-}$I would claim that this is in fact a direct reflection of the primarily linguistic (rather than musical) nature of the katajjait, and that the katajjait structures which pose these difficulties receive a more perspicuous interpretation when cast in terms of linguistic notation. Given a number of representational systems made available by current phonological theory, the musical transcriptions of the katajjait translate quite straight forwardly into standard non-linear phonological representations. Central to this translation process is the recognition of the autosegmental nature (i.e. relative independence) of the phonological features utilized in the katajjait, as well as the correspondence between musical notation and timing units presented in Chapter 2 for the analysis of Akan surrogate speech.

### 1.2.1. Independence of Features

The conversion of katajjait transcriptions into linguistic notation is facilitated by the fact that the modified musical transcription developed by musicologists studying these games is in a sense 'pre-autosegmentalized'. It already grants relatively independent (notational) status to a number of the phonetic elements found in katajjait, most notably the tone sequences and
the vaicing and breath patterns (which are written separately from the rhythms and segmental structures). Each katajjait is made up af five phonological variables (as mentioned earlier): tone (involving the levels $H$, $M$, and $L$ ), voicing (determined by the feature [voice]), airstream mechanism (the feature [expirated]), segmental material (forming the morphemes or vocables), and a rhythmic or timing structure. ${ }^{9}$ In Nattiez (1983a) and Beaudry (1978a) these elements are notated as follows: musical notes are used to encode the timing relations and the voicing and breath patterns; the tonal contour is written separately as a series of levels enclosed within slanting brackets; and the segmental material is also written separately. The shape and color of the note heads are used to indicate the voicing and airstream direction, according to the schema in (4).

Airstream Direction
[+expirated] [-expirated]

$$
\text { Voicing } \begin{aligned}
& \text { [+voice] } \\
& {[\text {-voice }]}
\end{aligned}
$$

Thus the complete notation of a typical motif in the system presented in Nattiez (1983a) would be as in (5) (the letter-number pair refers to the number of the motif in the Appendix, which provides a complete list of the motifs given in Nattiez (1983a) and Beaudry (1978a)).
(5)

(NB)
Each of the five phonological parameters may be varied independently of the others. For example, we find motifs with the same segmental pattern but different tones (hamma /_- - / (N4) and hampa / - - / (NS)), the same segmental and timing patterns but different voicing patterns (udlu / (N1O) and adlu/ (N11)); the same timing pattern but different segmental material (hamma/d / (N12) and ehor /

(N16)), and the same segmental material but different timing patterns (hamema/ d (B7) and hamema/fata (B9). In fact, for every possible pair of the five phonological parameters ( $\mathrm{P}_{1}, \mathrm{P}_{2}$ ) we can find a pair of motifs such that they share the same pattern for $P_{1}$ but have contrasting patterns for $\mathrm{P}_{\mathbf{2}}{ }^{10}$ It appears, then, that the separate elements of the katajjaq motif, especially [vce] and [exp] (and of course tone) are acting as prosodic features, since they are distributed semiautonomously over various spans of segmental material with varying timing patterns. It is worthwhile noting that this is strongly suggestive of an autosegmental phonological representation.

### 1.2.2. Notational Conversion and the Skeleton

The independence of phonetic features found in katajjait is encoded for some elements through the 'decomposed' musical transcriptions of Nattiez (1983a) and Beaudry (1978a). This independence is straightforwardly translated into linguistic terms by recognizing that these elements correspond to phonological features placed on separate tiers. The independent status of the timing patterns of the katajjait motifs also finds expression in linguistic notation in the form of the skeletal tier. In Chapter 2 an algorithm was provided for translating the length distinctions encoded by musical notes (the beam and flag) into elements of linguistic timing. To recapitulate briefly, this translation process is made possible by an extension of a number of recent insights provided by Lowenstamm and Kaye (1986), Levin (1983, 1985), and others into the nature of the skeletal tier. These researchers have shown that the elements on this tier are abstract timing units which have no inherent reference to segments of a particular type (e.g. consonant vs. vowel). This conception of the skeleton
is formally quite close to the use of musical notes to represent timing patterns, since in both cases such patterns are relatively independent of the segmental material they are associated with. 12 The key to the translation process involves equating the smallest unit of musical timing used in the system with the smallest unit of linguistic timing cone skeletal slot). If we assign the smallest note length one skeletal slot, then the relative lengths of longer notes may be encoded by assigning them the appropriate multiples of the original timing slot. This is illustrated in (6), which gives the skeletal representations of all note lengths used in the katajjait of this study.
(6) Note Value Skeletal

Representation


That is, the eighth note (6b) is twice as long as the sixteenth note (Ga) and is represented as twice as many skeletal slots. The dotted eighth note has the length of the eighth note plus half as much-- that is, two skeletal slots plus one more. Thus, the motif given in (5) would consist of four skeletal slots: [XXXX] (1 eighth note and 2 sixteenth notes).

### 1.2.3. Multi-Tiered Representation

It is now possible to combine the observation in Section 2.1 about the independence of features with the skeletal structures developed in 2.2 to yield a fully autosegmental representation of a katajjaq motif. The multi-
tiered structure of a motif which will be assumed in this analysis is shown in (7).
(7)


This representation consists of a core skeletal tier composed of a series of $X$-slots to which are linked four autosegmental tiers. One tier, the voicing tier, contains the feature [voice], and another-- the pulmonic tier-- contains the feature [expirated]. A third tier contains the tones and a fourth the remaining segmental material. 12

The motif given in (5) would have the multi-tiered representation in (8), where each plane is drawn separately and is to be interpreted as a perpendicular 'cross-section' through the skeleton (with no actual duplication of the skeleton involved).
(B)

| voicing tier | $[[+v c e][-v c e]]$ | tonal tier | L H M |
| :---: | :---: | :---: | :---: |
| skeleton | $\bigwedge_{x} \bigwedge_{x} \mid$ | skeleton | $\bigwedge_{x} \times 1$ |
| skeleton | $\square^{x}$ | skeleton | $\sim^{\wedge} \sim^{\wedge}$ |
| pulmonic tier | [+exp][-exp] | segmental tier | ha ma |

Whether the skeletal slots in this representation are viewed as timing slots or points (Levin 1985, Lowenstamm and Kaye 1986) or as mora 'beats' or weight units (Hyman 1985) is not in fact crucial for our analysis. An approach more along the lines of Hyman's weight units has been adopted for these representations in the linking of the segmental tier simply because: a) it better expresses the notion that the number of elements (whether segments or syllables) on the segmental tier is independent of the number of
elements on the skeletal tier (in other words, onsets and (in this case) codas are 'weightless'); and b) it seems more appropriate for representing katajjait structures in which a single vowel quality may be held over as many as six or more timing slots (cf. Hyman's (1983, 1985) analysis of Gokana, a language which permits sequences of up to six identical vowels in a row). However, for the remainder of this work I will continue to refer to such units as skeletal slots.
1.3. Voicing, Breath, and Timing Patterns

In the following sections we will be directing our attention to voicing and breath patterns below the level of word/motif. There are many interesting generalizations that could be made about the tonal and segmental tiers, as well as about the 'syntax' of katajjait, that is, the way in which motifs are strung together to form phrases. However, there is considerably less data in these areas, and it is hoped that the results of our investigation will point the way towards future investigation of these aspects of katajjait structure.

### 1.3.1. Patterns of [-vce]

A number of generalizations can be extracted from the corpus of motifs found in Nattiez (1983a) and Beaudry (1978a) (given in the Appendix) concerning the distribution of [vce] and [exp] over a given motif. One such generalization concerns a dependency between these two features. Although in all other respects the voicing and pulmonic tiers are independent of one another, there is a correlation between the values [-exp] and [-vie]. If a skeletal slot is linked to [-exp], then it will always be voiceless. We may formulate this as the following redundancy rule (cf. Archangeli (1984a),

Pulleyblank (1986), and Archangeli and Pulleyblank (1986) for detailed discussion of redundancy rules).
(9) [ ] $\rightarrow-$ [-vce] / [-exp, ._- ]

Although Nattiez (1983a), Beaudry (1978a), and Charron (1978) indicate that all four logically possible combinations of voicing and airstream direction occur in katajjait motifs, no examples of a [+vce, -exp] segment (their notation) are in fact provided in these works. This absence may be at least partially phonetically motivated: Catford (1977) states that, due to the shape of the vocal folds, "[...] it is impossible to produce good pulmonic suction [ingressive] voiced sounds; a 'croaking' type of inverse voice can, however, be produced [...]" (p.68). Cavanagh (1976) transicribes voiced inspirated sounds in the throat games of the Netsilik Inuit; however, there is some discrepancy between the transcriptions in this work and those in Cavanagh (1982). It is not clear, then, to what extent the generalization given by rule (9) represents a dialect-particular, rather than universal, constraint.

The remaining generalizations in this subsection are specific to the voicing tier. Simply considering the number of skeletal slots which may form a given motif, there is a potentially very large number of voicing patterns which one might expect to find. Assuming that in a typical motif of four skeletal slots each slot would have an equal chance of being either [+vce] or [-vce], there are 24 or 16 logically possible combinations. Yet in fact only two voicing patterns occur on four-slot motifs (abstracting away from the effects of rule (9)), exemplified by motifs (N8) and (N11) in the Appendix. Of course the discrepancies between logically possible and attested patterns increase exponentially when we consider that a given motif may have up to twenty-four skeletal slots. Clearly we are dealing with a
constrained system here (rather than random patterns) involving severe restrictions on the possible sequencing of voiceless and voiced sounds.

One such restriction relates to the fact that in alternations of both values of [vce] over a motif, the order \#[+vce][-vce]... is found to the exclusion of \#[-vce][+vce]... (where '\#' indicates the beginning of the motif). It appears that the basic unit of a motif is four or six timing slots long, and these may in turn be 'compounded' together; [-vce] can only precede [+vce] in a motif if it occurs at the end of the first half of such compounds. In other words, within either half of a motif, [-vce] may not precede [+vce]. Thus, we find motifs such as those in (10), but never ones like (11) (the effects of rule (9) are not shown in these representations).
(B1) ${ }_{\text {d. }}^{\text {(10) }}[\overbrace{X}^{[t+v c e][-v i c e]}]$
(BI0) $[\overbrace{x x y x-x x y}^{[t y c e]}]$
(P6) $\left[\frac{[+x(e]}{x \times x x x-x y x x y x}\right]$
(819) $\left[\frac{\text { [tyce] }}{x \times x \times x-x \times x \times x y}\right]$

f.
(B8)
$[\underset{x \times x \times x-x \times x}{[+x c e][-v c e]} \underset{x}{\text { [twes] }}]$
(11)

b. $\{[\overbrace{x \times x \times x-\overbrace{x}}^{[-v e][+v c e][-v c e][t v c e]}]$
c. $\left[\begin{array}{ccc}{[\text { [tvce }]} & \overbrace{x-x}^{[-y c e]} & {\left[\begin{array}{c}\text { [tvce }]\end{array}\right]}\end{array}\right]$

e. $:\left[\begin{array}{ll}{[-\mathrm{yce}]} & {[+\mathrm{cce}]} \\ x \times x \times x \times x\end{array}\right]$


A second observation about the distribution of [-vce] is the following: if the first slot of a motif is voiceless, then the entire motif is voiceless. That is, the patterns in (12) are not found, though the whole motif may be voiceless as in (13).
(12)

b. $4\left[\begin{array}{ccc}{[-v c e][+x c e]} \\ x x-x x x x\end{array}\right]$
c. $\pm\left[\begin{array}{ccc}{[-v c e][+v c e][-v c e]} \\ x & x & x\end{array}\right]$
(13)
(NII)

b.
(B18)


A third observation is that single skeletal slots never participate in voicing alternations (excluding [-vce] autosegments inserted by rule (9)), nor does a [-vce] span ever extend over an odd number of (consecutive) skeletal slots. In other words, the minimal span of [-vce] is an even number of slots. 13 Thus, patterns such as those in (14) are not found, although those in (15) are.
(14)
a.



d. $4\left[\begin{array}{c}{[+v c e][-v c e][+v c e][-v c e]} \\ 1 \times x \times x \times x \times x \times x \times x\end{array}\right]$
(15)
(88)

(810)
b. $\left[\begin{array}{cc}{[\text { +vce }} & {[-v c e]} \\ \overbrace{x \times x-x \times x}^{x}\end{array}\right]$

Finally, a motif may be entirely voiced, as shown in (16).
$(16)$
3.
(B4)

b.
$\left[\frac{[\text { [畋e] }}{x \times x \times x \times x \times x}\right]$

### 1.3.2. Patterns of [-exp]

The distribution of [-exp] in many ways parallels that of [-vce], although there are significant differences. As with [-vce], the following restriction holds: within either half of a motif, [-exp] may not precede [texp]. Thus, we find the patterns in (17) but not those in (18).
$\left.\begin{array}{c}\text { (17) } \\ \text { (N1) }\end{array}\right]\left[\begin{array}{cccc}{\left[\begin{array}{llll}{[+\exp } & 1[-\exp \\ x & x & x & x\end{array}\right]}\end{array}\right]$
b. $\left[\begin{array}{c}{\left[\begin{array}{c}{[+\exp ][-\exp ]} \\ x \times x \times x \times x \times x\end{array}\right]}\end{array}\right]$




(18)
a. $+\left[\begin{array}{ccc}{[+e]} & {[-e][+e]} \\ x & x & x\end{array}\right]$
b. $:\left[\begin{array}{ccc}{[t e][-e][+e]} \\ 1 & x & \\ x & x & x\end{array}\right]$

d. $:\left[\begin{array}{ccccc}{[t e][-e][+e][-e][+e][-e][+e][-e]} \\ 1 & 1 & 1 & 1 & 1 \\ x & x & x & x-x & x \\ x & x & x\end{array}\right]$

A second observation is that the first slot of a motif may not be [-exp].
(19) $\pm[\overbrace{x \times x}^{[-\exp ][+\exp ]}]$
b. $4\left[x_{x \times x}^{[-\exp ]}\right]$


Another restriction on the occurence of [-exp] is that, except for singie slots terminating a motif or either half of a compound motif, the minimal span for [-exp] is always an even number of slots. Thus, the patterns in (20) are ill-formed.
(20) $\left[\begin{array}{ccc}{[+e][-e][+e][-e]} \\ 1 & 1 & 1 \\ x & x & x\end{array}\right]$
b. $:\left[\begin{array}{ccc}{[t \exp ][-\exp ]} \\ x & x & \underset{x}{x} \\ x & x & x\end{array}\right]$
c. $:\left[\begin{array}{ll}{[\text { texp }]} & {[-\exp ]} \\ {\underset{x x}{x}}^{x-x x x x}\end{array}\right]$



Finally, motifs may be entirely pulmonic egressive:
(21)
a.
(84)

b.
(B2)


These observations concerning the distribution of [-vce] and [-exp] are summarized in (22).
(22)

1. a) Within either half of a motif, [-vce] may not precede [+vce].
b) Within either half of a motif, [-exp] may not precede [+exp].
2. a) If the first slot of a motif is [-vce], then the entire motif is [-vee].
b) The first slot of a motif may not be [-exp].
3. a) The minimal span of $[$-vcel is an even number of skeletal slots.
b) The minimal span of [-exp] is a single slot which terminates either a whole motif or the first half of a compound motif; otherwise an even number of slots.
4. a) [-vce] need not be present in a motif.
b) [-exp] need not be present in a motif.

### 1.3.3. Timing Patterns

To conclude this survey of patterns found in katajjait motifs, we may note that there are also certain restrictions on the number of skeletal slots which make up a motif. One of these is given in (23).
(23) No motif contains an odd number of skeletal slots, or an odd number of pairs of slots.

As a consequence, no motif will ever contain less than four skeletal slots. Thus, the skeleta in (24) are never found.
(24)
a. $*[X]$
$15 \operatorname{lot}$
b. $*[X X]$
$25 \operatorname{lot} 5$
C. $*[X X X]$
3 slots
d. $*[X X X X X]$
5 slots

A number of other restrictions are given in (25), illustrated in (26) with attested skeletal forms as well as logically possible but unattested patterns.
(25) a. No motif contains three repetitions of a basic 4- or 6-slot unit.
b. No motif contains more than four repetitions of a basic unit.
c. A basic 6-slot motif never occurs in isolation.
(26) a. [XXXX]
b. [ $X X X X X, X X X X]$
c.* [xXXX XXXX XXXX]
d. [XXXX XXXX XXXX XXXX]
e.* [xXXX XXXX XXXX XXXX XXXX]
f.* [XXXXXX]
g. $[X X X X X X X X X X X X]$
h.* [XXXXXX XXXXXX XXXXXX]
i. [XXXXXX XXXXXX XXXXXX XXXXXX]
j.* [XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX]

It should be reiterated that all of the generalizations given in this section have been based on the corpus of motifs presented in Nattiez (1983a) and Beaudry (1978a). As such, it is possible that some of the gaps in attested patterns which have been observed are simply accidental, in which case the generalizations in (22-26) may be spurious. However, it is the aim of this analysis to set up the most restrictive hypothesis that is compatible with the observed patterns, i.e. the restrictions in (22-26) are taken to be absolute. In this way, it will be possible to establish a framework which is directly testable and indeed falsifiable in the face of additional data. With this aim in mind, we may now turn to a theoretical account of the structure of katajjait motifs.

### 1.4. Phonological Domains

Clearly we do not want to say that the voicing and breath patterns described in the previous section must be specified in their entirety for each motif: this would amount to saying that they are completely random or idiosyncratic, with no predictable properties whatsoever (which is obviously not the case). Moreover, we must allow for the patterns to be generated quite freely, in view of the great productivity and high combinatorial possibilities of the system (Beaudry 1978a:271). How, then, are we to account for the quite complex restrictions on the distribution of voiceless and inspirated segments noted in section 1..3?

A fruitful approach is suggested by considering informally a number of properties of the behaviour of [-vce] and [-exp]. Notably, many of the restrictions presented in the previous section must make reference to odd or even numbered elements or positions within a motif. This is quite similar to stress systems in many languages, where stress often falls, for example, on every even numbered syllable within a word (cf. Hayes 1981, among others). Such systems receive a formal account in terms of metrical structure, suggesting that this type of analysis could be extended to the katajjait. A consideration of the pitch-accent system of Kimatuumbi, as analyzed by Pulleyblank (1983), indicates how this might be handled. In Kimatuumbi, tonal patterns within words are largely confined to alternating sequences of low and high: Pulleyblank (1983) proposes that this is a reflection of the fact that tones in this language are inserted and linked to positions specified in terms of metrical structure. Since metrical trees are binarybranching, an alternating pattern results automatically. Many katajjait motifs exhibit a similar alternating pattern of voiced-voiceless or expirated-inspirated sequences. It appears that in this system the features
[vce] and [expirated] are patterning in a similar fashion to the tones in a pitch-accent system such as Kimatuumbi's.

A reasonable strategy, then, is to define certain domains over a sequence of slots. Marking a given domain through the insertion either [vce] or [-exp] at one of its edges would then enable one to predict the values of the remaining slots (within that domain and in unlinked domains). In fact, nearly all of the restrictions on [-exp] and [-vce] may be explained by appealing to metrical constituent structure in defining these domains-- in particular, to notions of head/nonhead constituents, as made explicit in the work of Hammond (1984, 1986), as well as to a notion of phonological government or c-command as first suggested by Lowenstamm and Kaye (1986) (with reference to syllable structure) and utilized in the work of e.g. Piggott and Singh (1985). In this section I will sketch such an analysis within an arboreal theory of prominence. ${ }^{14}$

### 1.4.1. [-vce]

Let us consider first how an alternating voiced-voiceless pattern such as that in (27a) and a completely voiceless motif as in (27b) would be derived.
(27)

## a. $\left[\begin{array}{ccc}{[+v c e][-v c e]} \\ x & x & X\end{array}\right]$

b. $[\overbrace{x \quad x \quad x}^{\text {[-vce] }}]$

The following specification of metrical tree construction will allow us to delineate most of the required domains.
(28) Katajjait Tree Construction

Foot level: Construct left-headed bounded trees from right-to-left.
Suprafoot level: Construct left-headed bounded trees from right-toleft.

Word level: Construct a left-headed word tree.
The foot level is defined simply as the first layer of tree structure that is erected. The suprafoot level is intermediate between the foot and word levels and occurs, for example, in the stress systems of Passamaquoddy (Stowell 1979) and Klamath (Hammond 1986) to bind feet pairwise prior to the construction of word trees. At the word level all trees are assumed to be unbounded (Hayes 1981, Hammond 1986).

Applied to the 4 -slot skeleta of the motifs in (27), tree construction will yield the following structures.
(29)
a.

b.


We may now define the insertion of the feature [-vce] as applying to a slot which occupies a head (i.e. metrically strong) position at the foot level, as follows (the standard metrical terms strong (s) and weak (w) are being used in this discussion interchangeably with the more recent terms head and nonhead).
(30)
[-vce] Insertion
(optional)


Insert [-vce] on a slot immediately dominated by a head constituent. This will correctly predict the location of the leftmost slot bearing the feature [-vce]: if we insert the feature on the second strong node, we get
the specification for (27a), while if we insert it on the first strong node we get the specification for (27b).
(31)
a.



Now we need to specify the domain of rightward spreading of this feature. In (31a) this domain is the foot, but in (31b) it is the entire word tree. In order to capture this disjunction, we may appeal to certain ideas concerning phonological government (cf. Lowenstamm and Kaye 1986) in conjunction with the head/nonhead distinction in metrical constituency. Let us define the DOMAIN of a given slot as follows.
(32) The DOMAIN of a slot $X_{2}$ consists of all slots $c$-commanded by the head constituents immediately dominating $X_{1}$, that is, by all $s$ nodes which dominate $X_{1}$ with no intervening $w$ nodes.

The term c-command is used here with the original branching definition of
Reinhart (1976) (i.e. A c-commands B iff the first branching node dominating A also dominates $B$ ). Then the rule of katajjait spreading may be formulated as in (33).
(33) Katajjait Spreading

Spread rightward within the domain of the linked slot. The definition in (32) essentially translates the notion of maximal projection into phonological terms with respect to metrical tree structure. The domain of a slot is its (phonological) maximal projection, and spreading applies exhaustively within that maximal projection.

Slots not specified for [vee] by either rule (30) or rule (33) will receive the default value of [tvce] via the following redundancy rule.
(34) Default [vce] Insertion

$$
[\text { ] }-->[+v c e]
$$

Consider now the application of Spreading to the structures in (35), where relevant head nodes are underlined (default values are not shown):
(35)
a.

b.


In (a), there is only one head constituent dominating the linked slot, the underlined 5 node; this node c-commands only one other slot (the one immediately to the right) which therefore constitutes the entire domain. Spreading applies within this domain. In (b), there are two head constituents immediately dominating the linked slot; together these 5 nodes c-command all following slots and so spreading applies within the entire motif.

Consider now an 8-slot motif, which would have the metrical structure shown in (36) after application of foot, suprafoot, and ward tree construction.
(36)

(B8)

If we link [-vce] by rule (30) to the slot occupying head position in the second foot from the beginning, as indicated, then spreading will only be able to apply within that foot. This is because even though the linked
slot is dominated by two $s$ nodes, there is an intervening w node between them so that only the lowest one defines the domain of that slot (by (32)). Coupled with [-vce] insertion and spreading in the final foot, this yields the well-formed pattern of motif (BB). By also inserting [-vce] on the following foot (and spreading within its domain), we obtain the voicing pattern exemplified by motif (B12):
(37)

(B12)

If the option of inserting [-vce] is not chosen, the motif will surface entirely voiced through the operation of the default rule (34), resulting in the pattern exemplified by motif (B5).

An example of an ill-formed pattern is given in (38). This structure is correctly ruled out because spreading has not applied within the entire domain of the linked slot.
(38)


### 1.4.2. [-exp]

The distribution of [-exp] can be accounted for by the following insertion rule, in conjunction with Spreading (33) and the redundancy rule
in (40).
(39) [-exp] Insertion (optional)

$$
\begin{aligned}
& \text { [w...[X } \\
& \text { Insert [-exp] on the initial. or final slot of a non-head } \\
& \text { constituent above the foot level. }
\end{aligned}
$$

(40) Default [exp] Insertion

$$
[\text { ] --> [+exp] }
$$

Within a 4-slot motif, insertion of [-exp] on the final slot of the nonhead (i.e. weak) constituent at the word level will give the pattern in (41a), while insertion on the initial slot of the same constituent, followed by Spreading, will give the pattern in (41b) (the nonhead constituents arcessed by rule (39) are shown underlined). ${ }^{35}$
(41)
a.

b.


The following pattern is ill-formed because [-exp] has been inserted on a slot which terminates a head (i.e. strong) constituent above the foot level.
(42) *


Similarly for an B-slot motif, various combinations of insertion yield the well-formed patterns in (43).
(43)
a.

b.

(B9)

The ill-formed pattern in (44) is correctly ruled out becuase the second occurrence of [-exp] has been linked to the final slot of a head rather than non-head constituent, in violation of rule (39).
(44)


As with [-vee], failure to apply [-exp] Insertion will result in the motif surfacing as entirely [texp] by the default rule (40).

### 1.4.3. DCP Effects

By regarding the patterns of [-exp] and [-vce] to be the result of the linking of autosegments to metrically specified positions, it becomes possible to elucidate the effects of the Obligatory Contour Principle (OCF) in determining some of the restrictions on these patterns. Recall from Section 1.3 .2 that [-vce]/[-exp] always occupy an even number of consecutive skeletal slots. In the majority of cases this is ensured by the binary branching of the metrical trees used to define the spreading of an autosegment; consider, however, the pattern in (45).
(45) *


Both instances of [-exp] have been correctly inserted and spreading has applied as required, but the structure is still ill-formed ([-exp] occupies an odd number of slots). Notice, however, that in this case two identical features have been inserted directly adjacent to each other: what we seem to be observing here are the 'antigemination' effects of the OCP. According to MCCarthy (1986), the OCP is a phonological well-formedness constraint that blocks the operation of rules when they would otherwise create two adjacent identical segments. Here, [-exp] Insertion in the katajjait phonology is blocked from applying twice in the manner indicated in (51), since this would result in two neighboring slots each linked to its own [-exp] autosegment. ${ }^{16}$ The fact that in this case a central principle of linguistic organization-- the OCP-- is able to contribute to our understanding of katajjait motif organization attests very strongly to the linguistic nature of the katajjait system.

### 1.4.4. Some Problems

While the analysis presented in the preceding discussion can account for nearly all of the voicing and breath patterns of the katajjait, it runs into problems when faced with longer motifs, in particular those composed of 12 slots. Notice in (46) that the center four slots of each motif are grouped into a constituent at the suprafoot level and that this is a nonhead constituent at the word level: it therefore constitutes a self-contained
domain for Spreading. This has the unfortunate consequence that all manner of illicit voicing and breath patterns can be derived from it simply by correctly applying the feature insertion rules and Spreading.
(46)


The problem is this: within each motif a primary division into two halves must be recognized in order to delimit the proper domains of spreading. In 8-slot motifs this is accomplished automatically by the bounded trees at the suprafoot level, yet for $12-$ slot motifs the same trees incorrectly partition the motif into three primary constituents rather than two.

In addition to this empirical problem, there is a more fundamental conceptual difficulty with the analysis outlined so far. The metrical trees whose domains are utilized in locating the insertion of [-vce] and [-exp] are derivative, in the sense that they are built upon a series of skeletal slots that is supplied to them. But where do these skeletal slots come from in the first place, i.e. how are they generated? Furthermore, as it stands there is no way of ensuring that the correct number and pattern of skeletal slots is created each time a given motif is derived. 17 In the following section a resolution of these difficulties which relies crucially on the operation of a morphological component in the generation of motif structures will be presented.

### 1.5. Morphological Domains

The problems presented in section 1.4 .4 can be resolved by considering metrical tree construction to apply within morphological domains, these domains being defined on the basis of a process of total reduplication applying to a basic skeletal template. Numerous natural languages exhibit morphological constituent copying, in which entire words or stems are repeated to form a derived lexical item (cf. Moravcsik (1978) and Key (1965) for examples). In order to see the relevance of this process for the derivation of katajjait motifs, let us digress at this point to consider the interaction of stress assignment with a process of total reduplication in the Australian language Warlpiri.

### 1.5.1. Total Reduplication in Warlpiri and Katajjait

In Warlpiri, repetition of an entire noun (stem) is used to indicate plurality: yakalpa 'emu chick' -- yakalpayakalpa 'emu chicks', rdupulpari 'prominent hillock' -- rdupalparirdupulpari 'undulating, hilly country' (Nash 1980:130-31). In the framework of Marantz (1982:456) this is analyzed as affixation of a morphemic skeleton, represented by the node label $\mu$ that dominates each morpheme in a word-structure tree, to another $\mu$ constituent. This triggers copying of all submorphemic material (i.e. skeleton, segments, syllable and additional $\mu$ structure) of the constituent it is added to.

According to Nash (1980), each half of the reduplicated word (and each unit of a compound word) constitutes a discrete domain within which metrical tree construction applies; only under this assumption can the correct stress patterns be generated. Thus, in the reduplicated form yakalpayakalpa 'emu
chicks' tree construction within each morphological domain crucially yields two separate word trees, thereby correctly predicting the existence of secondary stress on the second constituent (Nash 1980:135). This is illustrated in (47), where we follow Nash in labelling these word trees ' $M$ ' (for mot; cf. Liberman and Prince 1977:260).
(47)


Word trees in compounds and reduplicated items are joined together into a higher level of metrical structure by a rule of compound word-tree formation, which creates a left-headed unbounded tree above the word level; cf. Nash (1980:108-10,135) for further details.

From this discussion it is readily apparent that total reduplication in Warlpiri establishes a fundamental 'hal fway' division in words which is critical to the construction of well-formed metrical trees. This is precisely the effect we are seeking in our analysis of katajjait motifs, and the same approach may be extended straightforwardly to this case.

I propose that there is an impoversished morphological component operative in the construction of katajjait motifs. This component consists
of a 'lexicon' containing two basic skeletal templates (one composed of four slots, the other of six) combined with a single morphological operation of total reduplication, as schematized in (48). ${ }^{18}$ In proposing the existence of morphological templates in the katajjait, I am following McCarthy (1979, 1981), who first introduced the notion of a skeletal level that can have independent morphological status.
(48) Katajjait Morphological Component
a. Lexical entries

1. $\left[\mathrm{XXXXX}^{\mathrm{K}}\right.$
2. $\left[X_{X X X X X}{ }^{\circ}\right.$
b. Morphological operations
3. Reduplicate $\mu$

Combined with the tree construction rules given in the preceding section (to which we add a rule creating left-headed compound word trees, as in Warlpiri) this yields the following derivation for a 12-slot motif. (49)
a. Simple form
[XXXXXX]
b. Reduplication

1. Affixation of morphemic template

2.Copying



## c. Tree construction




Notice that the separate word trees created within each morphological domain correctly partition the center pair of slots into separate metrical constituents, allowing the well-formed pattern in (50) to be derived by regular application of [-exp] Insertion (39) and Spreading (33).
(50)

(B16)

In this case [-exp] has been inserted on the initial slot of the constituent which is metrically weak at the level of the compound word tree; Spreading has applied within the domain defined by the three head nodes dominating that slot.

The ill-formed patterns given previously in (4G) are all ruled out automatically under this analysis. The revised structure of (*46a) is given in (51), incorporating our insights into morphological constituency and concomitant metrical structure.
(51)*


As can be seen, the first two instances of [-exp] have been incorrectly inserted: both have been placed on a slot which is internal, rather than peripheral, to a weak constituent (this constituent being at the word level in the first instance and at the compound word level in the second). In ( 52 ) we see that the structure of (*46b), although conforming to the rule of [-vce] Insertion, violates the rule of Spreading. The first two instances of [-vce] have not been spread within their entire domains (encompassing the slots c-commanded by the underlined 5 nodes).
(52) *


The revised structure of (*46e), given in (53), is ill-formed under any possible interpretation of the application of feature insertion. If we consider it to represent a single application of [-exp] insertion as in (62a), then Spreading has applied beyond the domain of the linked slot, while if we consider it to represent two applications of [-exp] Insertion as in (53b), then Spreading has underapplied within the domain of the second. In either case the structure is ruled out.
(53)


$\left.\left[\begin{array}{llllll}{[X} & X & X & X & X\end{array}\right]\left[\begin{array}{lllll}X & X & X & X\end{array}\right]\right]$


For 8-slot motifs, the only difference is that the simple 4-slot template is chosen instead of the E-slat template as the input to reduplication. In this case the resulting metrical structure is for the most part identical to that which would be assigned if the motif had no internal morphological constituency, since each motif-half has an even number of pairs of slots; feature insertion and spreading apply routinely as outlined in Section 1.4.

### 1.5.2. Triplication and Defective Simplexes

By positing a morphological process of total reduplication, we can not only explain the voicing and breath patterns of katajjait, but also provide
a principled account of restrictions on skeletal forms found in motifs. As outlined in Section 1.3, one such restriction is that no skeleton may contain an odd number of slots or pairs of slots. This is a function of two things: the lexical specifications of katajjait templates, which include a minimum of four and six slots, and the process of reduplication, which will always double the number of slots found in the simple templates, thereby creating a 'mirror image' within each motif.

The fact that no motif ever contains three pairs of slots is a bit more complex, and requires that we look in detail at the additional restrictions on skeleton shapes originally given in (25-26). Recall from this discussion that three gaps in the paradigm of logically possible skeletal patterns await explanation: First, no motif contains three repetitions of the basic templates ( $* 26 c, * 26 \mathrm{~g})$. Second, the maximum number of repetitions of each basic template found in a motif is four (*26e, *26.j). Third, the basic template containing six slots never appears unreduplicated (*26f).

An account of the first two of these restrictions is readily at hand once we consider the natural language operation which is generally known as triplication. A number of languages mark distinct morphological categories by performing reduplication twice on the same lexical item: Mokilese poadok 'to plant' -- poadpoadok 'to be planting' -- poadpoadpoadok'to continue to plant' (Harrison 1976); Akan kum 'kill' -- kunkum 'kill (multiple activity)'
-- kunkazkunkum 'kill (intensive)'19 (Christaller 1964, Schachter and Fromkin 1968); Shipibo $\mathrm{pi}^{\prime}$ 'eat' -- [no reduplicated form available] -pipi'pipi' 'keep on eating' (Key 1965). Where partial reduplication is involved, as in Mokilese, three repetitions of the original unreduplicated portion result (hence the name triplication). If total reduplication is involved, however, as in Shipibo and Akan, then four rather han three copies
of the original unreduplicated portion result. In other words, in triplication involving $\mu$-affixation, it will never be possible to get three repetitions of the base form. By positing a morphological operation of katajjait triplication-- that is, the application of total reduplication twice-- we can therefore account for the fact that katajjait motifs show four but not three repetitions of the basic template. This is illustrated in the derivation in (54): in (b), the first application of total reduplication yields one copy of the basic template, while the second application in ( $c$ ) results in copying of the entire previously reduplicated constituent.
(54) Katajjait Triplication
a. Simple form

b. First application of reduplication


## c. Second application of reduplication

$[x x x x x x][x x x x x x]$

$[[[\mathrm{XXXXXX}][\mathrm{XXXXXX}]][[\mathrm{XXXXXX}][\mathrm{XXXXXX}]]]$


Furthermore, we also have an explanation for why no motif exhibits more than four copies of the simple form. In extensive cross-linguistic surveys of reduplication, Moravcsik (1978) and Key (1965) found that no language ever systematically applies the same process of reduplication more than twice to the same item- in other words, there is no such thing as 'quadruplication' or 'quintuplication'. 20 The restriction on katajjait patterns, then, may be seen as simply a reflection of this universal natural language constraint which places an upper bound on how many times a constituent may be copied.

Finally, concerning the restriction that the 6-slot template never occurs in its simplex (unreduplicated) form, we may note that many, if not all, languages employing reduplication have lexical classes which are defective simplexes. It is very frequently the case that items in a significant portion of a language's lexicon exhibit the surface shape of a regular process of reduplication used elsewhere in the language, but with no
corresponding unreduplicated (free) forms. A striking example of this is Nez Perce, as described by Aoki (1963). Complete reduplication is used in this language to indicate diminutives, as in q'eyex 'chub' -- q'eyexq'eyex 'small chub'. For the majority of lexical items exhibiting total repetition, however, there is no associated diminutive meaning nor any unreduplicated counterpart: qalamqalam 'lodge pole pine' -- *qalap; xetxet 'spinal column' -- *xet. This cannot simply be ascribed to an unproductive lexical process, a historical residue which requires listing of the entire repeated word in the lexicon, for two reasons:
a) A productive process of distributive reduplication (of the form $C_{x}{ }^{i-}$ ) may apply to obligatorily reduplicated stems, but the reduplicative affix appears on both portions of the totally repeated stem. Compare ku:het 'long'-- kiku:het 'long (distributive)' with palaypalay'foolish' (*palay) -pipalaypipalay 'foolish (distributive)' and not *pipalaypalay. This indicates that distributive reduplication must apply to the (non-freelyoccurring) simplex form prior to the (obligatory) application of total reduplication;
b) Independently of language-specific considerations, we may note that listing of the obligatorily reduplicated form of the item in the lexicon implies that its shape is entirely unpredictable, and obscures the identity of word form exhibited by 'true' reduplicates and 'defective' reduplicates. By not deriving the item by the process of reduplication supplied by Universal Grammar, we fail to explain why there are no languages with a lexically defective form of reduplication that violates universals of reduplication (cf. Moravcsik 1979, Marantz 1982). That is, we never find a language with a defective simplex pair of the form abcddcba-- *abcd, in which the reduplicated portion exhibits complete reversal of segments in
violation of all known constraints on 'productive' reduplication. Similar distributions of obligatory reduplication, including application to loanwords, are found in many other languages; cf. Nash (1980:130ff.) for examples in Warlpiri, and Harrison (1976) for the interesting occurrence of defective reduplicates in Mokilese, i.e. verbs that occur only in simple and triplicated forms. The phenomenon of obligatory affixation is not confined to reduplicative affixation, either: English, for example, exhibits obligatory prefixation in such items as immune -- *mune and indulge -- *dulge. It seems clear, then, that obligatorily reduplicated stems should be listed in the lexicon in their simplex forms but with a diacritic feature indicating that they obligatorily undergo reduplication, e.g. [qalam]r+reaupi] 'lodge pole pine'. In the katajjait, then, we will simply follow the example provided by ordinary language morphology and stipulate in the lexical entry of the 6 -slot motif that it must obligatorily undergo reduplication. (55) presents a revised version of the katajjait morphological component, incorporating the insights developed in this section.
(55) Katajjait Morphological Component (revised)
a. Lexical entries

1. $\left[X_{X X X X}\right.$

b. Morphological operations ${ }^{\mathbf{2 1}}$
2. Reduplicate $\mu$
3. Triplicate $\mu \quad(=$ apply (1) twice)

### 1.5.3. Summary

By way of a brief summary, let us reconsider the constraints on voicing
and breath patterns enumerated in Section 1.3 (22) and see how they are accounted for in our combined phonological and morphological framework. Restriction 1, that within either half of a motif [-vce]/[-exp] may not precede [+vcel/[+exp], is a consequence of the fact that: a) each motif-half of four or more slots is a morphological domain conditioning the construction of its own word tree; and b) left-headedness of the metrical trees defines phonological domains within which spreading must apply exhaustively. Restriction 2, that [-vce] on a motif-initial slot implies voicelessness on the entire motif, falls out from the fact that the domain of the first slot is always the whole motif; that no motif may begin with [expl is a result of the fact that the initial slot of a motif is never part of a metrically weak constituent and therefore [-exp] insertion is inapplicable. Restriction 3 , that [-vce]/[-exp] always occupy an even number of consecutive slots, results from two things: the binary-branching of metrical trees, which partition the skeleton into minimal domains of two slots within which Spreading must apply; and the Obligatory Contour Principle. The second clause of Restriction 3-- that [-exp] can occupy a single slot only if it is at the end of the first half of a compound motif or is motif-final-- results from the fact that each morpheme-final slot of a reduplicated motif (and trivially so for simplexes) is at the periphery of a nonhead constituent, hence meets the structural description of [-exp] Insertion. Finally, the fact that [-vce]/[-exp] need not be present at all in a motif is simply a consequence of the optionality of the feature insertion rules (and their interaction with the redundancy rules).

### 1.6. Empty Morphology

### 1.6.1. Meaningless Morphemes

In the preceding discussion we provided motivation for a morphological component in katajjait motif-generation on purely structural and phonological grounds. Dne very important factor has been ignored in this entire discussion, though: the morphological constituents which have been posited (the skeletal templates) are completely semantically empty. Whatever meaning a katajjait motif has is contributed by the morphemes or segmental material of Inuktitut which are mapped onto these skeletal templates: indeed, if this material consists simply of vocables, then the entire motif will be devoid of meaning. On the face of it this may appear to be an unusual or even an undesireable result. After all, in natural languages the motivation for recognizing morphological units usually encompasses both form-related and meaning-related properties. However, in this section I would like to argue that the type of morphology exemplified by katajjait is not in fact unique, but is actually the dominant form of morphology utilized in the vast (though often overlooked) domain of speech disguises, play languages, and other alternative speech forms. Following McCarthy (1985), I will call this type of morphology EMPTY MORPHOLOGY. The distinguishing feature of empty morphology is that added elements (affixes, templates) are devoid of semantic content but closely mimic the structural and phonological effects of ordinary morphological operations.

The concept of morphemes which are semantically empty is not a new one. Aronoff (1976) demonstrated convincingly that the definition of morpheme as the "minimal meaningful element of languages" is not a viable one, without rejecting the notion of morpheme altogether. He showed that certain
structural units must be recognized within words-- 'morphemes' for all practical purposes--and yet no recognizable or Eonsistent semantic content can be assigned to these units. For example, - it in words like permit, comit, resit "is a morpheme [...] though it has no meaning" (p.13); its morphemic status is required on the basis of its allomorphic behaviour with respect to the suffixes -ion, -ory, -ation, etc. --behaviour which is otherwise characteristic only of 'meaningful' latinate morphemes. Of course, this phenomenon is tied to the extremely complex issue of productivity and the proper representation of allomorphy in the lexicon, an issue which is considerably beyond the scope of the present work. We may simply note in passing that in a number of recent theories of morphology such as Lieber (1980) and Selkirk (1982), 'meaningless morphemes' like -mit are incorporated into the productive morphological machinery of the language as bound stems or roots. Such an approach is in accord with the general line of reasoning being pursued here, namely that meaningless morphemes are less marginal and more 'mainstream' than they might at first appear.

### 1.6.2. Special Registers and Lexical $\mathrm{Cl} a s 5 e s$

### 1.6.2.1. Affixation

When we turn to the domain of alternate speech forms, we find that empty morphology is pervasive and indeed is the norm. The affixation of essentially meaningless morphs is taken to be a diagnostic in the descriptive literature for a number of special speech registers, among them baby talk, animal talk, so-called men's and women's languages, and various forms of mythical or expressive speech. The degree to which such morphemes may be considered to be truly semantically empty probably varies along a continuum, since in most cases such affixes do play an identifiable
linguistic role. They signal that an exceptional register is being used or classify the speaker or hearer as belonging to a particular category of individuals. Beyond this, however, they do not have any specific semantic content or grammatical function. In particular, they cannot be considered to modify or combine with the meaning of the words they are attached to or to carry information about other words in the sentence (as do 'meaningful' affixes). Typically these empty morphemes occur affixed indiscriminately to all or the majority of words in the discourse.

For example, in Gilyak baby talk (i.e. the form of speech used by adults when talking to children) the suffix $-k /-q$ is attached to most words: gi 'shoe' (ordinary speech) -- gik 'shoe' (baby talk), daf 'house' (ordinary language) -- dafk 'house' (baby talk) (Ferguson 1977). Similarly, in Latvian baby talk the infix -in- is added to verbs, while Berber utilizes the empty suffix $-\frac{y}{s} /-\xi_{t} t$, Japanese affixes $-k o$, and Quileute adds -ck' (ibid). In Cocopa animal talk (i.e. the speech used to address pets and other animals endearingly, or to personify them, the empty prefix $\boldsymbol{q}^{4}$ - is added to all words (Langdon 1978). Empty affixes are also found in the domain of 'men's and women's speech', i.e. languages in which words spoken by men all have one form (usually characterized by an empty affix) and words spoken by women have another form. Thus, in Yana the suffix -ma is attached to words spoken by men, while in Koasati -s is added to men's words (along with other phonological modifications in each case) (Haas 19E4). Finally, in Quileute a number of mythical speech forms and so-called 'abnormal' speech registers are used, most utilizing empty affixes: the culture hero $q^{\prime}$ wati prefixes $s x$ - to all words he speaks, while when speaking to a hunchbacked person one adds the prefix ts- (Frachtenberg 1918; see also Sapir 1915).

### 1.6.2.2. Reduplication

By far the most common type of empty morphology encountered is reduplication. While empty reduplication is evidenced both in ordinary language (in the form of defective simplexes-c $c$. the discussion of Nez Perce in section 1.5) and in the special registers mentioned above (especially baby talk), it is most pervasive in the class of lexical items known variously as ideophones, expressive/affective vocabulary, word pirtures, etc. (Samarin 1970). Cross-linguistically these items are often characterized by reduplication which is in all formal respects identical to the 'meaningful' reduplication found in ordinary languages, i.e. it does not involve random permutation, nor require access to arbitrarily defined string position, in conformity with the constraints noted by Moravcsik (1978) and Marantz (1982). It is, however, semantically empty, and such items typically lack corresponding unreduplicated forms. Partial reduplication is attested, as in the Tera ideophones cacaq 'in a rushing manner' and xəxəp 'sound of dove alighting' (Newman 1968) or the Columbian Salish imitative words нәrнәriнa? 'red-winged blackbird', sg'~g'шәss'~əs 'ruffed grouse', and c'ətəta? 'rattle' (employing regular collective, diminutive, and inchoative reduplication without their grammatical content) (Kinkade 1976). Total reduplication/ triplication is also found, as in the Yoruba ideophone kutakutakuta 'struggling to and fro (N)' (Courtenay 1976) and the Kota (Dravidian) 'imitative' kor kor 'sound of death rattle' (Emeneau 1969). In these cases we are not merely dealing with marginal portions of the lexicon: there are as many as 5000 ideophones in Gbeya, more than 2600 in Zulu, and they may be coined on the spot (Samarin 1970).

Finally, in the domain of child language the morphological process of reduplication is commonplace, but its usual function is not to signal any
particular grammatical or semantic information on the word it is found in (Schwartz et al. 1980, Fee and Ingram 1982, Ferguson 1983). Rather, it is used for a number of different purposes, among them as a strategy for mastering polysyllabic words and syllable-final consonants, and simply as a form of language play. Examples of reduplicated words recorded in child language include English pe:je: 'window' (Schwartz et al. 1980) with total reduplication and French dadap 'lady' (from dame) (Ingram 1974) with partial reduplication. Once again, what is striking about these examples of empty reduplication is their structural identity with ordinary language processes of 'meaningful' reduplication. They differ only by not carrying any semantic content. 22

### 1.6.3. Ludlings

The closest parallels between ordinary morphology and empty morphology are found in ludlings. While ludlings utilize many different processes to modify ordinary language words, they most typically employ some form of empty morpholagy. This is illustrated by the table in (56), which gives examples of a number of ordinary language ('full') morphological operations and their empty morphology counterparts (CV skeleta given in original sources have been translated into Levin's (1985) X-notation). The morpholgical operations in this table are divided into two categories which may be distinguished by the form their added elements take. So-called 'concatenative' operations (1-4) consist of adding elements whose skeletons are fully segmentally specified to other elements of the same form, i.e. adding what are traditionally known as affixes (or whole words in the case of compounding). So-called 'nonconcatenative' operations (5-8) consist of adding elements whose skeletons are completely or partially unspecified
segmentally. When these are added to words that contain both segmental and 5keletal material, the operation is commonly known as "reduplication' (5-7); when they are added to elements that consist only of segmental material, the process is commonly known as 'root and pattern' morphology, as in Arabic (McCarthy 1981, 1982).

As can be seen in (56), each 'full' morphological process is mirrored by an empty morphological process in some language's ludling (with the possible exception of compounding ${ }^{23}$ ). The only differences between the two types of morphology are that ludling affixes and templates: a) have no semantic content; and b) are usually added indiscriminately to all words. The latter property is in fact deducible from the former: empty affixes lack any inherent semantic or categorial features, hence they do not have any selectional or subcategorizational restrictions which would prevent them from being added to every word.
(56)

1.Prefixation English
2.Suffixation English
3. Infixation

Sundanese
(Moravcsik
1977)
NORMAL LANGUAGE
('Full' Morphology)

| Language | Added form | Semantic Content |
| :---: | :---: | :---: |
| and Source |  | - |

Concatenative'

$$
\left[\begin{array}{ll}
\text { in } & \text { 'negative' } \\
\text { ld } &
\end{array}\right.
$$

$$
\left.\begin{array}{l}
5 \\
x
\end{array}\right] \quad \text { 'plural' }
$$

1977) 


'plural'
4. Compounding

English


> 'bird'
> (in e.g. blackbird)
'Honconcatenative'

| 5. Prefixation | Agta (Marantz 1982) | [ X $\underline{X}^{\text {x }}$ | 'plurality' |
| :---: | :---: | :---: | :---: |
| E. Suffixation | Chukchee (Marantz 1982) | X X X $]$ | 'absolutive singular' |
| 7. Infixation | Samoan <br> (Broselow \& McCarthy 1983) | -XX- | 'plural' |
| 8. 'Root and Pattern' |  |  |  |
| a) No internal morphological structure | Arabic (McCarthy 1981) | [ $X \underline{X X X X X X}]$ | 'causative' |
| b) Internal morphological structure | Sierra Miwok (Smith 1985) | [ $[x \underline{x} \times][x \underline{x}]]$ | 'qualitative' |
|  | Yokuts <br> (Archangeli 1984a,b) | $\begin{array}{r} \left.\left.\left[x_{x}^{x} x\right]\right] x x x x x\right] \\ V \\ i \end{array} V_{0}$ | 'durative' |

## LUDLING

('Empty' Morphology)

|  | Language and Source | Added form | Semantic Content of Added Form |
| :---: | :---: | :---: | :---: |
| 'Concatenative' |  |  |  |
| 1. Prefixation | English <br> (Laycock 1972) <br> 'sparrow lang.' | $\left[\begin{array}{l} \text { mad } \\ 1!1 \\ x x x \end{array}\right.$ | 0 |
| 2. Suffixation | ```Tulu (Laycock 1972)``` | $\left.\begin{array}{c} \text { da } \\ 1! \\ x x \end{array}\right]$ | $\emptyset$ |
| 3. Infixation | Estonian (Lehiste 1985) |  | 0 |
| 4. Compounding | ```Finnish (Vago 1985) 'knapsack lang.'``` | $\left[\begin{array}{l}\text { kont } \\ \text { ¢fx } \\ \text { xxxxxx }\end{array}\right]$ | 0 |
| 'Nonconcatenative' |  |  |  |
| 5. Prefixation | Buin <br> (Laycork 1969) |  | 0 |
| E. Suffixation | Vietnamese <br> (Laycork 1972) | $\begin{gathered} \text { XXI } \\ \frac{1}{u} \end{gathered}$ | 0 |
| 7. Infixation | Tigrinya <br> (Bagemihl 1987) | $\left.\right\|_{9} ^{-X X-}$ | 0 |
| B.'Root and Pattern' |  |  |  |
| a) No internal morphological structure | Amharic (Micarthy 1985) |  | 0 |
| b) Internal morphological structure | Inuktitut <br> "katajjait' | $[[X X X X][X X X X]]$ | 0 |

Particularly relevant to our analysis of katajjait are the full and empty forms of root and pattern morphology, item 9 in (56). The typical full morphology example is Arabic, in which a bare skeletal template of derivational meaning is combined with various skeleton-less morphemes with inflectional or lexical content (McCarthy 1981). An empty morphology counterpart of this is found in Amharic, in which the segmental portion of an ordinary language word is mapped onto a partially specified skeletal template supplied by the ludling morphology (McCarthy 1985). Another type of root and pattern morphology has recently been proposed in the literature, one in which added templates are morphologically complex. For example, Smith (1985) analyzes the intricate verbal morphology of Sierra Miwok as involving contrasts in unspecified skeletal templates of the form [CVCCVC] vs. [[CVC][CVC]] and [[CVCCCU]C]. The skeleton-internal morphological divisions in the latter items must be recognized on the basis of the mapping of segmental melodies that they induce: morphologically simple templates require melody spreading, while morphologically complex templates trigger melody copying. Also falling into this category of root and pattern morpholagy would be the so-called affix-supplying templates of Yokuts, as analyzed by Archangeli (1984a,b). Certain suffixes in this language trigger the selection of a given skeletal template for the stem melody they are combined with. Archangeli ( $1984 \mathrm{a}, \mathrm{b}$ ) represents this as a diacritic on the lexical entry of these affixes, but the facts are also compatible with a morphologically complex template which is segmentally specified only on the 'suffix' portion.

The skeleton-internal morphological constituents which Smith posits for Sierra Miwok-- that is, the results of skeletal reduplication-- correspond exactly to the phenomenon that we are observing in katajjait motifs. In
other words, katajjait simply represent the ludling (i.e. empty morphology) counterpart to a particular type of ordinary language root and pattern morphology. McCarthy (1982, 1985), among others, has established that numerous ludlings do involve manipulation of material on the melodic or skeletal tiers independently of one another. In the katajjait this process has simply been carried to its extreme, with extensive modulation of numerous autosegmentalized features performed simultaneously. Much of the apparent creativity of katajjait motif generation can be seen to involve the selection and combination of the various elements made available by the morphological and phonological components of the system: choice of the basic template (lexical entry), whether to apply reduplication or triplication, where (and if) to apply feature insertion, and selection of tonal and segmental sequences (including the option of using meaningless vocables for the latter). The primary difference from most other language games is that the combinatorial possibilities offered by this system are so great that the basic units of the katajjait bear little in common (phonologically, morpholagically, or semantically) with individual units of the normal language (in this case Inuktitut).

Far from being exceptional and beyond the bounds of natural language morphology, then, katajjait actually conform to the general typology of morphological systems presented in (56), and in fact fill a paradigmatic gap in that typology. 24 Thus, katajjait can be seen to differ from language in degree rather than in kind: they exhibit the same fundamental characteristics of ludlings, but manipulate pure sound structure on a much larger scale.

By regarding katajjait as a form of language game, it is also possible to gain a broader perspective on the particular ways in which kataj.jait
deviate from normal language systems. For example, the rule of [-exp] insertion (39) as it is formulated violates Hammond's (1982) Metrical Locality Condition, which forbids segmental rules access to metrical structure above the foot level. While it is possible that this particular formulation of the rule is incorrect (something which further data should clarify), violation of a phonological constraint in this case is not out of line with what we know in general about the behaviour of ludlings. Many language games deliberately flout otherwise inviolable natural language constraints-- the most notable of these being the prohibition on complete reversal or permutation of segments or syllables (see section 3 of this chapter). When viewed as a type of language game, katajjait would in fact be expected to manifest similar tendencies.

### 1.7. Summary

In this section a number of central principles in phonological and morphological theory have been brought to bear on the complex range of phenomena embodied by the Inuit katajjait. It was shown that a fruitful approach to the katajjait's intricate voicing and breath patterns involves considering these to result from feature insertion on metrically specified positions, analogous to the tonal interpretation of metrical structures in a pitch-accent language. This in turn lent support to the notions of constituency and headedness in metrical theory, and allowed the operation of a number of natural language constraints on morphological and phonological systems to be revealed in the katajjait. At the same time, the very need to set up a morphological system for the katajjait-- one which is so obviously devoid of semantic content-- led us to the insight that this type of morphology is in fact the unifying characteristic of a number of diverse
forms of exceptional language behaviour-- among them, ludlings, expressive language, and sperial speeth registers. Thus, by looking at katajjait from a linguistic perspective, it has been possible to articulate in detail both the characteristics which this system shares with ordinary language systems, and the characteristics which set it apart.

That a revealing account of so many of the properties of throat games could be developed is a reaffirmation of both the linguistic principles utilized and the validity of applying them to kataj,jait. Of course, many questions remain unanswered with regard to the specifics of the analysis presented, and additional data are required to test the overall framework which has been set up. The true value of this framework lies in the fact that it has delineated a number of such avenues for future researin on this remarkable linguistic behaviour.

## 2. Tigrinya Ludlings and Phonological Architecture

Tigrinya is a language of the Ethiopic branch of Semitic, spoken by about three and one-half million people in Eritrea (and also in the neighbouring Tigre province of Ethiopia). Data from this language have figured prominently in a number of seminal studies in phonological architecture, that is, studies of the way in which phonological representations are structured into distinct tiers and planes and the crucial geometries which obtain between and within them. For example, the nature of 'true' vs. 'false' geminates in Tigrinya and its implications for the OCP have been studied by Schein (1981), Kenstowicz (1982), Lowenstamm and Prunet (1986), Hayes (1986b), and Schein and Steriade (1986). Schein (1981) also explores the nature of assimilation as autosegmental spreading in the context of Tigrinya Laryngeal Assimilation and Spirantization, while the role of Tier Conflation and the Morphemic Tier Hypothesis in Tigrinya is addressed by McCarthy (1986).

In this section I will examine these issues from a slightly different perspective, that of the Tigrinya -gV- Infixation ludling. Not only are these ludling data the first to be brought to light in this language, they also constitute a power ful tool for probing the architecture of phonological representations. This is especially relevant in view of the fact that a number of critical developments in our understanding of the nature of phonological structures and processes have occurred subsequent to the studies mentioned above. Among these are the recognition that segments are internally structured (cf. Clements 1985, Hayes 198Ea, Archangeli and Pulleyblank 1986, Sagey 1986, among others), and the elaboration of an explicit parametric theory of phonological rules set forth in Archangeli and Pulleyblank (1986).

The general outline of this section is as follows. In section 2.1 I present a detailed analysis of the ludling phonological and morphological systems, based on the autosegmental analyses of infixing langauge games initiated by McCarthy (1982). The discussion is couched within the metrical theory of syllabicity of Levin (1985) and the underspecification theory of Archangeli (1984a). In section 2.2 I examine (with the aid of ludling forms) the ramifications of the process of Laryngeal Assimilation in Tigrinya for feature-internal geometry; I will propose a default setting for one of the parameters in Archangeli and Pulleyblank's (1986) rule-writing format. Finally, in section 2.3 I take a closer look at the planar architecture in both the ordinary language and ludling morphological systems of Tigrinya.

### 2.1. Ludling Phonology

### 2.1.1 Syllabification and Epenthesis

The data for this study are the result of work with a native speaker of Tigrinya from the city of Asmara, Eritrea, Mr. Andemicael Telclemariam. The ludling which is the focus of the investigation was used by Mr. Teclemariam as an adolescent in Asmara, although the exact geographic spread, dialectal variation, or present status of this play language are not known. There appears to be some variability in the form of ludling words, with a certain amount of freedom in the extent to which a given item is modified, but two basic versions can be recognized. These are shown in (57). 25 (NL = normal language or non-luding form)

| (57) NL | LD1 | LD2 |  |
| :---: | :---: | :---: | :---: |
| a. $5^{\prime \prime}$ thifu | 5'agatigi fugu | 5' ${ }^{\text {ag athigi fugu }}$ | 'he wrote' |
| b. bitea | bigity aga | bl'git'aga | 'yellow' |
| c. Pintay | 2lgintagay |  | 'what' |
| d. K'arma | $k '$ agar maga | k'agar figimaga | 'gnat' |

Common to both of these versions is the infixation of the sequence $g v$ after each vowel, where $V$ is a copy of the preceding vowel. The versions differ, however, as to the syllable shapes found in each: version 1 (henceforth LD1) preserves the consonant clusters and closed syllables of NL Tigrinya, while version 2 (henceforth LD2) has only open syllables. When the NL form includes closed syllables as in (57c-d), in the LD2 form, these are opened by the insertion of the vowel " with subsequent repetition of that inserted vawel.

There are several ways that the difference between these two ludlings might be handled. For example, we could posit a sperial epenthesis rule, limited to application in LD2, which inserts 9 after any consonant in coda position. However, as the forms in (58) show, there is a general process of epenthesis operating independently in NL Tigrinya which serves to break up impermissable consonant clusters (cf. Leslau 1941, Pam 1973, Kenstowicz 1982). All syllables in Tigrinya are strictly of the form CV(C). 26

```
(58) a. /kfat/ ---> [kifat] 'open!'
    b. /birz-na/ ---> [birzina] 'our mead'
```

It is not accidental, then, that the inserted vowel in the ludling is the same as that of the NL epenthesis process, and a minimally redundanct account of the ludling phonology would strive to capture this overlap. Rather than posit a ludling-specific epenthesis rule, all we need specify is that LD2 differs from LD1 and NL Tigrinya in its permissable syllable
structures (allowing only CV shapes), with a single rule of epenthesis common to all three linguistic systems then applying whenever impermissible clusters arise. 27

In order to capture the fact that the epenthetic vowel in both the NL and ludling phonological systems is the same, as well as formalize the process of ludling formation, I will be utilizing the metrical theory of syllabicity developed in Levin (1985) and the underspecification theory of Archangeli (1984a) and Archangeli and Pulleyblank (1986; hereafter CSPR). Under these approaches, epenthesis is simply the insertion of an empty vowel slot (triggered by the presence of an unsyllabified skeletal slot) whose features are filled in by the general redundancy rules of the language (see Iaso Halle and Vergnaud (1980) and Harris (1980) for some early nonlinear and default vowel analyses of epenthesis). As these rules have the potential to apply in each component of the phonology, it is predicted that the epenthetic vowel will be the same regardless of whether insertion takes place in the ludling or the NL phonology.

The two NL Tigrinya shapes are given in (59) as they are represented in a metrical theory of syllabicity. In this section $I$ will be using the notational conventions given in (60), adopted from Levin (1985). (59) a.

b. $N^{\prime}$

b.
(60) Notational Conventions
a. $N$
$\underline{X}=\underline{X}=\left[{ }_{N} X\right]=$ syllable head
b. $X$ = syllable non-head
c. $X$, $=$ unsyllabified $X$
d. $X] \quad=$ syllabified $X$

The syllable structures in (59) are erected via the syllabification rules for Tigrinya given in (61).
(E1) Tigrinya Syllabification Rules
a. N-Placement
i. N-Placement 1
ii. N-Placement 2 (= Levin's (1985:267)


b. Project N"
c. Project N'



The chart in (62) gives the full surface feature specifications of vowels in Tigrinya.
(E2)

|  | $i$ | $e$ | 4 | $a$ | $u$ | $o$ | $a$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| high | + | - | + | - | + | - | - |
| back | - | - | + | + | + | + | + |
| round | - | - | - | - | + | + | - |
| low | - | - | - | - | - | - | + |

(63) gives the underspecification theory (UT) system needed to derive this array: an underspecified UR representation of vowels (a) along with the
default and complement rules needed to fill out the system (b).
(E3)
a. UR of Tigrinya vowels in UT

|  | $i$ | $e$ | 4 | $a$ | $a$ | $o$ | $a$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| high |  | - |  | - |  | - |  |
| back | - | - |  |  | + | + |  |
| round |  |  |  |  | + |  | + |
| low |  |  |  |  |  |  | + |

b. Redundancy Rules
i. Default Rules
a. [ ] $\rightarrow$ [+high]
b. [ ] ---> [-round]
c. [ ] ---> [-low]
d. [ ] $\rightarrow->$ [-high] / [+law ___]
e. [ ] ---> [-round, +back] / [+low __]
ii. Complement Rule
a. [ ] --> [+back]

The important thing to notice in this array is that [9] is completely unspecified underlyingly, all of its features being supplied by the redundancy rules in (63b). As a result, the process of epenthesis in Tigrinya may be formalized simply as the rule in (64), inserting an empty skeletal slot (sperified as a syllable head) following any unsyllabified slot.
(64) Tigrinya Epenthesis

```
0 -->> X / X' ___
```

2.1.2 Ludling Formation and Project ${ }^{\prime}{ }^{\prime}$

Having outlined the rules of core syllabification and epenthesis in NL Tigrinya, we are now in a position to formalize the process of ludling conversion. Ludling formation can be characterized by the two rules in (65).
(65a) is an infixation rule which inserts $g$ and an unspecified syllable head after every vowel, and (65b) is a rule of V-spread to link that syllable head to the features of the preceding vowel. 28
(65) Ludling Formation
a. Infixation

b. V-Spread


For now I will assume that the infixed $g$ occupies a plane separate from the NL melodic tier (s), following other nonlinear accounts of infixing ludlings (cf. McCarthy 1982, Broselow and McCarthy 1983); I will return to this point in section 2.3 .

For LD1, the rules in (65) are the only ones required to generate the correct ludling forms, as shown in the derivation in (EG) of $k$ 'agarmaga from k'arma 'box'. I assume here that core syllabification reapplies after Infixation and $V$-Spread. ${ }^{39}$
(E6)


For LD2 the crucial factor which distinguishes it from LD1 may now be specified very simply: LD2 merely lacks the rule of Project $N$ ' in its set of syllabification rules. In other words, core syllabification for LD1 and NL Tigrinya consists of the rules of N-Placement, Project N" and Froject-N', while that of LD2 consisits only of N-Placement and Project N". LD2 represents, then, a simplification of the NL syllabification rules, since it involves the elimination of a language-particular rule (Project N') in favor of the two universal (and hence cost-free) processes (location of N and N "Projection). 30 The result is that all post-nuclear consonants will remain unsyllabified at the end of the (LD2) core syllabification, thereby triggering epenthesis and eventually infixation. This is illustrated in (67) in the derivation of $k$ 'agarlgymaga, the ludling form of $k$ 'arma 'gnat'. In (67b), the coda consonant remains unsyllabified; this triggers epenthesis in (c)-(d), followed by ludling infixation in (e). The rule of V-Spread then specifies the empty syllable head in (f).
(E7) a. k'arma

b. k'a rma



Ludling Syllabification:

N-Placement, Project N"

Epenthesis

UT Redundancy Rules, Resyllabification

Ludling infixation


### 2.1.3. Final Fronting

In NL Tigrinya there is a rule which converts word-final 4 to [i] (cf. Pam 1973), evident in the derivation via epenthesis of $X X X X$ nouns, e.g. /kalb/ --epenthesis $->$ kalby --> [kalbi] 'dog'. (EB) gives a segmental formulation of this rule. (W=word)
(EB) Final Fronting
[+hi, -rnd] ---> [-bk] / _-_ ] ${ }_{w}$
LD2 forms which have an epenthetic final y due to a terminal closed syllable in the NL word do not undergo this rule. Consider the contrast exhibited by the following items.
a.

Sfgim
kagalbigi

Krgrmpgr
'name'
$k a g a l$ fgftbrgi $^{\prime} \quad$ 'dog'

Clearly rule (68) cannot apply after ludling formation, or else the incorrect LD2 form *S'gimigi for (69a) would result.

I will assume with Mohanan (1982:87-9) that (within a framework of Lexical Phonology) ludling formation occurs between the lexical and postlexical components, as schematized in (70). (See section 2.2 as well as

Chapter 4 for a discussion of revisions to this model.)
(70)


Rule (68) is ambiguously lexical or postlexical in NL Tigrinya-- there is no crucial evidence which would decide its location. However, the ludling forms demonstrate conclusively that this rule must be lexical (if we adopt the model in (70)). By placing this rule in the lexicon, LD2 forms with final closed syllables will correctly escape final fronting, as shown by the derivations in (71).
(71)
lexical phonology
a. UR
'name' 'dog'
b. NL syllabification
kalb
c. Epenthesis, UT rules, resyllabification
d. Final Fronting

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e. LD2 syllabification, epenthesis, UT rules


f. Ludling
formation,
resyllabif.



A problem does arise here, though, for words to which epenthesis has applied in the lexicon: the ludling form of 'dog' is incorrectly predicted to be *k台gáagybigi instead of kagalyg'blgi. This can be explained, however, by looking at general sequencing constraints in Tigrinya. There are in fact no sequences of the form iCi] anywhere in the language-- that is, a wordfinal $i$ separated from a preceding $i$ by one consonant never occurs.3i I assume that the ludling form undergoes a process of i-Delinking which

$$
\begin{aligned}
& \text { k } 41 \quad b i
\end{aligned}
$$

repairs the ill-formed structure created by ludling conversion so that it conforms to this NL constraint (see Chapter 4, section 2.2.3.1 for a full discussion of the effects of structure preservation on ludling forms and the implications of this for the location of the ludling component.) This is formulated in (72).
(72) i-Delinking

$$
\left.\begin{array}{c}
{[+h i,-b k]} \\
\times \backslash \\
\underline{X} \times \underline{X}
\end{array}\right]_{W}
$$

Following delinking, the redundancy rules of UT will fill in the empty slot with the vowel features of 1, as shown in (73) (a continuation of the derivation of the LD2 form of 'dog' from (71)).
(73)
a. After V-Spread
b. i-Delinking
c. UT redundancy rules


A summary of some of the rules present in each component for Tigrinya is given in (74) (the rules of Laryngeal Assimilation and Spirantization will be discussed in the following sections).
(74)

1. Lexical Phonology
a. Syllabification: N-Placement, Project N", Project Nr
b. Epenthesis
c. Final Fronting, Laryngeal Assimilation
2. Ludling Phonology
a. Syllabification: N-Placement, Project N"
b. Epenthesis
c. Ludling Formation
3. Postlexical Phonology
a. Syllabification: N-Placement, Project $N^{\prime \prime}$, Project $N^{\prime}$
b. Epenthesis
c. i-Delinking, Spirantization

### 2.2. Constraints on Spreading Rules

In recent years there has been a great deal of interest in the way phonological features are grouped with respect to each other and the skeleton. A major impetus behind much of this work-- e.g. Clements (1985), Hayes (1986a), and Archangeli and Pulleyblank (1986) (hereafter CSPR), among others-- has been the desire to characterize assimilation rules in a more constrained fashion. This has been accomplished by: 1) characterizing assimilations as rules of feature-spreading rather than feature-changing; and 2) identifying groups of features which act together in assimilations (and other processes) and building these directly into the architecture of the phonological representation, either through a hierarchical representation of features, as in Clements (1986)/CSPR (among others) or by setting up a limited number of subtiers as in Hayes (1986a).

The theory of assimilation being pursued in these approaches can generally achieve the desired level of restrictiveness for processes which are unambiguously total or partial assimilations. In these cases, the choice of which node or feature(s) to spread is fully dictated by the
sur face output of the rule. The same cannot be said, however, for processes that share characteristics of both partial and total assimilations; i.e. a rule whose output is a geminate but whose input consists of two segments that differ by only one or two feature values. In these cases the surface output is ambiguous as to whether spreading has been achieved in a total or partial fashion. In this section $I$ will argue for the adoption of a constraint on spreading rules as part of Universal Grammar which will eliminate this ambiguity. Consideration of the Tigrinya ludling forms indicates that, in the absence of evidence to the contrary, total assimilations are preferred over partial assimilations.

### 2.2.1. Laryngeal Assimilation

Tigrinya has a process of regressive Laryngeal Assimilation which converts homorganic stop sequences that differ only in voicing or glottalization into geminates (Leslau 1941, Pam 1973). 32 This is illustrated by the forms in (75) (C' represents an ejective, i.e. [+constricted glottis (CGL)], consonant).

```
    a. k'k ---> kk
    /sanduk'-ka/ ---> [sandukka] 'your(m.s.) box'
    b. gk ---> kk
        /Gaddig-ka/ m [Gaddikka] 'you(m.s.) bought'
    c. t'd ---> ddms
    /salit'-do/ ---) [saliddo] 'is it (black) sesame?'
    d. t't - m> tt
    /filf't'-ti/ --> [fflitti]`4 'known(f.)'
    e. td -m> dd
        /kulit-do/ ---> [kuliddo] . 'is it (a) kidney?'
    f. dt --m tt
        /kabbad-ti/ -->> [kabbatti] 'heavy(pl.)'
```

This process is restricted to homorganic sequences, since a word such as
/k'sad-ka/ 'your (m. 5.) neck' surfaces as [kisadka] and not *[kisatka]. That the resulting structures are true (doubly-linked) geminates (cf. Hayes 1986b) is confirmed by the fact that they are resistant to a general process of spirantization applying to voiceless velars. That is, the surface forms in (75a-b) are not *[sanduxka] and *[caddixka] as we would expect if a sequence of singly-linked structures were involved (cf. section 2.3.1 for more on this aspect of spirantization in Tigrinya).

In the frameworks of Clements (1985), Hayes (1986a), and Archangeli and Pulleyblank (1986), there are in fact two possible formulations of this rule. An approach utilizing tier decomposition/feature projection, 35 such as Hayes (198Ga), could characterize this as the displacement of the lefthand segment on an intact melodic tier (prior to tier decomposition) as in (76a), or as displacement of only the laryngeal features of that segment on the peripheral subtier (following tier decomposition) as in (76b). (76) Laryngeal Assimilation: Tier Deromposition/Feature Projettion 36

$$
\begin{aligned}
& \text { a. Total } \\
& \qquad\left[\begin{array}{l}
-\operatorname{son} \\
-\operatorname{con} t \\
\alpha \operatorname{ant} \\
\beta \operatorname{cor} \\
\gamma F \\
\frac{1}{2}
\end{array}\right]\left[\begin{array}{l}
-\operatorname{son} \\
-\operatorname{con} t \\
\alpha \operatorname{lant} \\
\rho \operatorname{cor} \\
-\gamma F \\
7
\end{array}\right]
\end{aligned}
$$

where $F=\{[C G L],[v c e]\}$
b. Partial


Central tier


Similarly, in frameworks that invoke a hierarchical representation of features such as Clements (1985) and CSPR, the rule could be formulated either as spreading of the root node leftward as in (77a) or spreading of the laryngeal node leftward as in (77b).
(77) Laryngeal Assimilation: Hierarchical Feature Representationa7
a. Total

Macro/Skeleton
Root

Laryngeal
Supralaryngeal
Place

b. Partial


The geminate integrity observed in the surface forms is compatible with a double linking either on the root tier/intact melodic tier or on the laryngeal tier/peripheral subtier. Nothing in the language, therefore, would select one representation over the other. Consideration of data from the ludling system, however, reveals that only the first possibility (i.e. total assimilation, (76a) or (77a)) is correct.

### 2.2.2. Ludling Forms

The ludling forms of words which have undergone laryngeal assimilation in the NL phonology are given in (78).


What is most notable about these forms is that segments which have been displaced by assimilation are obligatorily realized in the ludling. There can be no doubt that assimilation has taken place prior to ludling infixation because of the presence of the geminate, lack of epenthesis, and (in the case of velars) absence of spirantization where the two homorganic stops have come together, indicating the occurrence of a doubly-linked matrix in that location.

These facts can be straightforwardly accounted for if we assume that assimilation has been achieved through total spreading, as formulated in (76a) or (77a). Further, to account for the surface realization of the preassimilated stops, I will posit the rule of floating segment realization (FSR) in (79). This rule, confined to the ludling phonology, inserts an empty skeletal slot for the floating segment cast off by assimilation to dock onto (through general association conventions).
(79) Floating Segment Realization (FSR)

- —--> X / ___
(
The operation of this rule is illustrated in the derivation in (80) of sagan'Ig'Idugux'4g"kkaga (from /sanduk'ka/ 'your (m.5.) box'). In (80b), Laryngeal Assimilation within the lexical component has displaced the entire melodic segment $k^{\prime}$ (phonetic symbols are to be interpreted here either as intact, full feature matrix segments in the framework of Hayes, or root nodes and all the features they characterize in a Clements/CSPR-type framework). This segment remains floating when the word enters the ludling phonology ( $c$ ), triggering FSR to insert an empty skeletal slot in this position (d). After docking takes place, (ludling) syllabification and epenthesis apply as usual in (e), feeding ludling formation (f). When the word returns to the NL phonology (g), the postlexical rule of spirantization applies to the ejective velar, yielding the correct surface form. 3 A major theoretical consequence of the data in (78) is that they attest very strongly to the stability of segmental features once they have been delinked, i.e. in this case they survive at least beyond the lexical component (assuming the correctness of the model in (14)).
(80)
a. UR

b. Laryngeal Assimilation


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d. FSR (79), Association Conventions

e. Syllabification, Epenthesis, UT Rules

f. Infixation, V-Spread, Resyllabification

postlexical phonology
g. Resyllabification, Spirantization


In contrast, if assimilation had occurred as a partial spreading ( (7Eb) or (77b)), it would not be possible to generate the correct luding form. Within a framework invoking tier decomposition, (81) is the structure this word would have upon entering the ludling phonology. (Tier decomposition is shown only for crucial segments, with only relevant features indicated on earh subtier.) In this case, a [+CGL,-vCe] autosegment remains floating on the peripheral tier as a result of displacement by the laryngeal features to its right.
(81)


Once this form enters the ludling system, it is not clear how we can 'reconstitute' the assimilated segment so that it may show up intact and linked to its own slot again. Perhaps the rule of Floating Segment Realization could still apply, triggered in this case by the floating autosegment on the peripheral subtier. As shown in (82), this might then be supplemented by a rule of C-spread to supply that slot with the place of articulation features to its right on the Central tier:
(82)


We are a little bit closer to our goal, in that we now have a slot fully specified for the features of [k'], but we can go no further. At this point epenthesis would have to apply after the $k^{\prime}$, thereby triggering ludling infixation after that syllable. However, this is prevented by the double linking to that slot on the Central tier, and therefore we are left with an ill-formed representation, viz. *sanduk'kka.

Similar problems for a partial spreading analysis are encountered in a hierarchical feature representation. (83) gives the structure that this same word would have if spreading had only applied to the laryngeal node (once again, relevant features are shown only for the crucial segments; the feature hierarchy of CSPR is used in this example).
(B3)
MacrolSkeleton

Root Laryngeal

Supralaryngeal

Place

Secondary
Place
Again, FSR could insert an empty slot for the floating laryngeal node to
dock onto, but the spreading of the Place node of the adjacent consonant (needed to restore the original place of articulation) would create a branching structure that would block epenthesis and ultimately infixation: (84)

Macrolskeleton

## Root Laryngeal

Supralaryngeal

Place

Secondary
 Place

### 2.2.3. Assimilated $g$

Further evidence that laryngeal assimilation can only have been achieved through total spreading is provided by the exceptional behaviour of assimilated $g$ in the ludling phonology. As the items in (85) show, $g$ displaced by assimilation cannot reappear in the ludling forms, in direct contrast with the other assimilated segments (cf. (78)). (85)

| Underlying | Surface | Ludling |
| :---: | :---: | :---: |
| a. Gaddigka | Gaddikka | Gagaddigikkaga |
| 'you(m.5.) | ught' | *9agaddigigigikkaga |
| b. Pa?dugka | Pa?dukka | 2aga ${ }^{\text {Prgidugukkaga }}$ |
| 'your (m.s.) | onkeys, |  |

This failure of $g$ to reappear in the ludling clearly cannot be due to a surface constraint prohibiting multiple consecutive $g V$ sequences. Ludling forms with up to three $g \|$ syllables in a row are entirely acceptable so long as they are derived from NL words already containing a voiced velar stop
followed by a vowel:
(86)

## NL

Ludling
a. Taga Tagagaga 'towards (temporal)'
b. nagar nagagagarigi 'topic'
c. Tadgi Tagadigigigi 'donkey'
d. dingll diginigigigiligi 'virgin'
e. gins'il giginigis'fgiligi 'gun'

It would be possible to ascribe this peculiar behaviour of $g$ to a ludling- specific rule deleting a floating $g$ prior to the application of FSR. However, it does not appear to be accidental (as such a rule would imply) that $g$ is both the segment that is infixed by the ludling morphology and the one segment that cannot reappear in a ludling word. The apparently exceptional behaviour of this segment can in fact be shown to result from the operation of the OCP merging the floating $g$ displaced by assimilation with an adjacent infixed 9.40 A full account of this phenomenon requires a re-examination of the role of Tier Conflation within the ludling phonology, something which will be taken up in the next section.

Regardless of the precise mechanics of this operation, though, it can only be achieved by making reference to the entire set of features contained in 9 . That is, if laryngeal assimilation were in fact the result of partial spreading, then the floating autosegments that resulted from the assimilation of $g$ to $k$ would be identical to those delinked in the assimilation of any other voiced stop, e.g. dt $\rightarrow->t t$. The outputs of the two assimilations would be indistinguishable as far as the floating nodes/features are concerned, incorrectly predicting that $d$ and 9 should behave alike in the ludling phonology. Only by delinking the entire segment in each case can we preserve and access their distinctness when the form
enters the ludling component, thereby allowing the differential behaviour of $g$ to be mani fested.

### 2.2.4. Formalizing the Constraint

We have seen in the preceding discussion that the ludling forms of Tigrinya point conclusively to a formulation of laryngeal assimilation as total rather than partial spreading. Yet there is no evidence in the ordinary language to show that this is the case, and a child learning Tigrinya cannot be expected to have any exposure to the ludling forms which would allow him or her to learn such a distinction (due to their highly limited and specialized use). It must be concluded, then, that this aspect of the assimilation rule is a reflection of a general principle of Universal Grammar that does not have to be learned, rather than a language-particular restriction.

Within the frameworks of Hayes (198Ea) and Clements (1985), this constraint would be stated as an independent principle governing the formulation of phonological rules. The form such a constraint might take in a Hayes-type framework is given in (97), while in a Clements-type framework it might have the form of (88).
(87) Tier Intactness Constraint

A rule is formulated on the most intact representation of tiers that is compatible with its effects.
(88) Highest Node Constraint

A rule is formulated on the highest node of the feature hierarchy that is compatible with is effects.

Each of these constraints is sufficient to insure that total assimilations will be selected over partial assimilations in the absence of evidence to
the contrary. However, each is couched within a framework that has no recourse but to state such a principle independently and somewhat extraneously (as would any framework that employs standard rule-writing formats). On the other hand, this principle can be incorporated more naturally into the parametric theory of rules presented in CSPR (Archangeli and Pulleyblank 1986). In this framework, much of the information which needs to be included in the formulation of a rule is characterized by the setting of a very small number of parameters supplied by UG. The total set of parameters required by any rule is given in (89), where parenthetic elements subscripted with 'def' indicate the default setting of that parameter.
(89) CSPR Rule Format (Archangeli and Pulleyblank 1986)
I. Function
a. (insert)dar/delete
b. (maximal)dar/minimal
c. (content)aør/structure
d. (same direction)der/opposite direction/bidirectional
II. Argument
a. node/feature(s)
III. Trigger/Target Conditions
a. (free)daf/linked

Assimilation rules are those which insert structure (an association line) between an argument (the node or feature being spread) and another node (the target, whose subordinate specifications are subsequently delinked). Our concern here is solely the specification of the argument of a rule. Archangeli and Pulleyblank (1985:118) point out that structure rules which apply to feature arguments are less general, hence more costly,
than those applying to node arguments. We may extend this notion, so that the default choice of a node argument is taken to be the highest node dominating the feature(s) being spread, as in (90). This is in the same spirit as the specification of 'maximal' as the default setting of the function parameter (33b); this latter parameter, however, relates to the choice of the target, rather than the argument, of a rule. 41
(90) II. Arquent
a. (highest node)dor/feature(s)

Use of the term 'highest node' here is once again to be understood as referring to the highest node which is compatible with the rule's effects, and does not exclude specification of nodes lower than the Root as arguments. In a given language, this setting will interact with the particular array of data available to the language learner as well as with the feature hierarchy to determine uniquely the choice of an argument for a rule. Consider the surface realization of the three underlying stop sequences in (91) for a process of laryngeal assimilation in three hypothetical languages $\mathrm{A}, \mathrm{B}$, and C .
(91) Underlying Form Surface Form
A B C
a. /gk/
[kk] [kk] [kk]
b. /dk/
[dk] [tk] [tk]
c. /k'k/
[kk] [kk] [k'k]

In all three languages the fact that /gk/ surfaces as [kk] (91a) indicates that minimally the feature [-vce] is being spread leftwards; based on this much evidence alone, the default setting of the argument parameter would select the highest node dominating [-vce]-- the root node-- to spread.

Consider now the underlying sequence /dk/ (91b): in Language $A$ this
sur faces as [dk], indicating that no assimilation has taken place. This sequence is therefore irrelevant for the determination of the argument of the assimilation rule (though not for the selection of trigger/target conditions such as homorganicity), and is still compatible with the selection of the highest (root) node for those cases where [-vce] does spread. In Languages $B$ and $C$, however, this sequence surfaces as [tk], indicating that [-vce] has spread, and therefore this sequence is relevant for determining the specification of the argument of the rule. However, the surface form is incompatible with a root node argument, since clearly place of articulation features have not been spread. The next highest node above [-vce] that does not include place features is the laryngeal node, hence this must be chosen as the argument on the basis of (91b).

Finally, consider the underlying sequence /k'k/ (91c): in both Languages $A$ and $B$ this surfares as [kk], indirating that the feature [constricted glottis] is being spread. This is compatible with the root and laryngeal node arguments selected for $A$ and $B$ respectively on the basis of the other sequences. In Language $C$, however, the sequence surfaces as [k'k], indicating that the feature [CGL] is not being spread along with [vce] (i.e. the laryngeal node is not the argument). The choice of an argument must therefore be lowered one more 'notch' on the feature hierarchy, in this case down to the level of the single feature [vce]. Thus, the final argument choices are the root node for Language $A$, the laryngeal node for Language $B$, and the feature [vce] for Language $C$.
2.2.5. Further Evidence for the Highest Node Setting

The Tigrinya ludling data argue strongly for the highest compatible node in the feature hierarchy being the unmarked setting of the argument
parameter. A range of considerations beyond these data provide further support for this conclusion. In this section I will consider three types of evidence: instances of root node spreading, the rule of nasal spread (Anunaasikaatiprasaram) in Malayalam, and the role of the Elsewhere Condition in a parametric rule format.

### 2.2.5.1. Uhole Segment Spreading

A simple reflection on the behaviour of melodic elements in the environment of empty skeletal slots clearly reveals that the root node is the unmarked choice of an argument. Whenever there is an adjacent unfilled C-slot or $V$-slot in the representation, the usual route is to fill it by spreading an adjacent segment (rather than some feature of that segment). A brief sample from a number of familiar cases in the literature is given in (92).
(92) a. Compensatory lengthening: Latin (Ingria 1980)

b. Empty slots in lexical representations: Mokilese (Levin 1985)

c. Inserted empty slots: Kimatuumbi (Odden 1987)

d. Template mapping: Arabic (McCarthy 1981)


A further example would be the spreading of NL segments onto a ludling infix. In all of these cases, it is the entire melodic element of an
adjacent skeletal slot which spreads to fill the empty slot (or which is. selected for initial mapping). Of course, prior to the elaboration of the internal feature geometry of segments, no other type of spreading was possible. With the recognition that each segment is composed of a number of different class nodes, though, nothing in principle would rule out spreading of a node lower than the root in these cases (given an independentlyrequired process such as Archangeli and Pulleyblank's (1986) Node Generation, which fills in intervening nodes). Although such sub-Roct node spreading is not unattested, it is definitely the marked option. Nothing in the theory predicts that this should be the case, unless we adopt the highest node setting as the default choice of a rule's argument.

A parallel argument can be made for cases of tone mapping and spreading. In the tonal feature geometry proposed in CSPR, the features [upper] and [raised] are dominated by the Tonal class node. Again, nothing in principle would prevent each of these features from spreading or being mapped individually, yet in language after language they consistently behave together. This indicates that the tonal node is the unmarked choice for argument of a tone rule, and this follows directly from the default setting proposed in this section.

### 2.2.5.2. Anunaasikaatiprasar̃a耳

In Malayalam, there is a lexical rule which applies in colloquial forms to change (homorganic) voiced stops to nasals following nasal consonants. This is illustrated in the following items, taken from Mohanan and Mohanan (1984:584).42
(93)

Formal
a. bhaggi
$b(h) a \eta \eta i$
an̄̄̄anam
cannanam

Gloss
'beauty"
'a stone'
'sandal wood'

This rule, traditionally known as Anunaasikaatiprasar̄am'spreading of nasality', is formulated as spreading of the feature [+nasal] by Mohanan and Mohanan (1984):
(94) Anunaasikaatiprasā̄am (Mohanan and Mohanan 1984)


Like Tigrinya Laryngeal Assimilation, however, Anunaasikaatiprasar̄am takes as its input two segments that differ by only one or two features and yields a geminate as its output. Therefore, within a hierarchical model of feature geometry, it could be formulated either as a partial spreading of the feature [+nasal] (95a) or as a total spreading of the root node (95b). I assume with Piggott (1987) and MoCarthy (to appear) that the features [nasal] and [sonorant] link directly to the root node. (R=root; $L=1$ aryngeal; SL=supral aryngeal)
(95) Anunaasikaatiprasar̄am: Hierarchical Feature Representation
a. Partial
b. Total

SL


Although both of these formulations achieve the desired result of creating a nasal geminate, Total Assimilation (95b) is the preferred formulation according to the default setting of the highest node given in (90). The interaction of Anunaasikatiprasaram with a rule of Palatalization indicates that Total Assimilation is indeed the only correct formulation.

In Malayalam, velar consonants are palatalized after front vowels. As Mohanan and Mohanan (1984:587) point out, Palatalization is blocked when the target velar consonant is itself followed by a (nonidentical) consonant (960); otherwise, it applies to both single and geminate velars (96a-b). (In these forms, an apostrophe indicates palatalization; a is [-back].) (96) Malayalam Palatalization

(Anunaasikatiprasaram does not apply to ( 960 ) because the velar stop in this form is underlyingly vaiceless (and is still voiceless at the point where assimilation applies); it is is voiced by a late postlexical rule; cf. M M M for further discussion.) As the structures in (97) indicate, Palatalization applies so long as the root node of the target velar is both immediately preceded and immediately followed by a root node belonging to a vowel. If it is followed by the root node of another consonant (97e) (i.e. if the target velar has branching from the SL to the root nodes), Palatalization does not apply. ( $P=$ place; V=velar)


Consider now the structure that the velars in a word such as /teegga/
---> [teen' $y^{\prime a}$ ] 'coconut' would have following the application of Anunaasikaatiprasaram. If this rule were a partial spreading of only the feature [+nas], as in (95a), Palatalization would incorrectly be blocked:


In this case, the root node of the first velar is not followed by a root node belonging to a vowel, and so Palatalization should not apply (compare with the structure in (97c) above). 43 In contrast, if Anunaasikaatiprasaram is achieved through total spreading of the root node, as in (95b), the correct structure for Palatalization to apply will be created: ( $D=d o r s a l$ )


Thus, the Malayalam facts clearly indicate that the highest node setting is the default selection of the argument parameter, thereby providing
independent support to the conclusions reached on the basis of the Tigrinya ludling forms earlier in this section.

### 2.2.5.3. The Elsewhere Condition Hithin a Parametric Rule Format

A final argument for the general validity of the highest node setting is that it correctly predicts the precedence relation between two rules of assimilation in Yoruba, given a particular interpretation of the Elsewhere Condition (Kiparsky 1982) in a parametric rule format. Intuitively, the idea is that two rules whose effects are the same but which have different nodes in the hierarchy specified as their arguments should be in a disjunctive ordering relationship: the one which takes a lower node is more specific and therefore by the Elsewhere Condition should take precedence over the one which has the higher node as its argument.

This is indeed the case in Yoruba. In this language, there are two rules of vowel spreading which both result in 'total assimilation' (i.e. all vowel features are spread in each case). As Pulleyblank (1988) demonstrates, Progressive $V$-Spread has the root node as its argument while Regressive $V$-Spread has the dorsal node as its argument. Reg-Spread takes precedence over Prog-Spread, a fact which Pulleyblank (1988) attributes to extrinsic ordering. However, this disjunctive relationship follows from the Elsewhere Condition (EC) in conjunction with the highest node setting of the argument parameter. Since the dorsal node is more marked (everything else being equal) and therefore more specific as the choice of an argument, RegSpread is a more specific rule than Prog-Spread and hence should take precedence.

There is one wrinkle in this analysis, however: The EC is dependent on the notion of 'structural description' in rule formulations and this notion is actually no longer available in a parametric theory (as pointed out by

Archangeli and Pulleyblank (1985:20)). The desired interpretation can in fact be made to follow once it is recognized that, with the addition of the default highest node setting proposed in this section, each parameter in the CSPR rule format is provided with a default (unmarked) value. It is reasonable to regard a rule which consists of fewer default settings than another rule to be more 'specific' than the latter, and therefore to take precedence in its application. To give an obvious example: Languageparticular rules whose effects overlap with redundancy rules must be given precedence over the latter, and intuitively this would seem to fall under the jurisdiction of the EC. But precisely how? It is clear that redundancy rules-- when formulated parametrically-- will almost always have more default settings than any other kind of rule, since they are generally contextless and need only specify content (the particular feature inserted). Hence, under an interpretation of the $E C$ in which rules with fewer default settings take precedence over rules with more default settings, the precedence of language-particular rules over redundancy rules is derived directly.

Returning, then, to the ordering relationship between Prog-spread and Reg-spread in Yoruba, it is necessary to consider the number of default values in the parametric formulations of these rules. The relevant portions of these formulations are presented in (100) (based on Pulleyblank 1988; I assume that left-to-right, i.e. 'same direction', is the unmarked choice of spreading direction for the features/nodes in question). The two rules are identical with regard to the other parameter settings.
(100)a. Prog-Spread
I. Structure
(Left-to-Right)dor
II. (Root node) def
b. Reg-Spread
I. Structure

Right-to-Left (=opposite direction)
II. Dorsal node

Assuming that the choice of the highest compatible node in (100.a.II) is the default setting for the Argument parameter, it can be seen that Prog-spread has only one nondefault setting while Reg-spread has two. Thus, Reg-Spread is the more specific rule and would indeed take precedence over Prog-spread under the evaluation metric for the EC being proposed here.

To summarize, then, the establishment of a default value for the argument parameter in the CSPR rule format restores a symmetry to the inventory of parameters cotherwise, the argument parameter would be the only one lacking a default setting) and allows a natural interpretation of the EC to be developed within this framework. This interpretation is supported by the ordering relationship of Prog-Spread and Reg-Spread in Yoruba.

### 2.3. Flane Conflation and The Morpheme Flane Hypothesis

McCarthy (1986) proposes that all morphemes, whether concatenative or nonconcatenative, are introduced on separate tiers, these later being linearized by a process of Tier Conflation (see also Younes (1983)). This view, known originally as the Morphemic Tier Hypothesis, has received extensive support and argumentation in subsequent works such as Archangeli and Pulleyblank (1986) and Cole (1987), though it has been challenged recently by Lieber (1987). For the remainder of this discussion, I will adopt Cole's terms 'Plane Conflation' and the 'Morpheme Plane Hypothesis' (MPH).

In this section $I$ will explore three issues relating to the planar
separation of morphemes. First, I will show that in Tigrinya the MFH is indeed valid, at least for concatenative affixes. This can be demonstrated on the basis of the behaviour of true vs. false geminates in ludling forms. I will also examine the location of ludling conversion in relation to Plane Conflation. I will conclude that in Tigrinya, ludling formation must take place prior to Plane Conflation, and that Cole's (1987) limitation of PC to the end of the lexicon is essentially correct.

Second, I will consider how it is possible to have spreading processes apply across morpheme boundaries prior to Plane Conflation. I will argue that Schlindwein's (1985) proposal of rotating planes is to be preferred to an alternative account which would separate only features, rather than class node structure, onto different planes.

Finally, I will examine the relevance of the MPH within ludling morphal ogical systems. Although the MPH is valid for the NL phonology of Tigrinya, within the luding component it does not appear to be in effect. A comparison with Swedish indicates that there may be cross-linguistic differences as to whether ludlings observe the MPH. I will argue that this cross-linguistic variation is not unexpected, given the status of luding affixes as 'empty morphology'.

### 2.3.1. Geminates and Spirantization

### 2.3.1.1. Evidence for the MPH

NL Tigrinya has a pervasive process of Spirantization (mentioned briefly in the preceding sections) which converts post-vocalic stops into fricatives. In some dialects this affects the bilabial /b/ and the voiced velar /g/ (Leslau 1939, Pam 1973, Lowenstamm and Prunet 1986), but in all dialects the voiceless velars $/ k, k \prime, k \omega, k \prime w /$ are affected, and it is these
latter segments which I will be focussing my attention on. 44 A number of recent studies (e.g. Schein 1981, Kenstowicz 1982, Lowenstamm and Prunet 1986, Hayes 19866, Schein and Steriade 1986) have drawn attention to the fact that, owing to the process of Spirantization, the distinction between tautomorphemic ('true' or doubly-linked) geminates and heteromorphemic ('false' or singly-linked) geminates is particularly well-instantiated in Tigrinya. Consider the items in (101). 45
(101) Tigrinya Spirantization (informally k $->\times 1 V_{\text {_ }}$ )
a. /k'wak'wat/ ---> [k'wax'wati] 'francolin'
b. /mi'sar-ka/ ---> [mfsarka] 'your (m.s.) axe'
c. /sant'a-ka/ -- -) [sant'axa] 'your (m.s.) bag'
d. /mirak-ka/ ---> [miraxka] 'your (m.s.) calf'
*[mirakka]
e. /̧akkat/ ---> [Gakkat] '(kind of fruit)'
*[Gaxkat]
The forms in (101a-b) illustrate the process of Spirantization for nongeminate velars. The items in (101d-e) show the crucial contrast between tautomorphemic and heteromorphemic geminates: when two identical velar stops come together across a morpheme boundary, the first is spirantized (101d), whereas if the geminate occurs within a morpheme (101e), Spirantization cannot take place.

These facts originally led Schein (1981) and Kenstowicz (1982) to conclude that this contrast could only follow from different melodic representations for these two types of geminates, as illustrated in (102). Within morphemes, geminates were hypothesized to consist of a single melodic element linked to two skeletal slots (102a), while across morpheme boundaries, they were represented by two adjacent identical melodic elements
(102b).



Their behaviour with respect to Spirantization could then be made to follow from the appropriate formulation of geminate integrity/inalterability (GI), a constraint which essentially prevents rules from applying to only one-half of a doubly-linked matrix (cf. Levin's (1985) Condition on Structure Dependent Rules, Hayes' (1986b) Linking Constraint, Schein and Steriade's (1986) Uniform Applicability Constraint, etc.).

However, because the representation in (102b) contains two adjacent identical melodic elements and thereby violates the OCP, Schein (1981) and Kenstowicz (1982) were forced to say that the OCP was not operative in Tigrinya, at least not across morpheme boundaries. Not only was this a serious weakening of the putatively universal status of the OCP, but it was subsequently shown by Lowenstamm and Prunet (1986) that the OCP is indeed operative elsewhere in the phonology of Tigrinya. Clearly an account which can preserve the OCP while also providing an analysis of the two types of geminates is preferable. 46

McCarthy (1986) subsequently demonstrated that, by adopting the Morpheme Plane Hypothesis, it was possible to explain the differential behaviour of heteromorphemic vs. tautomorphemic geminates without having to abandon or compromise the OCP. Since the different morphemes in a form such as /mirak-ka/ occupy separate planes, as in (103a), there is no OCP violation present in the representation. Assuming that Spirantization applies before Plane Conflation, GI is not relevant (since there is no doubly-linked matrix) and only one half of the 'geminate' can be affected.
(103)
a. Following
affixation

b. Spirantization

c. Plane Conflation


Tautomorphemic geminates are still represented as doubly-linked matrices and hence escape spirantization by GI, as before.

Recently, Lieber (1987) has challenged the MPH, arguing that all of its effects can be derived from the interaction of underspecification theory and feature geometry (see setion 2.3 .3 for an exploration of these proposals in the context of ludling nonconcatenative affixes). Although Lieber does not specifically consider the Tigrinya case, it is in fact possible to rome up with an alternative account of the Spirantization facts which does not rely on the MFH and which still preserves the OCP. Specifically, if one considers Spirantization to apply cyclically, it is possible to have the stem and affix on the same plane without incurring an OCP violation:47
(104) a. UR

b. Spirantization

c. Affixation


Since the adjacent velar segments in (104r) are no longer identical (one is
a stop, the other is a fricative), no OCF violation results from having them on the same plane (as in (103)). Is the MPH, then, no longer a necessary assumption for Tigrinya?

A consideration of Tigrinya ludling forms indicates that an approach in which the OCP but not the MPH is operative cannot in fact be correct. Consider first the LD2 forms of items with voiceless velar geminates: (105) NL LD2

| a. Gakkat | > | Sagakkagatfgi | '(kind of fruit)' |
| :---: | :---: | :---: | :---: |
|  |  |  |  |
| b. mPraxka | > | migiragaxigixaga | 'your (m.s.) calf' |

When the geminate is tautomorphemic, it cannot be split by epenthesis within the ludling phonology (105a); in contrast, when it is heteromorphemic and its first half has undergone Spirantization (105b), the geminate is split by epenthesis. 48 These facts are consistent with any account: GI will prevent epenthesis in a morpheme-internal doubly-linked matrix, while GI will be irrelevant for tautomorphemic geminates (whether separated by planes or remaining distinct through Spirantization).

Consider now the following items, which involve non-velar geminates.

| (106) a | a. stinni | > | si'ginnigi | 'tooth' |
| :---: | :---: | :---: | :---: | :---: |
|  | b. Git'an-na | > | Sf'git'aganfiginaga | 'our (powdered) incense' |
| (107) a | a. Gaddi | > | GagaddPgi | 'city, country' |
|  | b. qud-do | > | Sugudig ${ }^{\text {Pdogo }}$ | 'is it (stick) incense?' |
| (108) a |  | > | yigix' ${ }^{\text {ghattigiligi }}$ | 'he is beating/killing' |
|  | b. $k i f p t-t i$ | > | kigrfigitigitigi | 'open (f.)' |

In each case, the geminate in the (a) forms is tautomorphemic while in the (b) forms it is heteromorphemic. Notice that the latter items behave exactly like the spirantized forms in (105): they are split by epenthesis in the LD2
forms. As we nated before, in an account which does not utlize the MPH, the failure of the velars in (105) to be merged by the OCP can only be attributed to the effects of Spirantization. In (106-108), however, no such analysis is possible: Spirantization is not applicable to the first half of the geminate and therefore it should merge with the adjacent identical segment. An analysis which assumes the OCP but not the MPH therefore incorrectly predicts that the ludling forms in (106-108b) should not be able to undergo epenthesis.

In summary, then, the only way to provide an account of the behaviour of tautomorphemic and heteromorphemic geminates in Tigrinya both NL and ludling) without abandoning the OCP is to adopt the MPH.

### 2.3.1.2. Plane Conflation and Ludling Conversion

In order for the distinction between tautomorphemic and heteromorphemic geminates to be maintained in Tigrinya ludling forms, ludling conversion must take place prior to Plane Conflation (PC). As illustrated in (109110), the operation of PC prior to ludling conversion would merge heteromorphemic geminates and obliterate the distinctive behaviour that was detailed in the preceding discussion.
(109) Conversion prior to Plane Conflation
a. NL form
b. LD2 Syllabification

c. Epenthesis, UT rules, resyllabification

d. Ludling Formation, resyllabification

e. Plane Conflation

(110) Conversion after Flane Conflation
a. NL form

b. Flane Conflation

| 9 | $u$ | $d$ | 0 |
| :--- | :--- | :--- | :--- |
| 1 | 1 | 1 | 1 |
| $x$ | $x$ | $x$ | $x$ |

C. LD2 Syllabification

d. Epenthesis
blorked by GI
e. Ludling Formation, resyllabification


How is it possible for an NL form to avoid undergoing PC throughout the entire lexical phonology prior to ludling Eonversion? If Plane Conflation applies at the end of each level and the ludling component takes the output of the lexicon as its input, there would in fact be no way to prevent $P C$ from applying prior to ludling. conversion. However, Cole (1987) has recently argued on independent grounds that $P C$ (or its equivalent, the Bracket Erasure Convention), should not be viewed as a cycle-final or stratum-final operation, but rather as a process that applies only once at the juncture between the lexical and postlexical phonology. $=0$

Her arguments take two forms. On the one hand, in a number of languages it is necessary for lexical rules to have access to morphological information from a previous stratum or strata. Among the processes she discusses are Seri Imperative allomorphy and /k/-Epenthesis, Ci-Ruri Present Continuous tonology, English derivational suffization, and Sekani Perambulative Reduction (see Chapter 4, section 2.2.1.2.1 for some additional discussion.). Crucially, though, no postlexical rules ever require access to such information. On the other hand, cases which appear to require FC to apply at the end of each level are open to reanalysis, or else can be made to follow from independently-required locality constraints (see Cole 1987:176-205 for a full discussion). By limiting PC to the end of the lexicon, Cole is able to overcome a number of the criticisms leveled at the model of Lexical Phonology and Morphology by Sproat (1985), Fabb (1984, 1986), and others, while still preserving the essential architecture of the theory and constraining the types of trans-stratal morphological information which may be accessed.

With the assumption that PC is a lexicon-final operation, then, the Tigrinya luding data are no longer problematic. Mohanan's original model of the location of luding conversion can be revised as shown in (111), placing the ludling component after all lexical rule applications but before PC.
(111)

LEXICON

phonet it representations
In the next chapter I will provide additional support, drawn from a number of different languages, for this location of ludling conversion and its interaction with Plane Conflation.

### 2.3.2. Heteromorphemic Spreading

Having established that morphemes occupy separate planes in NL Tigrinya, and that Plane Conflation does not apply until the end of the lexicon, the question arises as to how spreading rules whose trigger and target are on different planes can be effected. Consider the representation of /sanduk'-ka/ prior to the operation of the rule of Laryngeal Assimilation within the lexical phonology:
(112)


Spreading cannot actually take place here, for two reasons: 1) the trigger and target need to be on the same plane in order to 'see' each other (to determine if the rule is applicable); and 2) the trigger and target must be coplanar in order to cause delinking when the root node of $k$ spreads to the slot of $k^{\prime}$ (otherwise, displacement of one by the other must be independently stipulated). (This problem also arises for the application of Spirantization across morpheme boundaries, as in /sant'a-ka/ --> [sant'axa] 'your (m.5.) bag'.)

There are two ways that these problems can be overcome. The first is to consider the separate planes in this representation to be in constant rotation around the central axis of the skeleton, as proposed by Schlindwein (1985). Each plane rotates independently of the others, but when the planes cross paths during their rotation, the information present on one becomes visible to the other. If the structural description of a rule is met when two planes cross paths, the rule will apply and effectively 'lock' the planes together so that they rotate as one. This is schematized rather crudely in (113).


A second approach would be to consider that segments which are separated by planes have their node structure aligned, with only the terminal features actually present on different planes. This is diagrammed in (114), which shows the laryngeal and root node structure of this word.


Here, the laryngeal nodes of the two morphemes are aligned and hence can spread, even though the features they dominate are on separate planes. Adjacent node structures will not be collapsed by the OCP unless the terminal features they dominate occupy the same plane (e.g. following PC).

The problem with this second approach is that it depends crucially for its effectiveness on the full feature specifications of segments. In order to prevent adjacent node structures from being collapsed prior to PC, they must be specified for at least one terminal feature. What happens when segments are underspecified at the point where morphemes are concatenated? In a number of current theories of feature geometry and underspecification such as Sagey (1986) and Steriade (1987), the place of articulation of consonants is determined by the presence of a particular articulator class node (e.g. Labial, Coronal, Dorsal, Velar, etc.) which may not necessarily bear any terminal features. The specific inventory of articulator nodes which is required need not concern us here. The point is that under any account, two hetermomorphemic, identical segments such as the two d's in qud-do will share all the same nodes without having any place features specified:
(115)

Root

SupralaryngeaI

Place

Coronal


Consequently, the node structures of these segments should be collapsed, according to the account presented above. Yet as I demonstrated in the last section, in a word such as this the adjacent identical segments are clearly not merged, as evidenced by the failure of epenthesis to apply between them in the ladling phonology. It must be concluded, therefore, that of the two hypotheses considered above, Schlindwein's (1985) proposal of planar rotation provides a more satisfactory account of heteromorphemic spreading processes. ${ }^{51}$

### 2.3.3. Ludling Morphology and the MPH

Early nonlinear accounts of infixing ludings such as McCarthy (1982) and Broselow and McCarthy (1983) relied on the MPH to explain how empty $V$ slots infixed by a ludling could receive a segmental specification across an intervening consonant. If the infixed segment occupied the same plane as the NL word, spreading of a vowel from an adjacent syllable could not be achieved without crossing association lines:
(116) a. Ludling infix on separate plane

b. Ludling infix on same plane


With a more articulated conception of the internal organization of segments, however, it is in principle no longer necessary to assume that luding and NL morphemes occupy separate planes. Since, in nearly every theory of feature geometry which has been proposed, vowel features are dominated by a class node which is separate from consonant features, vowels can spread 'across' consonants without being on a separate plane. This is illustrated in (117), using the feature hier archy of CSPR. $=2$ (117)

Font
Supralaryngeal
Place
Se: ondary Place


In Tigrinya, consideration of the behaviour of floating 9 indicates that, in this language at least, the ludling infix is indeed not on a separate plane. Recall from section 2.2.3 that floating 9 , unlike other segments cast off by Laryngeal Assimilation, does not trigger FSR and hence cannot reappear in ludling forms. The relevant data are repeated here in (118).

## (118)

 Underlying Surface

This behaviour can be made to follow directly from the OCP, but only if it is assumed that the ludling infix occupies the same plane as the NL word.

Consider the derivation of the ludling form of /qaddigka/ in (119).
(119)
a. NL form after

Root
Supralaryngeal
Place
Secondary Place

b. Infixation

Root
Supralaryngeal
Place
Secondary Place


c. OCP verger

Root
Supralaryngeal
Place
Secondary Place



Following Infixation in (119b), there are two adjacent identical segments-namely, the infixed $g$ and the foating $g$. The OCP will merge these, thereby preventing the application of FSR and accounting for the failure of the floating $g$ to reappear in the ludling form. In contrast, if the infixed segments are assumed to orcupy a separate plane, the floating $g$ will never be adjacent to any of them (even after PC takes place, following V-Spread) and hence it will remain in the representation, incorrectly triggering FSR. We could, of course, assume that PC applies immediately upon infixation to merge the two planes, but then we would have to ask what the motivation is for placing them on separate planes to begin with. 53

Since the MPH is unnecessary to achieve $V$-spreading in infixing ludlings in general, and independent considerations in the Tigrinya case indicate that the ludling infix is not governed by the MPH, must it be concluded that the MPH is irrelevant for all luding morphology? In fact, ludling data from Swedish indicate that in this language at least, ludling affixes must be represented on separate planes.

Most cases of infixing ludlings invalve affixes which are specified for a consonant and unspecified for a vowel. A few examples of the reverse situation are attested, however: ludling affixes which have the vowel specified but the consonant unspecified. One such ludling is Swedish RGuarspraket; as illustrated in (120), the infix -oC- is added after each
consonant of the NL word.
(120) Swedish -oC- Infixation (Seppảnen 1982:31)
a. det $>$ dodetot
b. $\mathrm{Ar}>$ aror
c. bra $>$ bobrora

Data such as these are potentially problematic for an account in which ludling affixes do not observe the MPH, since they require that spreading of the NL consonant take place over a vowel. In the feature hierarchies of Clements (1985) and CSPR, for example, any such spreading would be impossible without the MPH: since consonant features are uniformly superordinate to vowel features in these models, consonants cannot spread across coplanar vowels without crossing association lines. However, in feature hierarchies which posit distinct consonant articulator nodes which are not superordinate to vowel features, such as Sagey (1986) and Steriade (1987), this problem will not arise in most cases.

Nevertheless, even theories which utilize articulator class nodes posit a dependency between the feature [rod] (for both vowels and consonants) and the articulator node [labial]. There is extensive cross-linguistic motivation for considering the feature [rnd] to be dominated by the class node [labial]; see McCarthy (to appear) for a summary of the evidence. If the ludling infix in RBvarspraket did not observe the MPH, it would be predicted that spreading of a labial consonant in the NL word would be blocked by the round vowel in this infix. Yet, as the item bobrora in (120c) illustrates, this is not the case. The architecture of this word is illustrated in (121), showing the impossibility of spreading without assuming the MPH.
(121) a. Ludling infix on same plane

Root
Supralaryngeal
Place
Labial

b. Ludling infix on separate plane

Labial
Place
Supralaryngeal
Root

Root
Supralaryngeal
Place
Labial


In (121a), where the ludling infix is coplanar with the NL word, the labial node on the infixed round vowel blocks the spread of the preceding labial consonant. In (121b), where NL. and ludling morphs occupy separate planes, the labial consonant in the NL word is free to spread onto the empty C-slot of the luding infix (though in this case spreading of the root node occurs, since it is the highest compatible argument). 54

In Swedish, then, ludling affixes observe the MPH, while in Tigrinya they do not. Why should there be this variation between languages? This is
probably a reflection, in part, of the status of the ludling affixes as 'empty morphology'. As we saw in section 1 of this chapter, ludling morphology differs crucially from NL morphology in that it is semantically empty. In one sense, then, ludling affixes actually straddle the boundary betwen purely phonological material and clearly morphological material. Like phonological elements, they lack semantic content, but their shape (polysegmental) and insertion locations resemble regular NL affizes. In NL systems, the MPH is relevant only for purely morphological elements, i.e. items which, by their distinct semantic content (among other properties), are identifiable as separate morphemes. Within luding systems, some languages will take the lack of semantic content of ludling affixes to indicate that they are not 'true' morphemes, and hence they need not observe the MPH (e.g. Tigrinya). Other languages, in contrast, will disregard the empty nature of ludling affices and accord them full morpheme status on the basis of their resemblance in form to NL affixes, thereby subjecting them to the MPH (e.g. Swedish).ss

### 2.4. Summary

In this section I have explored the segmental and planar architecture of Tigrinya NL and ludling forms. On the basis of assimilated segments in ludling items, I demonstrated that nodes higher up in the feature hierarchy are the unmarked choice for spreading. Within the parametric rule format of Archangeli and Pulleyblank (1986), this generalization can be expressed in a simple and straightforward way. To the extent that this is a valid generalization (and evidence beyond the Tigrinya data seems to indicate that it is), the fact that it finds a natural and elegant expression within the model of rule formulation advocated in CSPR argues strongly for the adoption
of such an approach.
I also showed that NL affixes in Tigrinya observe the Morpheme Plane Hypothesis, but ludling affixes do not. With respert to NL phonology in general, I provided support for Schlindwein's (1985) conception of plane rotation as an account of spreading processes which apply across planes, as well as Cole's (1987) relegation of Plane Conflation to the end of the lexicon. With respect to ludling systems in particular, I argued for a revision of Mohanan's (1982) model which gives the ludling component access to the pre-PC representation, and suggested that ludlings may differ as to whether they recognize their affixes as true morphemes (and hence require them to observe the MPH).


#### Abstract

3. The Crossing Constraint and 'Backwards Languages'

The prohibition on crossing of association lines (ALs) is one of the central tenets of autosegmental theory and the last of Goldsmith's (1976) original well-formedness conditions to survive intact. Recently this constraint has been the subject of renewed interest from a number of different perspectives. Sagey (1986, 1988a), for example, suggests that although the effects of the crossing constraint (CC) ${ }^{36}$ are valid, they can be derived from more general temporal notions such as precedence and overlap and therefore need not be independently stipulated as part of the grammar. On the other hand, McCarthy and Prince (1986) consider the possibility that the CC as an absolute prohibition on overlapping ALs should be relaxed. They suggest that while in the vast majority of cases ALs cannot cross, in certain other circumstances (e.g. reduplication) 'minimum crossing' may be permitted (i.e. as few association lines as possible are crossed).

In this section I will offer a somewhat different perspective on the CC. Specifically, I propose that the CC is actually parametrized, with the unmarked setting being 'no crossing' (this is used in the majority, if not the totality, of ordinary phonology). I will argue, however, that a particular class of ludlings, namely those which utilize various types of reversal, should be analyzed with the marked values of the CC, 'minimum crossing' and 'maximum crossing'. These marked settings are only available to ludlings, though, and the fact that reversal is achieved by essentially 'violating' the CC through these settings explains why it is so rarely attested in natural languages beyond the domain of ludlings. Moreover, I will show that even within ludling systems, crossed ALs are not allowed to remain in the representation for long, but are eliminated through movement of the elements they link. This is a way of resolving the conflicts in


linear precedence and overlap which Sagey (1985, 1988a) shows are at the heart of the $C C$.

The primary phenomenon to be considered in this study is an extremely widespread type of ludling often known as 'backwards language', involving different kinds of reversal of segments or syllables. A brief sample of the types of reversal which will be analyzed in this section is presented in (122).
NL
Ludling
Gloss
(122)
a. Transposition: Tagalag
kamatis tiskama 'tomato'
b. Interchange: Luchazi
yamukwenu yamunukwe
c. Segment Exchange: Javanese
satus tasus 'one hundred'
d. Sequence Exchange: Hanunco
balaynun nulayban 'domesticated'
e. Total Syllatle Reversal: Saramaccan
valisi siliva 'valise'
f. Total Segment Reversal: Javanese
dolanan nanalod 'play around'
g. False Syllable Reversal: Bakwiri
luugga . Jgaalu 'stomach'
h. False Interchange: Sanga
baatemwaa baamwatee
i. Permutation: Bedouin Hijazi Arabic

$$
\text { jtima9 } \quad \text { 9tijam }
$$

Many researchers have consigned the apparently chaotic language behaviour embodied by ludlings such as those in (122) to a role as external evidence' and have not attempted to develop an explicit and restrictive formal account of them. Such a view denies both the highly constrained nature of the processes evidenced here (no ludling permutes every third syllable, for example) as well as their great frequency and consistency across many languages. It also obscures a number of important generalizations to be made about this and related language game operations. In this section an approach more in the spirit of McCarthy (1982, 1985), Yip (1982), and Broselow and McCarthy (1983) will be taken, one which recognizes the significance of a rigorous theoretical treatment of this phenomenon for a full understanding of the organization of the phonological representation. ${ }^{57}$

In section 3.1 it will be shown that two possible ways of specifying reversal-- transformationally, or by positing 'Reverse' as an irreducible ludling operation-- are both inadequate. Such approaches are, on the one hand, too unconstrained (since they fail to exclude systematically many conceivable but nonoccurring types of ludling operations), while on the other hand they cannot account in a principled fashion for the full typology of reversal processes which are attested in ludings (e.g. transposition, false syllable reversal, exchange, etc.). Furthermore, these approaches fail to relate such operations to ordinary language morpholagical processes (as has been possible for all other types of ludling operations). The remainder of this chapter is devoted to detailing how a parametric theory of the $C C$ can overcome all of these problems. The essence of the analysis to be presented lies in the decomposition of the operation of reversal into three binary parameters which regulate the crossing of association lines: the
settings of these parameters determine how much crossing is involved (minimum or maximum), at what level the crossing occurs (syllable or segment), and what type of crossing is involved (intrasyllabic or intersyllabic).

### 3.1. Against 'Reverse' as a Ludling Dperation

I will begin this study of backwards languages by considering the most extreme types of reversal found in ludiings, total syllable and total segment reversal. These are exemplified in (123) for a number of different languages. 5 .
NL
Ludling
Gloss
(123) Total Reversal
a. Syllables

Zande (Evans-Pritchard 1954)

| tikpo | kpoti | 'salt' |
| :--- | :--- | :--- |
| vuse | sevu | 'belly' |

Tagalog (Conklin 1956)s9

| kapatid | tidpaka | 'sibling' |
| :--- | :--- | :--- |
| pagit | gitpa | 'ugly' |

Saramaccan (Price and Price 1976)

| valisi | siliva | 'valise' |
| :--- | :--- | :--- |
| gadu | duga | 'god' |

Chaga (Raum 1937)

| kapfo pfoka |  |
| :--- | :--- |
| ihenda | ndahei come' |

b. Segments

Javanese (Sadtano 1971) [t $j=k]$
dolanan nanalod 'play around' botjah hatjob 'boy'

English (Cowan, Braine, \& Leavitt 1985; Cowan and Leavitt 1982)

| gəra3 | 3arəg | 'garage' |
| :--- | :--- | :--- |
| so | of | 'though' |

Tagalog (Conklin 1956)
salamat tamalas 'thanks'
New Guinea Pidgin (Aufinger 1948)

| toktok | kotkot | 'say' |
| :--- | :--- | :--- |
| mumut | tumum | 'opposum' |

Syllable reversal ludlings such as (123a) have also been reported for Chasu (Raum 1937), French (Sherzer 197E, Lefkowitz 1987), Sanga (Sentner 19E2), and Swahili (Trevor and White 1955, Raum 1937), to name just a few. Segment reversals are also found in Czech (Laycock 1972), Finnish (Seppanen 1982), French (Sherzer 1976, Lefkowitz 1987), and Saramaccan (Price and Price 1976). 60

Although total reversals of this type may not be the most representative form of backwards languages-- segment reversals, for example, are considerably rarer than other types-- they do represent reversal in its purest form. By considering this most radical example of a ludling operation, it is possible to pinpoint the failings of potential theoretical accounts of all types of reversal. 61 Presumably one of the most powerful theoretical devices that could be admitted is one that would allow total reversals. If we adopt such a device, we would expect it at least to be capable of providing an account of all lesser types of reversal as well.

Should it still be unable to countenance the other forms of reversal found in ludlings, though, then clearly such a device is unacceptable. In this section I will show that one very powerful theoretical device for specifying total reversal fails to extend to other reversal types and (not unexpectedly) it also admits unwanted types of reversal. In contrast, a parametric theory of the $C C$ can encompass the full range of reversal types (of which total reversal is but one example) while also excluding unattested forms of reversal. Moreover, because it incorporates marked and unmarked settings, it can provide an explanation as to why some types of reversal (e.g. total segment reversal) are less preferred.

### 3.1.1. The Constrained Nature of Ludling Reversals

Dne possible way of providing a formal account of complete reversal is to utilize a transformational rule format. Prior to the advent of nonlinear rule formalisms, this was the only approach available to those who actually addressed the question of how to formulate explicitly the workings of backwards languages (e.g. Sherzer 1976). 62 In fact, the treatment of reversing ludings in many ways parallels the early rule-based descriptions of reduplication, another morphological process which did not lend itself easily to conventional formalisms. However, with the appearance of Marantz (1982) it was clearly established that a transformational approach for reduplication was simply too unconstrained, since it would admit virtually any type of copying operation as a possible reduplicative process. The same argument holds in the case of luding reversal.

Because the total reordering of segments or syllables appears so contrary to any linguistic constraints and unlike anything found in ordinary language, one is perhaps easily misled into thinking that ludings are
capable of virtually anything with regard to reversal. This is far from the case, however: ludings simply are not free to perform any conceivable type of reversal. No ludling, for instance, reverses the middle two syllables of a word; no luding permutes every other segment in a word, or moves the final syllable to the middle of a word. Yet these (and even more bizarre types of reversal) would not be systematically excluded under a
transformational account. Transformational power is not required elsewhere in the phonology nor in the description of any other type of luding operation; its elimination in this context (the last remaining case where it might appear necessary) would yield a highly constrained and unified theory of possible morphological operations. 63

A second, more plausible, approach to a formal description of backwards ludlings would be to posit reversal as a unitary, irreducible operation limited to the domain of ludling systems: The form such an operation might take is given in (124).
(124) Reverse $X$ (where $X=s y l l a b l e s$ or segments)

Such an approach has been adopted implicitly by a number of researchers in their theoretical treatments of various reversing ludlings (e.g. McCarthy 1982, Vago 1995); on closer examination, however, it too proves to be inadequate. To begin with, the same criticism levelled at a transformatonal approach is in fact applicable here: if an operation of 'Reverse' can be set up for ludings, nothing in principle prevents the setting up of other more unlikely operations at will, such as 'Invert-Even-Numbered-Segments'. Such an operation is, of course, entirely unattested, yet no explanation for its nonoccurrence is forthcoming if the theory allows the arbitrary introduction of additional operations. Df course, one could attribute the absence of these operations in ludlings to the fact that 'Reverse' is simply the only
process made available within the ludling component. But then one must ask whether there is a more fundamental reason that this process should recur to the exclusion of others, one which does not devolve exclusively upon stipulations in a particular component of the grammar.

### 3.1.2. A Typology of Backwards Languages

A number of additional problems are also faced by an account which would posit 'Reverse' as a luding morphological prime. One of these is that this approach would necessarily entail a proliferation of irreducible 'operations' in order to handle the several other varieties of reversal which are found in language games. Thus, although 'crazy' reversals such as the hypothetical example given above are not attested in the ludings of the world, a number of different kinds of reordering in addition to total reversal can be recognized with great frequency across the ludings of diverse languages. 64 One of these involves what I will call TRANSPOSITION, $6=$ that is, moving the first syllable of a word to the end (125a) or the last syllable to the beginning (125b) of the word. (For disyllabic words, this process will of course give the appearance of total reversal.)

NL Ludling Gloss
(125) Transposition

## a. First syllable to end

Cuna (Sherzer 1970, 1976)

| uwaya wayau 'ear' |  |
| :--- | :--- | :--- |
| arkan | kanar |

Fula (Noye 1975)

| deftere | teredef | 'book' |
| :--- | :--- | :--- |
| piiroowal | roowalpii | 'airplane' |

b. Last syllable to beginning

Tagalog (Conklin 1956)

| maganda | damagan | 'beautiful' |
| :--- | :--- | :--- |
| kamatis | tiskama | 'tomato' |

Zande (Evans-Pritchard 1954)66

| dewile | ledewe | 'my sister' |
| :--- | :--- | :--- |
| tamere | reteme | 'my younger brother' |

Transposition has also been reported in Buin (Laycock 1969), Chasu (Raum 1937), Finnish (Seppanen 1982), French (Lefkowitz 1987), Malay (Evans 1923), and Swahili (Steere 1955, cited in Coupez 1969).

A second type of reversal which is very widespread involves what I will call INTERCHANGE, that is, moving the second syllable of a word to the beginning or the penultimate syllable to the end. This is illustrated in (126).
NL
Ludling
61055
(126) Interchange
a. Second syllable to beqinning

Zande (Evans-Pritchard 1954)ss

| degude | gudede | 'girl' |
| :--- | :--- | :--- |
| mirase | ramese | 'tongue' |

Marquesan (Laycock 1972)
nukuhiva kunuhiva
Saramaccan (Price and Price 1976)
bakala kabala 'westerner'

## b. Penultimate syllable to end

Luchazi (Trevor and White 1955)
kundzivo kuvondzi
yamukwenu yamunukwe
Chasu (Raum 1937)
ikumi imiku 'ten'
Saramaccan (Price and Price 1976)
akuli aliku 'East Indian'
Finally, a third class of ludling reversals is EXCHANGE, i.e. the switching of the positions of segments or sequences of segments between or within words. This is the most diverse category of reversals, and it may involve consonants (127a), vowels (127b), CV sequences (127c), VC sequences (127d), and exchange of segments between an NL word and a following ludling 'nonsense' word (127e). The latter type is probably the most familiar representative of this category, corresponding to 'Pig-Latin' in English.

NL Ludling Gloss

## (127) Exchange

a. Consonants

Javanese (Sadtano 1971)

| satus | tasus | 'one hundred' |
| :--- | :--- | :--- |
| duwit | wudit | 'money' |
| 1937) |  |  |
| sano | naso | 'five' |
| kenda | ndeka | 'nine'. |

b. Vowels

Tagalog (Conklin 1956)
dito
doti
'here'

Chasu (Raum 1937)
wane wena 'four'
c. CV sequences

Hanunoo (Conklin 1959) 67

| balaynun | nulayban | 'domesticated' |
| :--- | :--- | :--- |
| rignuk | nugrik | 'tame' |
| bisjaw | gasbiw | 'nick' |

Finnish (Campbell 1980, 1981, 1986)
kenkansa polki ponkansa kelki ${ }^{9}$ his shoe kicked'
tule sisadn sile tusaan 'come in'
d. VI sequences

Burmese (Haas 1969) $6=$

| budayõ̌w bỡwdayu' | 'railroad station' |  |
| :--- | :--- | :--- |
| le?hma? | laphme? | 'ticket' |

Thai (Surintramont 1973)

| duu nẵ | daŋ nǔu | 'see movie' |
| :--- | :--- | :--- |
| dẵ nuu |  |  |$\quad$.

e. With 'nonsense' word

Mandarin (Yip 1982)
ma may ka
English (Halle 1962)
rōz ōzre 'rose'
Finnish (Campbell 1980, 1981, 1986)
susi kosi suntti 'wolf'
As these examples illustrate, the range of attested ludling reversals is
not so homogeneous as to be encompassed by a single process of 'Reverse' such as (124). In fact, it is not entirely clear how all of these diverse types of reversal can be accommodated into a simple operation such as (124) without setting up additional operations. Presumably one could add certain conditions to (124) (such as reversal at word-ends or the like), but this fails to explain why exactly these types of reversal-- and no others-should occur. Why, for example, does movement of syllables in transposition or interchange ludlings target peripheral (word-initial or -final) elements when internal ones could just as easily be specified? And why is the 'landing site' of a reversed element never exclusively in the most central portion of the word, but always instead gravitates to the edges? Furthermore, when more then one element moves (or appears to be moving), what determines whether those elements are adjacent or discontinuous? With a unitary operation of reversal, none of these considerations could be made to follow except by stipulation.

### 3.1.3. Ludlings and Drdinary Language

A major insight to emerge from the nonlinear theoretical accounts of ludlings developed by researchers such as Yip (1982), McCarthy (1982,1985), and McCarthy and Prince (1986) is that ludling operations are not radically different from ordinary language morphological processes, despite surface appearances to the contrary. Ludling processes typically involve operations which are simply extensions, modifications, or exaggerations of recognizable natural language processes. Infixing language games, for example, represent one broad class of ludlings which utilize affixation just as in ordinary morphological systems, but the constituent which is affixed is distinguished by being more radically underspecified or more heavily prespecified than in
ordinary language systems (cf. McCarthy 1982, Broselow and McCarthy 1983, Yip 1982). Other ludings may involve more extreme varieties of template morphology (McCarthy 1985). (See section 1 of this chapter for further discussion of the connections between luding and NL morphology.)

A third argument, then; against positing 'Reverse' as a luding operation (as well as setting up similar operations for other types of ludling reversals) is that such an account is unable to establish this sense of relatedness between ordinary language and ludling processes. Of course, no one would go so far as to suggest that a process of reversal itself should be granted status as a regular morphological process. It is curious, however, that reversal (in its variant manifestations) should remain the only ludling process whose relationship to some facet of ordinary language phonology or morphology cannot be explicitly acknowledged. As McCarthy and Prince (1986) point out, near parity between ludling and NL phonology/morphology has now been achieved; the incorporation of all forms of ludling reversal into the theory, though, remains the last formidable challenge in this research program.

3.1.4. Constituents and Nonconstituents in Luding Reversals<br>One attraction of an approach such as (124) (Reverse $X$ ) is that it seems to capture the fact that backwards languages are able to select a particular level or tier in the phonological representation as their target for reversal, i.e. either segmental or syllabic units may be accessed (see, for example, Cowan and Leavitt (1981) for a more or less explicit articulation of this assumption). One must immediately ask, however, why precisely these units-- and these units only-- should be subject to reversal. Consider the schematic representation of prosodic and melodic

hierarchies in (128) (assuming for the sake of this example an X-bar representation of the syllable as in Levin (1985) and the feature hierarchy of Archangeli and Pulleyblank (1986)).
(128) Word

Foot
Syllable
Rime
Nucleus
Skeleton
Root
Tonal
Supral aryngeal
Laryngeal
Place
Secondary Place


In principle, the constituents on virtually any of these levels of organization could be targeted for a process of reversal, and the maximally general form of the operation in (124) should be as in (129).
(129) Reverse $X$, where $X=a$ string or pair of phonological constituents Is it in fact a valid assumption-- as (129) implies--that backwards languages can draw upon all and only well-formed phonological constituents, or is a more constrained approach warranted? On the one hand, it appears that the attested cases of ludling reversal are remarkably restricted in this respect, drawing upon far fewer distinct levels of organization than those in (128). In fact, it seems that reference to subsyllabic, subsegmental, and suprasyllabic constituents is never required for luding reversals. On the other hand, even the seemingly clear-cut dichotomy between syllable-level and segment-level reversals is confounded by the phenomenon of 'false syllable reversals', which apparently require access to
both segmental and syllabic information simultaneously (and to the exclusion of timing information). I will consider each of these points in turn below.

To begin with, no strong case can be made for the necessity of accessing phonological constituents at the suprasyllabic level for backwards languages. Clear instances of foot reversal are virtually unattested, 69 and although a few examples of reversed word order have been reported (e.g. in one Chasu ludling the positions of heads and complements may be interchanged (Raum 1937)), it is not clear that this requires reference to phonological rather than syntactic constituents. In the overwhelming majority of backwards ludlings, elements within (or between) words below the level of foot are reversed while the words themselves remain stationary. The need to specify subsyllabic constituents in reversing ludlings is no more apparent. A number of ludlings do involve the exchange of vowels between adjacent syllables, as exemplified earlier in (127b). It is conceivable that this could be viewed as reversal of nucleus constituents, but the facts are also consistent with a purely segment-level process (i.e. movement of root nodes which are identified as occupying nucleus position). 70 This would in fact parallel the numerous examples of consonant exchange reported in ludlings, which generally operate strictly at the melodic level without reference to syllable position (onset vs. coda).

Several instances of what seem to be reversals of onsets are attested (perhaps the most familiar being games of the 'Pig-Latin' type). However, in view of the fact that 'onset' is not a constituent in many current theories of the syllable ccf. Clements and Keyser 1983, Levin 1985, McCarthy and Prince 1986), and that a number of alternative analyses of these ludings are available, it is not unreasonable to call into question an approach such as (129) which would require that onset be recognized as a constituent.

Finally, ludings such as the Burmese and Thai examples shown in (127d) appear to reverse rime nodes. Unlike the 'onset', the syllable rime is somewhat better motivated in NL phonology and therefore it might seem more plausible to access such a constituent in these ludlings. However, Yip (1982) has demonstrated the inadequacy of reference to syllable-internal constituents such as rime for the formalization of similar ludlings in Chinese. Although in Section 3.4 I will show that Yip's reduplicative approach does not extend to the Burmese, Thai, and related cases, her analysis is instructive in indicating that the apparent manipulation of rime constituents in ludings is often spurious. Furthermore, as Clements and Keyser (1983) and Davis (1985) point out, the relevance of a constituent such as 'rime' for the formal description of ludlings is severely compromised by the fact that a 'nonconstituent' made up of the onset and a single following vowel (in opposition to the remainder of the nucleus plus the coda) must be recognized with nearly equal regularity in the ludings of the world (cf. the Finnish and Hanunoo examples in (127c)).

In sum, then, a number of reversing ludlings are compatible with analyses that would directly access subsyllabic constituents. However, it does not appear that any of these ludings actually requires reference to such constituents (i.e. in nearly all cases alternative analyses are available), and a number of ludings cannot be analyzed with reference to such constituents. Given that our goal is a general theory of ludling reversal, it would seem preferable not to introduce additional theoretical devices until it seems absolutely necessary. Since we need to develop an analysis which does not make reference to subsyllabic constituents for a number cases in any event, a unified account would simply extend the same theoretical apparatus to all types of reversal.

At the segmental level, ${ }^{7}$ one finds that reference to constituents other than the root node is never required. For example, no ludling reverses the sequence of laryngeal nodes in a word (e.g. converting daf into tay) or inverts the order of place nodes (e.g. daf becoming bas). Similarly, contour segments (in the sense of Sagey (1986)) are consistently reversed as units; that is, the internal order of their constituents is always preserved. Examples include affricates in the (segment-reversal) ludlings of Javanese (Sadtano 1971), English (Cowan and Leavitt 1982; Cowan, Leavitt, Massaro, and Kent 1982; Cowan, Braine, and Leavitt 1985), Amharic (Leslau 1964), and Nengone (Leenhardt 1946), and prenasalized stops in Zande (EvansPritchard 1954) (though see note 71). Finally, no ludling reverses tone sequences independently of segmental sequences (for more on the relationship between tone, segment, and syllable reversals, see Section 3.3.1).

The arguments presented above are quite damaging to an account such as (129), since they indicate the necessity for a more constrained approach with respect to the specification of phonological constituents. However, they testify more to the overriding importance of notions such as 'syllable' and 'segment' than to any insurmountable difficulties in a particular formal account of backwards languages. It would in fact be possible to build reference to these and only these constituents directly into the formalism. With judicious selection and combination of frameworks, for example, one could arrive at a model of the phonological representation which makes no hierarchical units other than segment and syllable available: in Selkirk (1984:31), for instance, the notions of prosodic word and foot are abandoned; similarly, a number of non-hierarchical models of the syllable have been advanced (e.g. Kahn 1976, Clements and Keyser 1983, McCarthy and Prince 1986), while Hayes (1986a) develops an articulated theory of the
internal organization of segments that does not rely on hierarchical constituents. To the extent, however, that the various constituents represented in (128) have been shown to be useful if not indispensible components of (NL) phonological theory, this would constitute a loss in general explanatory power.

An alternative approach is to recognize that while segments and syllables may have internal constituency, such constituents are distinctly subordinate and hence cannot be directly accessed by ludlings. There are a number of ways that such 'subordinacy' could be formally implemented: if, for example, we follow Levin (1985) and others in adopting an X-bar conception of the syllable, it might be hypothesized that reference only to the maximal projection (N") is possible for ludlings. With the recognition of the importance of a notion of headedness in a hierarchical model of feature geometry, as detailed in Shaw (1987), this could plausibly be extended to segments. For instance, the root node can be thought of in some sense as the 'maximal projection' of the entire feature hierarchy, this perhaps being related to the fact that the root can be shown on independent grounds to be the default choice of a rule's argument (as was demonstrated in section 2). I will assume, then, that only 'maximal projections' (in this specific sense) may be accessed by reversing ludlings.

While this assumption enables us to restrict in a principled way the operation of 'Reverse' in (129) to only segments and syllables, this approach is still inadequate for a proper characterization of backwards languages, for the following reason. When the operation of reversal is performed on segments, all subsegmental material must be assumed to move along with each root node; similarly, when syllables are reversed, we expect all subsyllabic material to be moved with then. In other words, when a
particular phonological category is chosen for the operation of reversal, all subardinate levels of organization are irrelevant-- this is simply inherent in the definition of 'constituent'. However, there exists a significant class of ludings in which reference to syllable nodes alone is insufficient, since syllables appear to be moving but the pattern of vowel length and/or gemination (i.e. skeletal slots) is left behind. Some examples of this FALSE SYLLABLE REVERSAL are given in (130).
NL
Ludling
Gloss
(130) False Syllable Reversal
a. Luganda (Clements 1986)

| kutegeeza | zageteeku | 'to inform' |
| :--- | :--- | :--- |
| $k u b a j j a$ | jabakku | 'to work in wood' |

b. Batwiri (Hambert 1975)

| luùggé | jgàalu | 'stomach' |
| :--- | :--- | :--- |
| zééyà | yáazè | 'turn' |

c. Finnish (Seppatnen 1782)
kuuluupi piiluuku
As these items illustrate, a nonreversed timing pattern is coupled with an apparent reversal of syllables in these ludlings.

In order to account for cases such as (130) and still maintain a luding operation such as (124), one would have to say that syllables are being reversed but somehow the timing properties of those syllables are exempt from inversion. This would amount to an abandonment of the invialability of a prododic category such as 'syllable', since only certain aspects of the internal composition of those syllables are being picked out to be carried along in the reversal. Clearly the integrity of the syllable node as a target for reversal is strained under such an account. Moreover, the type
of access to syllable-subordinate information which is required for these cases involves a bypassing of the skeletal or timing tier that mediates between the melodic and prosodic sectors of the representation, since it is this level that is not being reversed. 72 If we allow discontinuous relations between the segmental and syllabic levels, what is to prevent other more unconstrained prosodic/melodic level bypasses from being admitted, e.g. moving root and place nodes independently of the supralaryngeal tier?73

It must be concluded that an approach which posits 'Reverse' as an irreducibie ludling operation fails to capture the workings of backwards languages even where the seemingly straightforward process of syllable reversal is involved. To continue to maintain such an acsount would entail unacceptable weakening of notions of constituent integrity and locality between prosodic and melodic levels, notions which in fact provided much of the original motivation for developing such an acount in the first place.

### 3.1.5. Summary

In this section I have shown that the types reversal encountered in ludlings are in many respects more highly constrained than a simplistic theoretical treatment would acknowledge, while in certain other respects they are considerably richer than current formalisms can accommodate. I have also shown that the types of constituents which must be accessed for backwards languages are neither as general nor as straightforward as a superficial examination of segmental and syllabic reversals would lead one to believe. Neither of these aspects of ludling reversals can be adequately handled by an account which posits a unitary operation of reversal as a ludling primitive. Such an actount, furthermore, is unable to relate directly these luding reversal processes to acknowledged aspects of NL
phonological/ morphological systems. In the next sections an alternative, and ultimately more surcessful, account will be suggested, one which abandons a monolithic view of reversal in favour of a compositional accourt tied crucially to the crossing of ALs.

### 3.2. Crossing Association Lines

3.2.1. The 'Mirror-Image' Configuration

Marantz (1982) points to the central role played by the $C C$ in eliminating 'mirror-image' type reduplications, that is, reduplicative processes in which the order of the copied segments is the complete reverse of the corresponding segments in the base. Such reduplications are of course unattested in ordinary language systems, but it should be apparent by now that this process of 'mirror-imaging' is precisely the phenomenon which occurs in backwards languages (though without any copying involved). If this phenomenon is expressly ruled out by the crossing ronstraint in NL systems, then a reasonable strategy in attempting to develop a constrained theory of luding reversals (one which admits 'mirror-imaging', i.e. total reversal, without lirensing haphazard kinds of reardering is to focus attention on the crossing of association lines. Consider the representation in (131).
(131)


Two things are notable about this structure: a) it specifies a reversed ordering relationship between elements on the two tiers (that is, the first element on one tier is linked to the last element on the other tier, the second element on one tier is linked to the penultimate element on the other, and so forth); and b) it involves the maximum number of crossed ALs
possible in such a configuration (that is, every line crosses with every other line). Interestingly, this structure is also technically well-formed under Goldsmith's (1976) original formulation of the CC, as noted by Sagey (1986, 1988a). 74 Now consider the structures in (132).

b. $C_{c}^{B C D}$

Unlike the structure in (131), these representations contain far fewer than the maximum possible number of crossed ALs, and they specify the haphazard sort of reordering which is unattested (or at least extremely rare) in ludiings (i.e. abcd >bcad, abcd > dbac) (on the occurrence of permutation in ludlings, see section 3.5). They would also be ruled out by any formulation of the CC , including Goldsmith's. Suppose, then, that we allow ludlings to invoke maximum crossing of association lines (as in (131)); how could this be utilized in developing an account of cases of total reversal such as those in (123)?

McCarthy (1985) has shown that ludings must be allowed to dissociate the segmental portion of a word from its skeleton (similar to the dissociation of segmental melodies in nonlinear theories of reduplication such as Marantz (1982)). In the Amharic example which he considers, this segmental melody is then reassociated to another skeletal template supplied by the ludling component. For backwards languages which involve total reversal, though, we can consider the segmental melody to reassociate simply to the same skeletal template, with the usual association conventions in effect except that maximum crossing (rather than no crossing) is observed. In other words, free segments are linked to free skeletal slots one-to-one, left-to right, but crossing as many ALs as possible. This is illustrated in the derivation of Javanese hatjob from botjah in (133). $75\left(t_{j}=\left[{ }_{k}^{k}\right]\right)$
(133)a. NL form
b. Dissociation

$\times \times \times \times \times$
botjah
c. Reassociation with maximum crossing


An example of syllable reversal, with dissociation and relinking of syllable nodes, is shown in (134) for the derivation of Zande sevu from vuse 'belly'. (In this and all subsequent derivations I will be utilizing CV slots and flat syllable structures; this is primarily a notational expedient, and is not to be taken as a specific endorsement of these structures over and against contentless timing units and a hierarchical syllable structure). (134)a. NL form

b. Dissociation
$\sigma \quad \sigma$

c. Reassociation with maximum crossing


### 3.2.2. Uncrossing by Movement

The crossed ALs in (133c) and (134c) encode a reversed ordering relationship between elements on the skeletal tier and elements on the segmental and syllable levels respectively. However, no actual reordering
has been performed on any of the tiers in question. A number of considerations indicate that specification of a reversed ordering relationship through crossing must be followed by actual reversal (movement) of the elements so specified. First of all, as Sagey (1986, 1988a) has shown, crossed ALs encode a logical inconsistency in precedence and overlap for the elements which they join. Although Sagey uses this to reaffirm a prohibition on crossing lines in the first place, it is clear that once crossing has been allowed to be introduced, the logical inconsistencies in the representation should not remain.

Second, it is impossible to determine the correct application of rules to reversed forms if they still include crossed ALs. In segmental reversals, for example, individual consonants and vowels in the ludling output usually undergo the same allophonic processes found in the NL, but with the conditioning environments of their new (reversed) positions (see, for example, Cowan and Leavitt (1981:51-2)). Consider the representation of reversed English dIp 'dip' in (135).
(135)


Because this structure does not involve actual repositioning of segments, we would incorrectly predict that the $p-$ by virtue of being word-/syllablefinal on the melodic level but word-/syllable-initial on the skeletal and prosodic levels-- might be able to undergo rules appropriate to both environments simultaneously. Yet, not surprisingly, this does not happen: in this instance the $\rho$ would display characteristics only appropriate to syllable- or word-initial position, while it is the $d$ which would undergo the syllable- or word-final processes. Similarly, without actual reversal
of the melodic elements in this representation, it is impossible to determine whether the phonetic rule which lengthens vowels before tautosyllabic voiced stops should apply to this form. If the melodic level is consulted, lengthening should not be able to apply, since in this case the stop following the vowel is voiceless. If the prosodic level is consulted, however, lengthening should apply, since at this level the is in fact 'followed' by a tautosyllabic voiced stop, the (initial) d. Without movement of the elements to the reversed positions specified through crossed ALs, this paradox cannot be resolved.

Finally, as I will show in the following section, movement of elements whose reversal is encoded in terms of crossed ALs is a crucial step in the derivation of many other reversal processes. This is particularly true of cases where elements switch places (e.g. segment exchanges) or where more than one reversal process is applied to a given luding item.

In an account which utilizes crossed ALs to encode reversed ordering relationships, the movement of elements required in these instances is in fact easily specified: one simply moves the segments or timing units until all ALs have been uncrossed. This process is stated more precisely in (136) and illustrated in (137-138) with the completion of the derivations of the items in (133-134).
(136) Uncrossing

If $x$ and $y$ are two elements on the same tier whose linear precedence is encoded in conflicting terms on another tier, move $x$ or $y$ so that these conflicts are resolved.
(137)

(138)


In (137), uncrossing is effected by moving melodic elements, while in (138) it is accomplished by moving skeletal slots.

As these items show, a representation in which crossed ALs have been introduced is manipulated in such a way that it conforms to a strict version of the CC (i.e. one which allows no conflicts in precedence/overlap on different tiers). Thus, movement is simply a strategy used to eliminate inconsistencies in timing relationships between tiers. This account also appeals to the CC in two crucial ways: first, introduction of deliberate 'violations' of the CC into the representation allows the reversed locations of elements to be specified, while returning the representation to a linear sequence which respects the CC allows the actual reordering of those elements to be effected. In this way, a very restrictive theory of phonological movement can be articulated: an element can only be moved to a position dictated by the AL joining it to another tier. By never (or hardly ever) allowing crossing of ALs in NL phonology, it follows that phonological movement should be virtually unattested in ordinary language systems, since there will never be any conflicts in ordering relationships between tiers.

One area in NL systems where violations in linearity do occur is in nonconcatenative morphological systems such as that of Arabic. 76 For example, in the word samas (derived from the consonantal root 50 ), the consonant and vowel melodies are originally on separate tiers, and the both precedes and follows the final a. This conflict in precedence is removed from the representation via Plane Conflation (cf. McCarthy 1986), which folds together the consonant and vowel tiers, causing fission of the
D. To the extent that it, too, resolves conflicts in precedence and overlap, Uncrossing is quite similar to Plane Conflation, and perhaps is to be derived from it. Alternatively, both Plane Conflation and Uncrossing could be seen as manifestations of an overriding requirement that logical inconsistencies be removed from the representation when (for independent reasons) they have been allowed to be introduced. 77

### 3.3. Parameters of Crossing

### 3.3.1. False Syllable Reversals

Not only does an account which utilizes maximum crossing of ALs allow a restrictive analysis of total reversal to be developed, it also permits the phenomenon of false syllable reversals to be accommodated without any of the problems raised earlier by a unitary view of reversal.

Notice in the examples of false syllable reversal in (130b) that not only is the timing pattern of the word stationary, but the tones remain in their original positions as well. Consider also the formal similarity between the ludlings in (130) and the consonant-exchange reversals in (139), in which the location of gemination remains constant.

NL
Ludling
Gloss
a. Amharic (Leslau 1964)

| bəčya | Yəbba | 'alone' |
| :--- | :--- | :--- |
| waddaqu | dawwhqa | 'fall' |

b. Fula (Noye 1975)

| bello lebbo | '(proper name)' |
| :--- | :--- |
| debbo |  |

These two considerations indicate that false syllable reversals must in fact be operating strictly at the segmental level (like the consonant-exchange
ludings), as concluded by Clements (1986) and Vago (1985). But if this is the case, how are such ludlings to be distinguished from the 'true segment reversals' in (123b)? In other words, how is it that the syllable-internal order of segments is preserved for false syllable reversals but not for true segment reversals?

The key to this problem may be found in the luding reversals performed by one particular speaker of English reported in Cowan, Braine, and Leavitt (1985). In addition to regular segment (140a) and syllable (140b) reversals, this speaker could also reverse the order of segments within syllables while keeping the syllables themsel ves stationary (140c).
(140) English (Cowan, Braine, and Leavitt 1985)
'basket' 'indignant'

| NL form | bæskEt | Indignant |
| :---: | :---: | :---: |
| a. Segrents | teksæb | tnengrdnx |
| b. Syllables | $k \in$ tbæs | nentdrgin |
| c. Segments within syllables | sæbtEk | nxgrdtnen |

These data indicate that the syllable-internal order of segments can be manipulated independently of the syllables containing them. I will propose, then, that there are in fact two types of line crossing at the melodic level-- intrasyllabic crossing (crossing within syllables) and intersyllabic crossing (crossing between syllables). The reversal in (140c) involves intrasyllabic crossing only (within syllables), while that in (140a) involves both intra- and inter-syllabic crossing (within and across syllables). What about intersyllabic crossing alone-- in other words, crossing of segments between syllables only? In fact, the phenomenon of false syllable reversal exemplifies exactly this situation.

The derivation of the false syllable reversal of Bakwiri laùjgá > ggàalú 'stomach' in (130b) under this account is given in (141) (where the segmental symbols are to be understood as abbreviating root nodes and the features they characterize, and where tones are omitted). (141)
a. NL form


## b. Maximum intersyllabic crossing



Notice in (141b) that all crossing takes place across syllables, with no ALs overlapping for segments within the same syllable. That is, the ALs belonging to the two segments in the first syllable ( g 9 and a) do not cross with each other; similarly, the ALs belonging to the two segments in the second syllable ( 1 and $u$ ) do not cross with each other either. 78

Let us compare this account of the Bakwiri ludling with the analysis presented in Vago (1985). Vago gives the following formulation of the rule which converts NL words into ludling forms.
(142) Exchange the segmental units of the initial and final syllables of a word. This statement correctly recognizes the necessity of accessing both segmental and syllabic information, and it certainly works for the case in question. However, any account which relies, as this does, on a prose formulation of a luding rule is clearly too unconstrained: there is nothing inherent in such an approach which would indicate why a rule such as (142) should be more highly valued than one such as (143).
(143) Exchange every other segmental unit of the first and third syllables in a word.

Needless to say, a process such as (143) never occurs in any luding. The advantages of the crossing analysis presented in this paper are obvious: it
allows us to delimit explicitly what is a possible luding operation and what is not. Furthermore, in this case there is no 'rule' involved, simply a particular setting of the crossing parameter which affects the general association conventions. The setting in question severely constrains the range of movements allowed, so that operations such as (143) are automatically excluded.

There is another welcome consequence of this parametric, line-crossing approach to luding reversals: it makes a very strong prediction about the interdependence between reversal of tone and timing patterns which could not otherwise be articulated. Since apparent syllable reversals in this framework may in fact be the result of maximum crossing at either the syllable ('true') or segment ('false') levels, it is possible for tones to remain stationary only for false syllable reversals (where root nodes are being accessed). The following constraint should therefore hold for all languages.
(144) If tone reverses in a ludling, then the timing pattern will also reverse.

This implicational statement is, of course, only relevant for languages with both phonemic tone and a length contrast on vowels and/or consonants, but it does appear to be borne out by the relevant cases which I have investigated. That is, of the logically possible combinations of reversed tone and timing patterns diagrammed in (145), I have not been able to find a ludling in which tone is reversed but the timing pattern is not.
(145)

NONREVERSED TONE Bakwir
REVERSED TONE

NONREVERSED TIMING
Bakwiri
*

REVERSED TIMING
Thai $1^{79}$
Thai II

This follows automatically in the present framework: in order for the timing
pattern to remain stationary, the ludling must be operating at the segmental level, i.e. on root nodes, whereas for tone to be reversed the ludling must be operating at the syllable level (assuming with Archangeli and Pulleyblank (1986) that the tonal node is not subordinbate to the root node); and the ludling cannot be operating at both levels simultaneously. This also predicts that in the ludling of Luganda illustrated in (130a)-- for which Clements has not given the tones-- we would not expect to find the tonal pattern reversed with the segments.

### 3.3.2. Transposition

As indicated in the preceding section, it appears that only a very limited number of variables must be considered when ALs are crossed: essentially, what level the crossing occurs at (prosodic, i.e. syllable level or melodic, i.e. segment level), how much crossing is involved (maximum/minimum/no crossing), and what type of crossing is required (intrasyllabic/intersyllabic). Under this conception, then, the crossing constraint is seen to consist, not of a single statement, but rather of a hierarchy of binary-valued parameters. The setting of a particular value for one may entail the selection of a number of other, dependent, values. As schematized in (146), all possible combinations of settings are attested, although only the crossing/no crossing distinction is relevant for the opposition between most NL and ludling phonological processes.


In this way, the relationship of ludling reversals to ordinary language systems is clearly and precisely established: 'backwards languages' of all types simply involve setting of the opposite value of this parameter from that used in the majority of NL phonology. The general property of reversal shared by such ludlings is also made precise under this account: although
reversal may be instantiated in many different ways in different ludlings, it can in every case be traced back to the use of the 'crossing' (as opposed to the 'no crossing') setting of the parameter.

The great diversity of reversal types found in ludlings can be derived from the interaction of the various settings of the CC parameters with earh other and with independently required constructs of phonological and morphological theory, such as affixation and spreading rules. In this and remaining sections I will consider in turn the various settings indicated in (14E) and how they are utilized in deriving the remaining reversal types.

Transposition-- moving an initial or final syllable to the beginning or end of a word-- is simply an instance of affixation of an empty syllable template, as in McCarthy and Prince (1986). The unique aspects of this process derive from the fact that the melodic content of this template is specified through maximum crossing (rather than the minimum crossing utilized in McCarthy and Prince's (1986) account of reduplication). Thus, movement to word-end such as the Fula example given in (125a), deftere > teredef 'book', results from suffixation of a maximal syllable:ei (147)
a. NL for

$\qquad$
b. Suffixation

C. Template Satisfaction

--->


Similarly, movement to the beginning of the word, as in Tagalog maganda > damagan 'beautiful' follows from prefixation:
(148)
a. NL forn b. Prefixation c. Template $\begin{aligned} & \text { Satisfaction }\end{aligned}$


As these examples show, part of the reason why ludling reversals tend to focus on word-peripheral elements (as noted in Section 3.1.2) is directly. explained under this account. Affixation is, of course, a process which is most often associated with word edges. Since transposition ludlings utilize affixation, it is clear that the elements whose reversal is specified in this manner will only be word-initial or word-final. 0 a

### 3.3.3. Interchange

The distinguishing characteristic of interchange ludlings is that a next-to-initial or next-to-final syllable is moved. In NL phonology the phenomenon of extraprosodicity is available to handle next-to-peripheral elements which must be aceessed as if they were peripheral. That is, marking a word-initial syllable as extraprosodic renders the second syllable effectually word-initial. It might appear that this approach should be extended to the case of interchange ludlings: a peripheral syllable would be marked as extraprosodic, coupled with affixation of a maximal syllable template satisfied through minimum crossing. Since the initial or final syllable is made invisible through extraprosodicity, it cannot be used to satisfy the prosodic template. This is illustrated in the derivations of Zande degude > qudede 'girl' and Luchazi njikuleke > njikukele'let me tell you' below.
(149) Zande
a. NL form

b. Extraprosodicity \& Prefixation

c. Template Satisfaction (minimum crossing)

d. Uncrossing

(150) Luchazi
a. NL form

b. Extraprosodicity \& Suffixation

c. Template Satisfaction (minimum crossing)

d. Uncrossing


However, consideration of a number of factors indicates that this is not in fact the correct approach to interchange within the framework being
pursued here. First of all, this analysis employs extraprosodicity in a way which does not strictly conform to the 'peripheral-only' condition (this is also true of McCarthy and Prince's use of extraprosodicity). In particular, in the derivations in (149) and (150), a peripheral syllable which is marked as extraprosodic must remain so even after the affixation of a syllable template. In each of (149b) and (150b) the syllable must be considered extraprosodic even though it is not peripheral at the syllable level cbeing preceded or followed by another syllable node). One could perhaps sidestep this objection by noting that the violation of the peripherality condition is incomplete, occuring only at the prosodic level, by virtue of the fact that the affix consists of a template unspecified below the syllable level.

Another, more serious, objection to this approach is that use of extraprosodicity with maximus crossing would allow unattested reversal types to be generated. That is, if affixation occurs at the opposite end of the word from the extraprosodic syllable, this would predict that movement of the penultimate syllable to initial position and the second syllable to final position should be possible.ea
(151) a.

b.


Such reversals are not in fact attested, indicating that extraprosodicity cannot be involved in the derivation of reversed forms.

Another analysis of these interchange data which does not rely on extraprosodicity is available. Suppose we say that these forms involve only minimum crossing of ALs and affixation. Then the derivation of Zande degude > gudede would proceed as follows, where in (152c) the template is satisfied
through linking to the initial syllable.
(152)
a. NL form

b. Prefixation

6. Teaplate Contisfaction

In (152d) uncrossing will serve only to merge the first two syllable nodes in this case; no movement of any constituent can be effected, since it is only the adjacent syllable which has been targeted by the template. As a consequence, it is not be possible to derive any luding forms which are distinct from their NL forms under this account. Suppose, then, we say that in cases of interchange the minimum number of ALs are crossed which will result in constituent moverent. The derivation would then proceed as follows.
(153)
a. NL fora b. Prefixation c. Template d. Uncrossing


Notice in (153c) that the second syllable is the closest one that can be accessed through line crossing while still resulting in constituent movement through uncrossing.

Under this analysis of interchange, a much more symmetrical account of reversal types is possible. In particular, interchange and transposition are seen to be entirely parallel: they are simply the manifestations of prosodic
affixation with minimum and maximum crossing respectively. If extraprosodicity is used, then there is an unexplained gap in the typology: transposition is affixation with maximum crossing, interchange is affixation and extraprosodicity with minimum crossing, but affixation and extraprosodicity with maximum crossing is unattested. Moreover, in this account the preoccupation of reversing ludlings with the outer edges of words is once again explained, since affixation at word edges is one of the crucial operations involved.

### 3.3.4. Exchange

In the present framework, exchange ludlings are the result of various types of segment spreading rules (with maximum or minimum crossing), sometimes combined with syllable reversal. Before we turn to a detailed analysis of the various types of exchange, however, it should be pointed out that the theoretical treatments available in the literature for these kinds of ludlings are in fact inadequate for all but those which involve an associated 'nonsense' word, i.e. the 'Pig-Latin' types illustrated previously in (127e). According to McCarthy and Prince (1986) and Yip (1982), such examples may be analyzed as a form of reduplication in which the affixed (or suppletive) template is heavily prespecified. As the derivations in (154-155) illustrate, though, such an account is available only because the segments of the 'nonsense word' can be construed as the prespecified information on the template.
(154) Mandarin aa >ay ka (Yip 1982)
a. NL form

C $V$ 11
b. Ludling template

[^1]c. Reduplication and association of NL melody

(155) English rōz > $\overline{o z r e \bar{e}}$
a. NL form
c V V c

b. Ludling template (simplified)

c. Reduplication and association of NL melody


Consider now a case such as the Finnish ludling illustrated in (127c), which converts the NL sequence kenkansa polki 'his shoe kicked' into ponkansa kelki. A reduplicative approach such as that shown in (154-155) is irrelevant in this instance, since there is no fixed segmental sequence which could be considered to be part of a template: the 'prespecified' portion would have to differ for each pair of consecutive words that undergoes the ludling operation. And of course a reduplicative approach has nothing to say about the single segment exchanges illustrated previously in (127a-b): these processes typically occur within a single word, where the possibility of appealing to prespecification does not even arise-regardless of the (somewhat questionable) merits of utilizing such a device in the first place.

In this section $I$ will explore an alternative treatment of exchange ludlings which relies only on crossing of ALs. The approach which 1 will develop makes the strongest possible claim regarding such ludlings, namely that no reference to syllable-internal constituency is required in a formal
account of these systems. This position necessarily enforces certain other requirements regarding the formulation of exchange ludling processes. The benefits which accrue from such an approach-- in particular, the unification and constraint of possible reversal types-- outweigh, I feel, the initial setbacks which may arise in such an endeavour. If this research program is ultimately not successful, though, this simply indicates that the basic line-crossing analysis developed here needs to be enriched with reference to certain subsyllabic constituents. The fundamental validity of such an approach, however, is not diminished.

### 3.3.4.1. Segment Exchanges

Under a line-crossing account, the switching of the first two consonants of a word (as in (127a)) can be achieved through a spreading rule such as the following, which flops a consonant onto a word-initial C-slot (W=word). ${ }^{-94}$
(156) Consonant Exchange (minimum crossing)

$$
\left[\begin{array}{lcl}
c & c & \\
\text { f } & -\neq & \text { Root node } \\
0 & 0 &
\end{array}\right.
$$

Consider how this rule would apply to the Javanese form satus > tasus 'one hundred', whose NL form is given in (157). If the crossing parameter is set at 'no crossing' (i.e. if (156) were a rule of NL phonology) this rule would of course be inapplicable, since there is no non-nuclear segment in the representation that can be spread onto the word-initial slot without crossing ALs.


If, however, the setting of minimum crossing is utilized for this rule, it will have the following effect:
(158)


That is, the second consonant will spread onto the slot of the first. After delinking and uncrossing, we are left with a displaced and floating initial consonant and an empty skeletal slot in the second syllable:
(159) CVCVC

5


If this were in an NL phonological system, the floating s could not link to the empty skeletal slot, since to do so would require crossing of ALs. In the ludling system, however, where the 'crossing' setting is in effect, application of general association conventions (with minimum crossing) will result in the docking of the floating segment onto the empty slot, thereby deriving the correct ludling form.
(160)


Vowel exchange ludlings such as the Chasu and Tagalog cases given previously in (127b) are handled with exactly the same type of rule, except that nuclear slots are specified.
(161) Vowel Exchange (minimum crossing)


Root node
All the examples of vowel exchange which I have been able to locate involve only two-syllable words, so that the formulation in (161) without a word bracket is sufficient. This is illustrated in (162) with the derivation of Tagalog dito > doti 'here'.
(162)
a. NL form

b. Vowel Exchange

c. Uncrossing

d. Association

e. Uncrossing


If it turns out that there are, in fact, examples of vowel exchange involving only the first two vowels of a word (which is not implausible, given consonant exchange processes), then addition of an initial bracket to the formulation in (161) would suffice, assuming maximal tier scansion (cf. Archangeli and Pulleyblank 1986). That is, if the rule is scanning the nucleus/rime tier for the relevant structural description, then the nucleus of the first syllable will be picked out as 'word-initial' on that tier even though the segment it dominates is not in fact word-initial at the melodic level. This conception of adjacency/ peripherality on the relevant level of rule scansion will also be relevant in our discussion of sequence exchanges below.

What happens in a consonant exchange ludling when the first two consonants of a word are identical? If segments are simply being permuted by a unitary operation of 'Reverse' such as that abandoned in the preceding sections, nothing special would be expected to occur. The NL and ludling forms should end up being identical: a hypothetical form totula would 'become' totula after switching the first two consonants. However, under
the spreading account presented here we might expect something unusual to take place, since there is a stage in the derivation where the switched consonants are immediately adjacent, and hence should be subject to the OCP (cf. (160, 162c) above). In fact, in at least one ludling reported in the literature, something unexpected does occur in items which have the same first two consonants. Consider the Fula forms in (163).
NL
Ludling
Gloss
(163) Fula (Noye 1975)

| a. war | raw | 'comes' |
| :--- | :--- | :--- |
| saare | raase | 'concession' |
| Pumaru | mu?aru | ' (proper name)' |
| b. baaba | baana | 'father' |
| daada | daana | 'mother' |
| mamma | manna | '(proper name)' |
| jaaje | jaane | '(proper name)' |

The items in (163a) show that this ludling involves the exchange of the first two consonants of a word. If those consonants are the same, however, as in (163b), the ludling form surfaces with an [n] in the position of the second consonant.es If we assume that [n] is a default consonant available within the luding system, then the forms in (b) follow without any fur ther rules or stipulations, given regular application of the consonant exchange rule in (35) and the operation of the OCP in merging two adjacent identical segments.es This is illustrated in (164).
(164)
a. NL form ${ }^{[77}$

| $c v$ | $V C D$ |  |  |
| :---: | :---: | :---: | :---: |
| $j$ | 1 | 1 | 1 |
| $j$ | $a$ | $j$ |  |

b. Consonant exchange

c. Uncrossing

d. OCP

e. Default Rules


These items therefore provide additional support for analyzing exchange ludlings, and by extension all other types of reversal, as the result of line crossing.

### 3.3.4.2. Sequence Exchanges

Given the independently-required processes of segment exchange detailed in the preceding discussion, it is possible to derive the exchange of sequences of segments in ludlings simply from various combinations of these rules with each other and with syllable reversals. It should be noted that, irrespective of sequence exchange systems, ludings frequently combine a number of distinct operations with each other, regardless of whether such operations occur independently in the ludlings of that particular language (although they are always attested as independent operations in the ludlings of other languages). So, for example, numerous ludlings combine reversal operations with affixation processes: Fula couples transposition with various types of infixation (Noye 1975), Saramaccan utilizes complete syllable reversal in combination with infixation and reduplication (Price and Price 1976), while Tagalog (as noted earlier) mixes several infixation and suffixation processes with total syllable
reversal (Conklin 1956).an Similarly, a number of languages also employ more than one type of reversal operation in the same ludling: for example, Zande often incorporates both consonant exchange and transposition/interchange into the same ludling word (Evans-Pritchard 1954). The combination of transposition and (word-final) consonant exchange in the derivation of ngbaduse > dengbasu 'chest' is illustrated below.
(165) Zande
a. NL form

b. Exchange

c. Transposition


As this example illustrates, what appears superficially to be a very complex form of reversal actually reduces to the sequential application of fairly simple and independently-required ludling operations. Now, sequence exchange processes involve some of the most intricate manipulations of phonological structure to be found in ludlings. On closer examination, however, these too may be broken down into a number of discrete and elementary operations.

Consider first the Hanunoo ludling given in (127c) which exchanges the initial $C V$ sequence of the first and last syllables of a stem, e.g. rignuk > nugrik 'tame'. This is simply the combination of both consonant and vowel
exchange for syllable-initial segments (maximal scansion), but in this case with 'maximum" crossing (in contrast to the minimum crossing required for the exchange rules given earlier for Javanese and Tagalog in (156) and (161)). These rules may be collapsed as in (166), where the $X$-slot stands for either a nuclear or a non-nuclear position (I assume that only nuclear segments may exchange with other nuclear segments, i.e. Cs exchange with other $C_{s}$ and $V_{s}$ exchange with other $V_{s}$ ).
(166) Hanunoo Consonant and Vowel Exchange maximum crossing maximal scansion


Root node

The operation of these rules in the derivations of rignuk $>$ nugrik 'tame', balaynun > nulayban 'domesticated', and bisjaw > gasbiw 'nick' is shown in (167).
(167)
a. NL form

b. Consonant exchange

c. Uncrossing and Association Conventions

d. Vowel Exchange

e. Uncrossing and Association Conventions


f. Uncrassing


Notice in (167b) that the initial consonant of balaynun spreads as far as it can (since maximum crossing is involved) to land onto another syllableinitial consonant, bypassing $l$ but not going as far as the second $n$ (since this is syllable-final). Maximal tier scansion is required to pick out the vowel of the first syllable as initial on the rime/nucleus tier.

What would happen if the segment exchange rules in (166) were set at minimum rather than maximum crossing? We would predict that segments should spread only as far as the adjacent syllable-- in other words, the effect should be one of interchange (switching of the first or last two syllables). However, since the rules are operating at the segmental level rather than at the syllable level, this inversion should be independent of the tone and timing properties of those two syllables. Thus, what we should find is actually the interchange counterpart of the false syllable reversals described earlier. In fact, just such a 'false interchange" ludling is found in Sanga, as described by Coupez (1969). As the items in (168) illustrate, in this ludling only the segmental portions of the final two syllables of a word are exchanged; the tones and vowel length of those syllables remain
stationary.
NL Ludling
(168) Sanga (Coupez 1969)

| kúdímá | kúmádí |
| :--- | :--- |
| múkwètù | mútùùkwè |
| nkàámbò | mbò́nnkà |
| bàátèmwaà | bàámwàté |

This receives a straightforward account in the present framework: the following segment exchange rule, which is the 'minimum crossing' counterpart of Hanunoo's in (166) (ignoring the initial vs. final distinction), will derive the correct forms ( $W=$ word). Its operation in the derivation of bàátèmáa > bàánàtéè is illustrated in (170) (tones omitted).
(169) Sanga Consonant and Vowel Exchange minimum (intersyllabic) crossinges maximal scansion

$$
\left.\begin{array}{lc}
x & x \\
\neq & \text { 者 } \\
0 & 0
\end{array}\right]_{W} \text { Root node }
$$

(170)
a. NL formpo

b. Consonant Exchange


c. Uncrossing and Association Conventions

d. Vowel Exchange

e. Uncrossing and Association Conventions

f. Uncrossing


Consider next the Burmese ludling illustrated previously in (127d), which converts e.g. budayốw 'railroad station' into bôwdayu. ${ }^{21}$ This is the result of exchange of syllable initial consonants with maximum crossing (given in (171a)) to derive the intermediate form yudabôn, followed by complete syllable reversal (171b) (tones omitted).
(171) Burmese
a. Consonant Exchange (maximum crossing)


b. Syllable reversal


Thus, this ludling parallels the Zande case shown in (165), except that syllable reversal is used instead of transposition, and the consonant exchange involves maximum rather than minimum crossing.

A similar analysis is available for the Thai ludling in (127d) which converts e.g. duu năg 'see movie' into either dăך nuu or day nüu. Exchange of syllable-initial consonants will take duu năg to nuu day, and (true) syllable reversal will give dăj nuu. If syllable reversal is accomplished through intersyllabic crossing at the segmental level ('false'), then the alternate form day nlu with nonreversed tones will result.

Finally, the Finnish ludling in (127e) which derives ponkansa kelki from kenkans尚 polki 'his shoe kicked' reduces to prefixation of a CV syllable to each NL word. The 'switching' of segments across words may be specified as linking to empty skeletal slots from word-initial position with maximum crossing (the directionality of linking is irrelevant). I assume that pairs of consecutive NL. words are in a sense 'compounded' together within the ludiing system to form a larger morphological unit beyond which spreading/line-crossing cannot occur. (W in (172) refers to the boundary of each item in such a compound rather than to the entire unit.)
(172) Finnish Segment Exchange
maximum crossing maximal scansion


Root node

The operation of this rule is illustrated in the derivation in (173) (ignoring the changes in vowel quality induced by harmony).
(173)
a. NL sequence + 'compounding'

b. Prefixation

c. Segment Exchange

d. Uncrossing


I assume in (173d) that the empty skeletal positions are then simply deleted and resyllabification applies to give the surafce form ponkansa kelki.es

Although there may be independent reasons for maintaining a reduplication/prespecification analysis for the 'Pig-Latin' type of ludings examined by Yip (1982), McCarthy and Prince (1986), and Zhiming (1988), the account developed here extends straightforwardly to such cases with no further machinery (and also overcomes some of the drawbacks of these prior approaches). That is, such ludings are identical to the Finnish case just discussed except that the second word in the sequence is a 'nonsense'
ludling word rather than a real NL word. For example, the derivation of a Finnish kontti kieli ludling form such as kosi suntti from susi 'wolf' would proceed as follows, where the key step is the 'compounding' with the ludling word kontti in (174b). 90
a. NL form

$$
\left[\begin{array}{llll}
c & v & c & v \\
1 & 1 & 1 & 1 \\
s & u & s & i
\end{array}\right]
$$

b. Ludling compounding

c. Prefixation

| $v$ | $\left[\begin{array}{llll}c & v & c & v \\ 1 & 1 & 1 & 1 \\ s & u & s & 1\end{array}\right]$ | $\mathrm{c} v$ | $\begin{array}{llllll}c & v & c & c & c & y \\ 1 & 1 & 1 & l^{\prime} & 1 \\ k & 0 & n & \end{array}$ |
| :---: | :---: | :---: | :---: |

d. Segment Exchange

e. Uncrossing and resyllabification

$$
\left[\left[\begin{array}{llll}
c & v & c & v \\
1 & l & l & j \\
k & o & s & 1
\end{array}\right]\left[\begin{array}{cccccc}
c & v & c & c & c & v \\
1 & l & l & l^{\prime} & \\
s & u & n & t & & 1
\end{array}\right]\right]
$$

There is one major question which has not yet been addressed in this account: how are forms with more than one pre-nuclear consonant in a wordinitial syllable to be derived? Only one such example is in fact presented in Campbell (1980, 1981, 1986), namely klorofylli > korofylli klontti 'chlorophyll', but this item does indicate that both pre-nuclear consonants
are transferred. ${ }^{4}$ It is likely that this can be expressed quite straightforwardly in a moraic theory of the skeleton, such as the framework of prosodic morphology developed in McCarthy and Prince (1986). In such a framework one would simply specify that a single light syllable ( $\boldsymbol{\sigma}_{\boldsymbol{\mu}}$ ) is prefixed to each word; since onsets do not have their own timing units, as many prenuclear consonants as are present will automatically be accommodated within this syllabic template ( $\sigma_{\mu}$ represents a bimoraic, or heavy, syllable):
(175)
a. After ludling compounding

b. Prefixation

c. Template satisfaction

d. Uncrossing and resyllabification


This approach can probably be extended to cover other examples of 'onset switching' in ludlings; I will, however, leave this issue open for now, simply pointing out that the line-crossing account presented here is worthwhile pursuing further in this regard. The alternative, a non-line-
crossing analysis such as Vago (1985), is seriously disadvantaged in comparison, since it must resort in the Finnish case to brute stipulation of a $\mathrm{C}_{\mathrm{o}} \mathrm{V}$ sequence (and therefore renders such a sequence no more highly valued than e.g. a $C_{2} V_{3}$ sequence or a discontinuous series).

### 3.3.5. Permutation

The approach to reversal developed in this section has been set up to expressly exclude random reorderings. Nevertheless, the fact remains that permutation of consonants has been reported for ludlings in two languages, Moroccan Arabic (McCarthy 1986) and Bedouin Hijazi Arabic (McCarthy 1982), the latter illustrated in (176).
(176) Bedouin Hi jazi Arabic (BHA) (McCarthy 1982)

| a. NL: | jtima9 | kaatab |
| :--- | :--- | :--- |
| b. Ludling: | mta9aj | baatak |
|  | mtija9 | taakab |
|  | jta9am | taabak |
|  | 9timaj | baakat |
|  | 9ti jam | kaabat |

Although these are both well-documented cases, it is notable that no other examples have been cited in the literature (there are considerably more examples of total segment reversal, for example).

A line-crossing analysis in fact offers an explanation as to why this form of reversal should be so marked cross-linguistically. In the present framework, the only way to derive these items is to have a context-free consonant exchange rule such as (177) which can apply to its own output indefinitely.
(177) BHA Consonant Exchange (minimum or maximum crossing)


Root node
As shown in (178), successive application of this rule to various segments while alternating minimum and maximum crossing will yield the various reorderings indicated in (176b) (consonant-induced changes in vowel quality are ignored here; the infixed $t$ occupies a separate plane).
(178)
a. First application (minimum crossing)

b. Second application (maximum crossing)

c. Third application (minimum crossing)

d. Fourth application (maximum crossing)


This treatment of permutation is marked in two respects. First, it involves an exchange rule which is not specified as to the environment in which it applies, and which can be utilized with either maximum or minimum crossing. In contrast, exchange ludlings in most other languages specifically reference syllable- or word-peripheral positions in their
segment spreading rules, and are limited to a single setting for each crossing parameter (as we saw in the preceding sections).

Second, this account requires application of the same reversal process (consonant exchange) to a given lexical item more than once. While a number of ludlings do combine more than one reversal process in the derivation of a single lexical item, such processes are in all cases different types of reversal. For example, we saw earlier that transposition may be combined with consonant exchange (Zande), or syllable reversal with consonant exchange (Burmese). However, there is a strong tendency to avoid reversal processes which operate at the same level (melodic or prosodic)--one never finds transposition with interchange, for instance (and this in fact accounts for the absence of random permutation of syllables). Occasionally consonant exchange is combined with vowel exchange (Hanunoo), but iterative application of consonant or vowel exchange to its own output is unattested beyond the two Arabic dialects considered here. ${ }^{95}$

### 3.3.6. Default Settings

By setting up a parametric version of the CC, we predict that certain settings should be unmarked in relation to others, representing the value of preference within and across languages. Clearly the 'no crossing' setting is the default value for the entire parameter, since NL phonology is built solidly on the principal that ALs may not cross. Within the hierarchy of parameters that together constitute the 'crossing' setting, however, it is possible to discern a number of additional markedness relations. For example, it seems clear that crossing at the syllable level is less marked than at the segment level; this is in line with the evidence presented in section 2 that the 'maximal', i.e. highest, level in the phonological
representation is the unmarked setting for the target and argument parameters as well. In addition to the fact that of the two reversal types which differ only in this parameter-- total syllable and total segnent reversal-- the latter is clearly the more marked, it appears that syllablelevel reversals of all kinds (transposition, interchange) are generally more common than segment-level reversals (false interchange, false syllable reversal, exchange). Moreover, when a language uses both syllable-level and segment-level reversals in the same ludling, syllable reversals always take precedence over segmental reversals. This is illustrated in (179) for the French ludling of Verlan (Lefkowitz 1987) and the Saramaccan ludling labelled Akoopina 3 by Price and Price (1976). As these items show, syllable reversals are performed whenever possible (i.e. when there are at least two syllables in the $N L$ word); segment reversal is a last resort strategy, used only for monosyllabic items when no other types of reversal are possible.ge (179)

NL Ludling Gloss
a. French, Verlan (Lefkowitz 1987)

| prezãtasjõ | sjõtazãpre | 'presentation' |
| :--- | :--- | :--- |
| komãdo | domãko | 'commando' |
| butik | tikbu | 'store' |
| fu | uf | 'crazy' |

b. Saramaccan, Akoopina 3 (Price and Price 1976)

| valisi | siliva | 'valise' |
| :--- | :--- | :--- |
| pingo | ngopi | 'wild pigs' |
| de | ed | 'to be' |

As far as the type of crossing is concerned, intrasyllabic crossing is definitely more marked than intersyllabic crossing. Even within ludling systems, 'pure' segment-within-syllable reversals are unattested beyond the
exceptional speaker of English described in section 3.3.1. Moreover, the intrasyllabic setting is dependent on the intersyllabic setting (see note 80): crossing ALs within syllables always entails crossing ALs across syllables as well (as in segment exchanges), whereas crossing across syllables need not also include crossing within syllables (e.g. false syllable reversal).

The one parameter for which I have no clear indication of a default setting is the maximum/minimum crossing distinction. One way to assess the relative markedness of each of these settings is to compare the two reversal types which differ only in this parameter: transposition (affixation with maximum crossing) and interchange (affixation with minimum crossing). Crosslinguistically, there does seem to be a slight preference for transposition, although the numbers are probably too close to draw any firm conclusions. However, within one ludling which allows the option of utilizing both of these reversal types, French Verlan, there is a definite preference for transposition. The data in (180), from Lefkowitz (1987), represent the attested luding variants for various polysyllabic words. Total syllable reversal or transpositions are used more frequently than interchanges, and interchanged words always have non-interchanged ludling variants.

| (180) NL for |  | \% Reversal | Transposition | Interchange |
| :---: | :---: | :---: | :---: | :---: |
| ãkule | 'to commit sodomy with' | lekuã | --- | aleku |
| defõse | 'stoned' | sefõde | fonsede | - |
| degaze | 'released' | -- | gazede | --- |
| degoe las | 'lousy' | - | lasdegoe | --- |
| etrãze | 'stranger' | --- | Yeetrã | --- |
| fatige | 'tired' | getifa | --- | --- |
| kEstata | 'what's wrong?' | --- | takEsta | --- |
| polisye | 'policeman' | --- | syepoli | --- |
| proibitif | 'prohibitive' | tifbiipro | --- | --- |
| restorã | 'restaurant' | --- | torãr ${ }^{\text {c }}$ | --- |
| rigole | 'to joke' | --- | goleri | --- |
| sigartt | 'cigarette' | retgasi | garttsin retsiga | --- |
| verite | 'truth' | terive | --- | veteri |

This would seem to indicate that 'maximum crossing' is the unmarked setting. On the other hand, in single segment exchanges, 'minimum crossing' (e.g. switching of a consonant with the one closest to it) is more common than maximum crossing. Moreover, if we adopt McCarthy and Prince's (1986) linecrossing account of NL reduplication, this would perhaps argue for 'minimum crossing' being the unmarked setting. I will leave this issue open for now. The default settings of each of the parameters which constitute the CC are summarized in (181). I follow Archangeli and Pulleyblank (1986) in marking default values with parentheses and a subscripted 'def'.
(181) The Crossing Constraint
a. Crossing parameter
(no crossing)der/crossing
b. Amount of crossing maximum/minimum
c. Level of crossing
(syllable)dar/segment
d. Type of crossing
(intersyllabic)dar/intrasyllabic

### 3.3.7 Summary

In the preceding discussion I have shown that the full range of attested ludling reversal types may be accommodated by a parametric, linecrossing account. True syllable reversals, false syllable reversals, segment reversals, transposition, interchange, segment exchanges, sequence exchanges, and permutation (in all their diversity) are seen to constitute a coherent and unified set of ludling operations, rather than a collection of disjoint and arbitrary rules. The variations exhibited by each of these reversal types may all be reduced to the interaction of a very small number of parameters governing line crossing, in conjunction with independentlyrequired principles or constructs of phonological theory, or from the combination of several elementary ludling operations with each other. At the same time, some explanation has been offered for why ludling reversals should take the particular forms that they do. In particular, they follow from aspects of phonological and morphological theory drawn from beyond the domain of ludling systems: among these, processes of affixation and segment spreading, in some instances informed by notions of maximal/ minimal tier
scansion and certain aspects of prosodic morphology. 97

### 3.4. Conclusion

From the point of view of ordinary linguistic systems, backwards languages are clearly exceptional. In this section I have elucidated in exactly what fashion they depart from the norm: they contravene one of the most fundamental organizing principals of the phonological component, the prohibition on crossing of association lines. Specifically, reversing ludlings invoke the marked setting of the Crossing Constraint, whereas ordinary languages operate uniformly with the default 'no crossing' setting.

From the point of view of ludling systems, though, backwards languages are not nearly so exceptional, since they exhibit a regularity and restrictiveness which is characteristic of other luding types (e.g. infixing language games). I have demonstrated that by parametrizing the CC, it is possible to develop a theoretical account of luding reversals which is at once constrained and illuminating.

The view of the Crossing Constraint which emerges from this study combines a number of the insights of both McCarthy and Prince (1986) and Sagey (1986, 1988a) while also departing from their accounts in several respects. Like McCarthy and Prince's proposals, this analysis supports the idea that association lines may cross in limited, well-defined circumstances, although I have not specifically addressed the question of whether this should be permitted for NL reduplication. I have elaborated a number of more specific proposals regarding precisely how much, what type, and in what location crossing may occur. The account which I have presented also requires that association lines be treated as phonological objects which can be independently manipulated. In this respect I depart from Sagey
(1986, 1988a), who denies the status of ALs as genuine linguistic entities. However, my analysis is actually a strong affirmation of the general illformedness of crossed ALs within the grammar. Not only is crossing clearly the marked option, but the ordering conflicts which are introduced in ludling systems through 'violations' of the CC are not in fact readily tolerated. They must be resolved through movement of the elements linked by crossed ALs. This is significant, since it indicates that the properties of temporal precedence and overlap from which Sagey (1986, 1988a) derives the CC can only be momentarily violated within ludling systems. Their integrity is, ultimately, truly inviolable.

## APPENDIX

The following is a complete list of motifs given in Nattiez (1983a) and Beaudry (1978a), along with their linguistic representations. Where no segmental/tonal or voicing/breath material are indicated for a given motif, these are to be understood as identical to the preceding motif (except for B11-B18, for which no tones were transcribed). Motifs numbered with N are from Nattiez (1983a), those numbered with B are from Beaudry (1978a); the number in parentheses indicates the page in these sources on which the given motif is found. To aid in translating between musical and linguistic notation for motifs with more than four slots, dashes have been placed in the skeleton to indicate the note-breaks; they have no theoretical significance. Linking of segmental material to timing units generally follows the approach of Hyman (1985), with the additional assumption that it is the vocalic portion of a syllable which is held over a sequence of timing slots. It may be that linking of syllable nodes, rather than segments, to skeletal positions would be more suitable, as in Selkirk's (1984) grid-based theory of linguistic timing (cf. note 11). In any case, the segmental mappings indicated are to be understood as tentative, since they are based solely on the alignment of vocables with musical notes as presented in the two sources; where a plausible linking could not be determined on this basis, segments have not been shown linked.

N3.
(464)

$$
\begin{aligned}
& \text { udla } \\
& 1--\infty
\end{aligned}
$$



N4.
(464)


N5.
(464)
hamia
I-_
17.
(464)


N9.
(465)

udlu
■一_1


N11,

udlu
$1-1$
N12.
(4E5)

${ }_{N}$ (46.


NI6.
(466)

$\begin{array}{ll}\text { N18. } \\ \text { (467) } \\ & \\ & \text { ahor } \\ & \text { I-I }\end{array}$


N6.
(464)
hama
I--I

N8.


N10.
(465)


N13.
(465-66)
hama/udlu/haheg
L——I

NI5.
(465)
haheg


N19.


ish h
L L L


E2.

$\begin{array}{lll}H & H & M \\ H & H & H \\ H & L & L \\ H & H & H\end{array}$
83.
(266)

84.
(266)
A'ロaG
ha-ma-qo-lop
MMMM


B5.
(266)
$\therefore d$.
ha-mak
H


B6.
(266)

ha-ma-ke-po
H M M M M
(same as Bl5)


HA ME MA
HMHHH

(267) A9 A A A

HA-ME-MA
HHNHHLH


HA
M HLH


HAM-MA

$\stackrel{812}{(268)}$
(268)


HAM-MA

813. $\underset{(268)}{\square}$

HA-MA-HA HA

$\left.\begin{array}{ll}814 \\ \text { (268) }\end{array}\right] d \cdot \sqrt{3}$ HA-HEU-MA

 HA-MA-KE-PE



H 7 H 7
 $\sum_{\varepsilon}^{\nabla} \cdot P P^{(0612)}$


NOTES
${ }^{1}$ A complete discography of commercially-available katajjait recordings is given in Nattiez (1983a).

2Although many of the generalizations which will emerge from this study may be applicable to the other dialects, there simply are not enough data at this point to make any conclusive statements.

3It is interesting to note in this regard that, cross-culturally, language games are frequently referred to as 'bird language' or some similar name (Laycock 1969:65); for more on katajjait as a form of language game, cf. Section 1.6.

4 For spectrograms of some katajjait motifs, cf. Charron (1978).
sNot to be confused with glottalic ingressive airstream, utilized regularly in languages for implosive consonants.

GA few instances of pulmonic ingressive airstream being used in what appear to be more straightforwardly musical systems have been reported in the literature: among the Silti Gurage people in Ethiopia, women apparently use a special rhythmic breathing pattern to accompany clapping and drumming (Kimberlin 1980:242), while the kartugak genre among the Hazarajat in Afghanistan is said to involve the use of a "throat sound" (Nattiez 1983b:41,42). These cases are sparsely documented and certainly merit further investigation before they can be considered counterexamples to the generalization presented in this section.

These are not even unique to musical systems, of course, since verse and folkloristic narrative also make use of repetition and symmetry. enf course, standard musical notation (developed primarily for the representation of European art music) is inadequate for the transcription of many non-Western musical systems (cf. Hood 1982:85ff for further
discussion). However, the problems encountered with the katajjait appear to be particularly acute even for non-Western musics.
${ }^{3}$ Additional parameters are alluded to in Beaudry (1978a), including dynamic level (loudness/ intensity) and timbre (whether the sound quality is produced with open or closed mouth). These are not transcribed for the majority of motifs, however, and we will not consider these in our analysis.
${ }^{10}$ This is illustrated in the chart in (i): the pairs of numbers in each cell refer to pairs of motifs listed in the Appendix which have the same pattern for the feature in the left-hand column and different patterns for the feature in the top row.

tone [vce] | $\mathrm{P}_{2}$ (Different) |
| :---: |
| [exp] segmental rhythm/timing |

| $P_{1} \text { (Same) }$ tone | -- | N4-N8 | 84-B6 | N5-N9 | B5-86 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| [vce] | N4-N5 | --- | B15-B16 | N1-N2 | N11-B18 |
| [exp] | N4-N5 | B15-819 | --- | N1-N2 | B2-84 |
| segmental | N4-N5 | N10-N11 | B2-83 | --- | B11-B12 |
| timing | N4-N5 | N10-N11 | B15-816 | B9-810 | --- |

${ }^{11}$ Another linguistic construct is available for the translation of the rhythmic and timing patterns of musical notes, namely the metrical grid. As Selkirk (1984:302ff) demonstrates, the grid offers a straightforward way of representing the syntactic timing (lengthening and pausing) patterns of language. It is not clear that my use of skeletal slots in this instance is actually distinct from Selkirk's use of grid positions (cf. especially Selkirk 1984:310), and it may be more than fortuitous that both types of unit are represented by X's. However, a number of interesting generalizations concerning katajjait timing patterns with respect to natural language nonconcatenative morphology emerge under the assumption that such

X's are equivalent to skeletal slots; this approach has therefore been explored at length in the present analysis.
${ }^{22}$ The analysis being pursued here is not incompatible with a hierarchical conception of feature organization such as that presented in Clements (1985), Archangeli and Pulleyblank (1986), and others. These latter approaches have not been adopted for the present analysis simply because it is not as yet clear where in the feature hierarchy [expirated] should be placed.

13 There is one exception to this generalization, namely motif (B13). At present I have no explanation for the pattern found on this motif.

14Recently a grid-based theory of prominence has emerged which also incorporates notions of headedness and constituency (cf. Halle and Vergnaud 1987). Since these notions originated in tree theory, though, an arboreal account has been chosen as the starting point for this analysis. It remains to be determined whether an approach utilizing bracketed grids would be more appropriate (and indeed this is still an open question for ordinary language stress systems as well).
${ }^{13}$ The pattern in (41b) is not actually found in the corpus of motifs given in the Appendix; however, it does occur on the second half of compound motifs (as in (B10)), and therefore I assume that it is a well-formed structure on simple motifs.

16We must, however, allow for two adjacent [-vce] features to be inserted through the operation of the redundancy rule (9) given in Section 1.3. Presumably this is a consequence of the fact that rule (9) is very likely a universal redundancy rule (cf. Section 1.3.1): Archangeli and Pulleyblank (1986) note that the OCP has blocking effects only for languageparticular rules (in this case the rules of feature insertion), whereas it
serves to merge adjacent identical elements created by universal redundancy rule.
${ }^{17}$ Even if the prosodic structure is regarded as primary, with skeletal structure derivative (as in Lowenstamm and Kaye 1986) or non-existent (as in McCarthy and Prince 1986), this problem would still arise. How and where the higher units of that prosodic structure are specified and/or generated would still have to be accounted for.
'OUse of a term such as 'reduplicative operation' is of course a bit misleading, since nonlinear accounts of reduplication (e.g. Marantz 1982) have established that reduplicat ion is not in fact an operation distinct from other morphological processes of affixation. Rather, the distinctive aspects of reduplication result primarily from the fact that unspecified skeletal templates or morphological constituent nodes are affixed (cf. Section 1.6.3 for further discussion). Use of the term here should be understood as simply referring to this special type of affixation.
${ }^{19}$ Sperific glosses for some of these forms are not given in the two sources; these have been supplied on the basis of the descriptions of the semantic functions of reduplication and triplication which are provided.

20By 'systematic' is meant a process that signals a specific grammatical function; many languages allow constituents to be repeated an indefinite number of times for stylistic purposes to signal a general prolongation or emphasis of activity/state, much as in English 'He walked and walked and walked and walked ...'.

21 Since no language employs triplication without also employing reduplication, the fact that the katajjait morphology includes operation (55.b.1) is in fact redundant and can be predicted from the presence of (55.b.2) in the grammar.

22For an example of child language reduplication which does have a grammatical function, cf. Munson and Ingram (1985).
${ }^{23}$ The Finnish 'knapsack language' Kontti kieli included in (56) as a ludling form of compounding is described by Vago (1985) as involving the addition of the 'word' kontti to normal language words (accompanied by other modifications). In section 3 of this chapter 1 will present an analysis of this ludling that does involve compounding with kontti; see also Chapter 4, section 2.2.2.2 for more on ludling 'words'.

24A number of researchers have recently focused attention on the need to specify prosodic information in conjunction with, or instead of, skeletal information in nonconcatenative morphological systems-- cf. Shaw (1985, 1987), Lowenstamm and Kaye (1986), Levin (1983, 1985), and McCarthy and Frince (1986). Accordingly, the processes exemplified by items (5-8) in (56) should more properly include specification of syllable structure and/or higher order prosodic units. However, regarding these processes as operating on a level above the skeleton does not obviate the central claim of this section, namely that empty morphological systems mirror full morphological systems and that the katajjait find their place within the former. Analyzing katajjait as a form of prosodic morphology along the lines of McCarthy and Prince (198E) may in fact prove to be quite fruitful-- lexical entries could perhaps be specified in terms of foot structure, though a process of total morphemic reduplication would still have to be recognized.

20Tigrinya has the following inventories:
a. Consonants

$f$

b. Vowels

| $i$ | $f$ | $u$ |
| :--- | :--- | :--- |
| $e$ | $d$ | $o$ |

m $n$
1
$r$
$w \quad y$

26Lowenstamm and Prunet (1985), following Pam (1973), analyze Tigrinya as having a length distinction on vowels, with 4 and a being (roughly) the phonetic realization of short /i,u/ and /a/ respectively. This approach is in large part dependent on the particular view of syllable structure which they are arguing for. I have not adopted this analysis because it runs into problems when luding forms are considered: the copied vowel in the luding infix always matches the quality of the NL vowel. If vowel quality is seen as entirely derivative of a length distinction (as Lowenstamm and Prunet suggest), this would force us to abandon a shape-invariant specification of the luding affix. We would have to say that the luding infix consists of two V-slots when added to a NL syllable with a long vowel, but only one $V$ slot when added to a syllable with a short vowel.

27John McCarthy (p.c.) has pointed out that this variable treatment of coda consonants (i.e. optionally subjecting them to epenthesis) appears to be quite unusual cross-linguistically, and has queried whether it might reflect the influence of orthography. As far as occurrence in other ludings, I have found similar examples in Hebrew (Yakir 1973) and Amharic (Griaule 1935). The question of influence of orthography is a complex one (and also relevant to the Hebrew and Amharic cases). The Ethiopian syllabary
which is used to write Tigrinya represents coda consonants with the socalled 'sixth order' consonant-vowel symbol (cf. Bender, Head, and Cowley 1976), i.e. the symbol which otherwise represents the sequence $C$ " Thus, [birzina] 'our mead' is written as $\cap \subset \mathcal{M} 9$ bi-ri-zi-na. It is true, then, that for those speakers who are literate in Tigrinya (including my consultant), LD2 could be considered to involve simply 'sounding out' all of the vowels represented by the orthography. However, it should be noted first of all that the ludlings described in this section are played by literate and nonliterate speakers of Tigrinya alike. Second, it is as erroneous to assign primacy to the written form where ludlings are concerned as it is where normal language forms are concerned. The process of epenthesis applying to such NL forms as /birznal 'our mead' (the UR of the form given above) could be viewed as the 'sounding out' of the (inherent) presence of the sixth order vowel in the symbol $H \geq(i)$. But whether or not a speaker pronounces a given sixth order vowel is determined by the general syllable structure constraints of the language and not by the orthography itself: in the example above, the first three orthographic symbols all include sixth order vowels, yet the second is not pronounced since the language allows coda consonants in this position. In the luding form, coda consonants are not allowed in any position, hence the appearance of the sixth order vowels after each. Finally, even if this particular aspect of the ludling phonology could be ascribed to the orthography, this would not invalidate the general utility of the ludling data, particularly with regard to the reappearance of certain assimilated segments in ludling forms, which is clearly not orthographically based (see the discussion below in section 2.2.2 and note 40).

20The location of infixation probably does not need to be stipulated in
this rule. As Davis (1985) and McCarthy and Prince (1986) point out, luding infixes typically lodge in environments where they will create well-formed syllables in the NL that avoid clusters. CV infixes end up after vowels, where they create V-CV sequences, while VC infixes end up after onset consonants to create $\mathrm{C}-\mathrm{VC}$ sequences.
${ }^{29}$ In many of its words Tigrinya exhibits the familiar root and pattern morphology of Semitic languages, with consonants and vowels on separate planes. For ease of representation, though, all melodic segments will be shown or the same plane.

300ne minor adjustment to the syllabification rules already presented in (61) is required for this account: N-Placement 2 as formulated would incorrectly vocalize a post-nuclear [thi] segment which is left unsyllabified by the lack of Project $N^{\prime}$ in the ludling syllabification rules. This is illustrated, for example, by the word way 'water', which would have the form in (i) after N-Placement 1 \& 2 and Project N": (i)


To remedy this, we need to specify in the environment of N-Placement 2 that the unsyllabified slat is preceded by a syllable non-head, notated simply as X:
(ii) N-Placement 2 (revised)


This revision will prevent N-Placement in this environment during luding
syllabification, thereby feeding epenthesis. Although this modification may be specific to the luding system, it would not affect NL syllabification were it present in the NL system, since no stray glides will ever appear in post-nuclear position in NL forms due to the rule of Project N'. Alternatively, since $\mathcal{V}$ sequences are never attested in Tigrinya, the illformedness of (i) could be made to follow from a more general filter or constraint rather than complicating the formalization of N-Placement 2. ${ }^{21}$ The only possible exception to this generalization is $\boldsymbol{p i x i}$, listed in Leslau (1941:73) as an alternate pronunciation of the 2 f.s. copula $79 \times i$ 'you (f.s.) are'. In the speech of my consultant this alternate form is not heard.
a3There appears to be considerable dialectal (and subdialectal) variation in this assimilation process (as there is for the process of spirantization). Lowenstamm and Prunet (1986), for example, suggest that there is in fact no rule of regressive glottal assimilation in Tigrinya at all, at least for velars (contrary to previous accounts of the language, e.g. Leslau (1941), Pam (1973)). It appears, though, that this is probably a reflection of the dialects, or idiolects, under study. The form for /sanduk'ka/ 'your (m.s.) box' which they report from their consultants is [sandupka], with no assimilation/gemination and a glottal stop as the phonetic realization of spirantized $/ k$ '/. In the speech of my consultant, however, spirantized /k'/ is auditorily quite distinct from a plain glottal stop (cf. note 44), and the surface form of this word clearly contains neither. Furthermore, glottal stops (and other post-velar consonants) in his speech are subject to a late (postlexical) rule of epenthesis which inserts a very short $I$ between 7 and a following consonant, illustrated in (i). This vowel position is clearly not present underlyingly, since the
canonical shape of the words it occurs in represent well-defined template classes which do not have vowels in these positions when other (non-postvelar) consonants are involved.
(i) a. y ${ }^{\text {XXXXX}}$ broken plural
/yifgar/ ---> [yifigar] 'feet' (plural of 7Igri)
b. 7aXXXX broken plural

17a7dug/ $\rightarrow$ [7a?Pdug] 'donkeys' (plural of 7adgi)
c. $X X X X X$ noun
/sa?n/ ---> [sa?łni] 'sandal'
d. Across word boundaries
/sanbu7 baggi'a/ ---> [sambu7fibaggi'g] 'sheep's lung'
Thus, if assimilation had not taken place and [7] were the actual realization of spirantized $k^{\prime}$ in /sanduk'ka/, we would expect epenthesis to apply to this glottal stop as well, incorrectly giving *[sandu?ixa].

The rule of Laryngeal Assimilation is not to be confused with a prouess of regressive nasal assimilation exhibited by such forms as / /7ab-monga/ 'in between' --> [Pammongo] (Leslau 1941:8) and /kab-mabrat/ 'from Mebrat' --> [kammabrat] (Lowenstamm and Prunet 1986). This appears to be a separate assimilation rule located in the earlier lexical stratum containing the prefixes $7 a b, k a b$, etc. (see note 45 ) since it does not apply to suffixes: /รud-na/ 'our (stick) incense' --> [รudna], *[9unna]. This rule probably involves assimilation of other features as well-- cf. /7ab-wit'i/'inside' $\rightarrow$ [7awwist'i] (Leslau 1941:7-8).

29In the Akkele Guzay dialect described by Leslau (1941), voiceless stops always assimilate to an adjacent (homorganic) voiced stop regardless of the directionality of spreading, so that the sequence /dt/ is realized as [dd] (in contrast to the Asmara dialect of my consultant, where the
righthand member always wins out, regardless of its laryngeal sperification).
${ }^{34}$ In item (75d) the segmentation of the word is a bit misleading: the feminine suffix -ti has actually been added to the XIXXIX template for forming feminine adjectives, with the root melody ff-I-t' associated to this. Similarly for (75f), /kabbad-ti/: this actually represents the plural adjectival template $X a x \times 3 \times t i$ associated to the root melody $\sqrt{k}-b-d$.
${ }^{35}$ This is the term given to tier decomposition in CSPR.
36The formulation of assimilation should also contain a specification that the two stops agree in the feature [round], since labialized velars do not assimilate to non-labialized velars: / Ta9nak'w-ka/ 'your (m.s.) beads' ---> [7a9nax'wkal, *[7a9nakka]. This detail, however, has been suppressed from the rule for simplicity's sake.

27In these representations, identical features/nodes on the adjarent segments have not been collapsed since they occur across a morpheme boundary and hence occupy separate planes; see section 2.3 for a more detailed discussion. Bruce Hayes (p.c.) has also pointed out that this rule formulation is odd in requiring that the two segments bear opposite values for laryngeal features. This requirement is necessary to block the rule from applying (vacuously) to create a linked structure on adjacent identical (heteromorphemic) segments such as kk in /mPrak-ka/. As we will see in section 2.3 , heteromorphemic geminates undergo epenthesis in luding forms, which would not be possible if spreading had taken place.

3oLD1 forms also exhibit the reappearance of assimilated segments, e.g. sagandagux' Ig jkkaga. Throughout the remainder of this section, however, only LD2 forms will be used as examples, since my consultant is most familiar with this dialect.

39This derivation requires the first half of a geminate in coda position to remain unsyllabified upon leaving the ludling component，thereby violating Structure Preservation as well as MiCarthy＇s（1979）condition on the syllabifiability of lexical rules．In the next chapter I will provide a substantial amount of evidence that the domain where ludling conversion takes place in Tigrinya is neither structure－preserving nor subject to other lexical constraints．

4OThe failure of $g$ to reappear in the ludling when other assimlated segments do cannot be attributed to the orthography（see note 27）．Where assimilation is concerned，words are written in essentially phonemic form， in that the sequence prior to assimilation is represented（though with spirantization indicated for voiceless velars）．As the items in（i）show， both assimilated $g$ and other assimilated segments alike are included in the orthographic representation．

| a．／sanduk＇ka／ |  |
| :---: | :---: |
| ＇your（m．s．）box＇ |  |
| b．／fillit＇ti／ | 「可 $\boldsymbol{T}$ 穴 |
| ＇known（f．）＇ | fi（1）lit ${ }^{\prime}$（f） ti |
| c．／7a？dugka／ | 去 边 of $\dagger$ |
| ＇your（m．s．）donkeys＇ | 7a $7\left(1{ }^{\prime}\right)$ du $\left.g(1)^{\prime}\right) \mathrm{ka}$ |
| d．／Gaddigka／ | 9 \＆ 77 |
| ＇you（m．S．）bought＇ | 9a（d）di g（P）ka |
| e．／nafigka／ | 4697 |
| ＇you（m．5．）refused to pay＇ | na fi g（f）ka |

If the ludiing were based on the orthography，then，no differential behaviour for 9 would be expected．

Further evidence that this behaviour is to be attributed to the OCP
comes from another Tigrinya ludling reported to me by my consultant, identical to the previous ones except that $s^{\prime}$ is the infixed segment. In this ludling, forms in which assimilated 9 can reappear are apparently acceptable, e.g. Gas'addis'ig4s'ykkas'a. However, my consultant is not a 'native speaker' of this ludling, and further investigation is required before any definite conclusions can be drawn from it.
${ }^{42}$ In view of the correspondence between default 'maximal' settings for both of these parameters, however, it is worthwhile exploring whether this derives from a more general principle of UG whith favours the 'highest" specification regardless of whether it concerns a rule's argument or target.

42 The effects of a late rule which inserts a schwa onglide following voiced obstruents have been suppressed from these transcriptions.

43 In this representation, the adjacent root nodes are not collapsed following nasal spread beacuse they do not dominate the same material: the second dominates a laryngeal node bearing the feature [tvie], while the first is unspecified for a laryngeal node.

44The following chart summarizes the dialectal variations in Spirantization reported in the literature, where an asterisk indicates that the segment is not subject to spirantization.
(i)

| Dialect/Region | Source | Segments |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Akkele Guzay | Leslau (1941) |  | $k$ | $k^{*}$ |
| Hamasien | Leslau (1939) |  | k' | k'w |
|  |  | * | *g | * ${ }^{*}$ |
| Asmara | Pam (1973) |  | k | ${ }^{\text {w }}$ |
| Aksum |  |  | $k$ ' | k'w |
|  |  | $b$ | 9 | ? ${ }^{\sim}$ |
| Adwa | Lowenstamm \& |  | $k$ | k ${ }^{\sim}$ |
| Makale | Prunet (1986) |  | k' | k'w |
| Asmara |  | $b$ | *g | *g ${ }^{( }$ |
| Adwa | Leslau (1939) |  |  |  |

As evidence of further variation，in the speech of my consultant the voiceless ejective fricative／s＇／has an affricate allophone［t＇s＇］in environments that tend to pattern with the distribution of continuant／non－ continuant stops subject to spirantization．Word－initially，after a consonant，and when geminated this segment is usually pronounced with a certain degree of affrication，while after a vowel it is clearly a fricative：
（ii）a．／s＇＇＇bbuk＇／－－－＞［t今s＇rbbux＇］＇fine，beautiful＇
b．／lams＇am／－－－＞［lamts＇am］～［14ms＇am］＇leprous＇
c．／fis＇s＇um／－－－＞［ffts＇um］＇finished，per fect＇
d．信告s＇／－－－＞［hargas＇］＇crocodile＇
It may be that this segment is in the process of being reanalyzed as underlyingly a non－continuant，subject to the rule of spirantization．This is also perhaps the source of the confusion in the literature as to whether this segment is really a fricative or an affricate（cf．Ullendorff 1955：115 and Palmer 1957：14E）．

4SPhonetically，$x$ is a voiceless uvular fricative $[\chi]$ ，often voiced in rapid speech to［B］，especially intervocalically．In slow speech $x^{\prime}$ is an ejective voiceless uvular fricative［ $\chi$＇］；at the normal rate of speech， however，its phonetic identity is altered and it exhibits a number of allophones，some in free variation．Most commonly it is heard as a glottalized voiced uvular fricative or resonant［R＇］～［B＇］，often tending towards a flap－like uvular articulation intervocalically［G］n［l̂］．Word－ finally or before a voiceless consonant，it often surfaces as a partially devoiced uvular stop with simultaneous glottal stricture［Gิ̣̂？．All of its allophones are frequently accompanied by pharyngealization on the consonant or on adjacent vowels．In addition，consonantal duration is not the
exclusive phonetic correlate of gemination. In rapid speech, degemination often occurs, so that the only remaining distinction between geminate and non-geminate /k/ is the continuancy of the latter. See Palmer (1957) for additional discussion.

46Lowenstamm and Prunet (1986) provide one such account. They cite stress and nasalization data which support a level-ordering/boundary strength distinction for affixes in Tigrinya. Object and possessive suffixes such as $k a$ 'you, your' are added at Level 2 and constitute a 'strong' morphological boundary, while prefixes such as 7at 'in, at' and kat 'from' are added at Level 1 and constitute a 'weak' morphological boundary. In their analysis, the OCP-- though operative in the grammar of Tigrinya-does not affect Level 2 affixes, i.e. it does not merge adjacent identical segments across a 'strong' morphological boundary. In this way, they can explain not only why $k a$ fails to merge with a $k$-final stem, but also why the OCP does apply to Level 1 affixes, preventing the spirantization of the bilabial in [kab-barhad 'from Berhe': *[kaßbarha] (cf. [kaßhiwot] 'from Hiwot'). I have not pursued this analysis for two reasons: 1) The desirability of building boundary-sensitivity into the OCF is unclear: for example, does the OCP routinely merge segments across word boundaries? To avoid appealing to boundary-sensitivity, this analysis could also be recast in terms of planar separation by placing $F C$ within the lexicon after Level 1 and assigning spirantization to Level 2; 2) Regardless of its implications for the OCP, the distinction between Level 1 and Level 2 geminates predicted by this analysis does not appear to be manifested in the speech of my consultant. First of all, it is obscured by an additional condition on bilabial Spirantization. Although Spirantization does affect b, it appears to occur only when the segment is both preceded by a vowel and followed by a
sonorant. So, for example, spirantization applies in /nabri/ --) [naßri] 'leopard' and /hibay/ --> [hibay] 'baboon', but it is blocked both in /kabhiwot/ $\rightarrow$ *[kaßhiwot] and in /kabbarha/ --> *[kaßbarha], indicating that it is not the presence of the geminate per se which is responsible for blockage. Secondly, the fact that PC has not applied in a form such as kabbaraxat 'from Bereket' at the time of ludling conversion is confirmed by the fact that its LD2 form is kagablgibagaragaxagatigi, with epenthesis in the two b's.

47t aight appear that Spirantization cannot be a lexical (cyclic) rule, since it is non-structure-preserving ( $x, x^{\prime}$ are not part of the underlying inventory of Tigrinya). However, Mohanan and Mohanan (1994) have shown that lexical rules are able to create segments which are not present under lyingly in a language. Moreover, in Chapter 4 I will show that a revised vieu of Stucture Preservation (based on a number of recent studies) recognizes a non-structure-preserving domain in the latter half of the lexicon. Therefore, this analysis cannot be ruled out a priori.

40Spirantization in fact appears to apply optionally in the ludling forms, especially in slower speech. So for example, shglragakigikaga is heard as an alternate for the LD2 form migiragax'gixaga 'your (m.s.) calf'. This probably reflects the result of a reanalysis of each NL-ludling syllable pair (i.e. $C \cup g($ ) as equivalent to a word, since spirantization is optional across word boundaries in N\& Tigrinya. (See Chapter 4, section 2.2.2.2.1 for further discussion of NL syllables reanalyzed as separate ludling words.) True geminates, however, definitely cannot be spirantized in the ludling, e.g. *9agax(x)agatlgi is not an acceptable alternate for qagakkagat'19's.

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40This is acceptable only as an LD1 form.
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sostrictly speaking, the Bracket Erasure Convention (BEC) and PC may not be entirely equivalent. As Cole (1987) notes, there is some evidence that PC may need to apply within the lexicon in some languages (cf. McCarthy 1986), while the BEC (under her analysis) does not appear to require lexicon-internal application. For the purposes of this discussion, though, I will ignore this difference and consider them to be essentially equivalent. ${ }^{31}$ Another approach to this problem is suggested by Yip (1988): Plane Conflation can be viewed as consisting of two distinct operations, collapsing of planes followed by merger of any adjacent identical elements. Yip proposes that various phonological rules may intervene between these two operations, thereby giving the appearance of applying to an underlying representation that does not respect the DCP. It seems to me that this account entails a substantial weakening of the OCP, since it allows adjacent identical elements to arise in the course of a derivation and then persist unaltered (at least until the required rules have had a chance to apply).

52This analysis will not hold, however, for theories which distribute vowel features between two or more articulator class nodes e.g. Sagey 1986 , Steriade 1987). If [round] is dominated by the class node Labial, for example, while [low] is dominated by Dorsal, then it will not be possible to spread both features across a consonant without having to refer to each of these articulator nodes separately (since the Place node of the consonant will block spreading of the vowel's Place node). See McCarthy (in press) for additional problems which arise when attempting to spread vowels intact across consonants; see also Sagey (1988) for an analysis of Barra Gaelic in which it is proposed that individual vowel features may indeed spread separately rather than through their superardinate class node(s).

[^2]the lass of $g$ in the Tigrinya case; this could be analyzed as another example of the OCP affecting ludling infixes on the same plane. According to Otsikrev (1963:5), the ludling involves infixation of -IV- after each NL syllable:
(i) Samoan, -IV- Infixation (Otsikrev 19E3)
tama 'boy' $>$ talamala
tofa 'hello' $>$ tolofala
afitusi 'matehes' $>$ alafilitulusili

As the items in (ii) show, when the NL word already has an $l$ in it, the NL oucurrence of this segment disappears:

```
(ii) alu 'go' > alaulu, *alalulu
    falemeli 'post office' > falaelemeleili, *falalelemelelili
```

This could be seen as the effect of the OCP merging two adjacent I's, followed by a rule which deletes the second skeletal slot of a doubly-linked matrix:
(iii) C Deletion
[ ]
$c^{\prime}$ (c)
As the following derivation shows, this analysis only goes through if it is assumed that the luding infix occupies the same plane as the NL word, or else the two l's would not be adjacent.
(iii) alu > alaulu
after infixation $\quad$ OCP merger $C$ deletion


While this could perhaps be adduced as another case of a ludling which does not observe the MPH, there is an alternative analysis in this case. When the
orcurrence of the $l$ in the NL form is word-initial, the 1 does not disappear: lagi 'sky' > lalagili, *alagili. This could be accounted for by placing a condition on $C$ Deletion to the effect that the initial slot be word-medial. However, this seems rather to reflect a (dissimilatory) constraint prohibiting three consecutive $I V$ syllables (notice that when the $I$ is word-initial, only two consecutive $I V$ syllables are created).

54John McCarthy (p.c.) has pointed out several other examples which clearly also require ludling affixes to be on separate planes. A ludling in Benkulu (Burling 1970:136), like the Swedish example, involves an infix unspecified for its consonant. Furthermore, there is a Cairene Arabic luding in which the stressed vowel is prefixed with Utin, and the base vowel copies 'acrass' the infixed vowel i: buwa > butinuwa (Burling 1970:136): Finally, McEarthy points out that there is a major asymmetry in infixing ludlings which can only be explained by assuming that (at least in the unmarked case) ludling affixes are on a separate plane. In all cases, when the infix follows the NL syllable, its V-slot is unspecified (eventually acquiring the preceding NL vowel through spreading), whereas when the infix precedes the NL syllable, its vowel is always prespecified. This is illustrated by a ludling in Erazilian Portuguese (Sherzer 1982), where two ludling variants exist. One has a postfix $p($, the other has a prefix pe: menina $>$ mepenipinapa, pemepenipena. In other words, there do not appear to be any ludlings which infix a syllable unspecified for its vowel in front of an NL syllable. This follows automatically from the planar segregation of ludling affixes: for a postfix, the NL vowel can spread rightward 'across' the ludling consonant on a separate plane, whereas it cannot spread leftward to a hypothetical luding infix with an empty $V$ slat because of the NL consonant intervening on the same plane.

تoWhether or not a luding observes the MPH cannot be correlated to its conversion location. One might have initially hypothesized that postlexical ludlings would not be constrained by the MPH, whereas ludlings whose conversion location is within the lexicon must observe the MPH. However, Tigrinya -gV- Infixation, which does not observe the MPH, is a 'lexical' ludling (in the sense that it applies before the last operation of the lexicon, Plane Conflation). Conversely, Swedish RBvarspraket is one of a number of ludlings whose conversion takes place within the postlexical phonology (as I will demonstrate in the next chapter), and yet it does observe the MPH.
${ }^{36}$ This constraint has gone by several names in the literature or, more usually, been unnamed. For convenience I adopt here the term used in Archangeli and Fulleyblank (1986).

57An anonymous NLLT reviewer of this section has suggested one very specific reason why processes of reversal should not be given a formal place within linguistic theory. If reversal were attributed to a linguistic parameter, then we might expect backwards forms to be used at least some of the time with the meaning of e.g. 'reverse' or 'negation'. This is by analogy to the closest formal ally of reversal in natural languages, reduplication, which often indicates linguistically significant notions such as 'plurality', 'repetition', or 'intensity'. In fact, it is only by incorporating reversal within linguistic theory and recognizing that it is a form of ludling morphology that we can explain the lack of a parallel here. As McCarthy (1985) makes clear, and as I pointed out in section 1 of this chapter, the one crucial difference between luding morphological processes and NL morphological processes is that the former are always semantically empty-- that is, they never carry any 'linguistically significant' meaning.

Thus, by recognizing that reversal is simply one other type of ludling morphological process, we expect that it should be semantically empty (just as ludling affixation is). Moreover, since I will argue that it is the marked setting of the $C C$ which makes reversal possible, and this setting is by and large unavailable to ML phonology, it follows that reversal will never appear in NL systems where it could potentially carry some meaning.
seexcept where noted, orthographies of original sources are retained throughout. For some forms no specific glosses are available because nany authors provide only sentence-by-sentence translations.
sothe marking of predictable stress and vowel lengthening provided in Conklin (1956) has been suppressed from these and all other transcriptions of Tagalog presented in this chapter. See Chapter 4, section 2.2.2.3 for discussion of the interaction of ludling conversion with stress assignment and vowel lengthening.
coA word on the influence of orthography or uriting systems is in order here. It appears that an alphabetic writing system may be a prerequisite for a segment reversal ludling to appear in a language, since all of the segment reversal ludlings I have examined occur in languages with such writing systems/orthographies. However, this is not a sufficient criterion, since many languages with alphabetic systems have only syllable reversing ludlings (e.g. Swahili). Moreover, in languages with segment reversing ludlings, the reversal is clearly not based on the orthographic representation, as the English examples in (123b) illustrate; cf. Cowan and Leavitt (1982) and Cowan, Braine, and Leavitt (1985) for explicit comparison of these sound-based reversals (with which the present paper is exclusively concerned) and orthographic-based reversals. It seems that the presence of an alphabetic writing system is necessary for the establishment of some
metalinguistic awareness of the notion of 'segment'; beyond this, however, the phonological system takes over as the primary basis for reversal.
${ }^{61}$ It has been suggested to me by several NLLT reviewers that total reversals-- especially total segment reversals-- are simply too extreme and should not even be admitted as luding operations. Rather, they should be regarded as a form of exceptional extralinguistic ability. I disagree with this assessment for a number of reasons. First, in many languages, total reversals (both segmental and syllabic) are simply one of an arsenal of different ludling operations which may be used interchangeably in the derivation of luding items: this is the case in Tagalog (Conklin 1956), French (Lefkowitz 1987), Javanese (Sadtano 1971), and Saramaccan (Price and Price 1976). Moreover, processes of total reversal often combine with other, nonreversing, ludling operations in the derivation of a single ludling word. For example, in the Tagalog ludling form koqapandapan, derived from gako 'I', total syllable reversal is applied first, followed by suffixation of -pUndVpV- and $-\eta$ (Conklin 1956). If one or more of these operations is designated 'extralinguistic' while the others are truly 'linguistic', one would be hard pressed to explain the apparent lack of such a distinction within the ludlings themselves.

Second, total reversals such as the English segment reversals pattern exactly like other ludlings in their interaction with NL rules and the influence of various NL structural constraints on the luding form. In an extensive cross-linguistic survey of ludlings, I have identified three principal conversion locations within the grammar, one of which is situated at the boundary of the 'Syntactic' and 'Postsyntactic' components of the postlexical phonology (cf. Mohanan 1986). A cluster of properties is associated with ludings assigned to this particular location (though these
need not all be manifested in one ludling), includling non-structurepreserving operations; conversion prior to allophonic and other postsyntactic rules; conversion after lexical, morphological, and Fl postlexical rules; sensitivity to prosodic categories of the syntax/phonology interface; and potential violations of representational constraints such as geminate integrity (see Chapter 4 for a complete discussion). English total segment reversals share these properties with other more 'normal' ludings (infixing, templatic) assigned to the same location. If total reversals were truly 'extralinguistic', we would expect them to manifest exceptional behaviour in this area as well.

Third, the hesitation to incorporate total reversals within even a theory of ludling operations seems to stem in large part from the rather 'drastic' distortion of NL. structures which occurs in total reorderings. However, by the same criterion many other luding types should be excluded as well, since even though they do not involve total reversal, they involve a radical reorganization of NL forms (with decoding of the NL word rendered extremely difficult). For example, one Fula ludling combines transposition with -ntUna- infixation and consonant deletion to yield such opaque conversions as baalte > tentenabaa 'morning' (Noye 1975). At what point does a ludling operation become too drastic?

Finally, at the risk of belabouring the point, it should not be forgotten that there has always been a great deal of reluctance to incorporate apparently 'extreme' phonological phenomena within the domain of linguistic research, especially when those phenomena challenge existing notions of what is 'linguistic' (as we noted in Chapter 1). Consider the case of the unusual syllable structures of Salishan and neighbouring languages of the Pacific Northwest. Hockett (1955) reports the now-famous
incident in which a German editor refused a paper by Franz Boas on the language Bella Coola because "as everyone knows", vowelless words do not exist. Such words, of course, do exist (see Hoard 1978), though they are certainly marked from a cross-linguistic standpoint. It is the task of a theory of grammar to provide some explanation as to how and why such extremes deviate from what is found in other languages. Similarly, by defining in precise formal terms exactly what sets total reversal apart from NL as well as other luding operations (as I will show in this section, total segment reversal uses all the marked settings of the CC ), we can arrive at a better understanding of NL and luding systems alike.
caMany researchers also, of course, simply used prose formulations of ludling operations, which are essentially equivalent to transformational rules in their lack of constraint. Also, operations of insertion/substitution such as that proposed by Zhiming (1988) for the Mandarin exchange ludlings are similarly unconstrained (thanks to Morris Halle for bringing this paper to my attention). Zhiming argues that the Mandarin ludlings are instances of total reduplication (copying) followed by insertion of various syllabic constituents (essentially along the lines of Steriade's (1988) analysis of NL reduplication): after copying, a new onset is inserted in one syllable while a new rime is inserted in the other. This approach fails to explain the exchanging nature of the ludling operation (a similar failing of a presepcification analysis): why must insertion of a new onset in one syllable necessarily be accompanied by insertion of a new rime in the other (rather than, say, a new coda, or no insertion at all)? Also, nothing in this account prevents even more haphazard substitutions, such as insertion of a new nucleus in the first syllable and a new onset in the second. See sections 3.3.1 and 3.3.4 for some further discussion.
${ }^{63}$ In addition to these conceptual problems, a transformational format cannot in fact be utilized to specify total reversal of all segments or syllables in a word, for a very simple reason. A transformational representation of total reversal necessarily requires listing of all elements to be permuted. Since words are of variable (and in principle, unbounded) length, there is no way that such a string could actually be encoded.
© ${ }^{4}$ Some ludlings are consistent in their use of a particular reversal operation, applying it to all words in a given sentence, while others apply different processes to different words, apparently at random. In this typology no distinction will be made between these two types of luding, though see section 3.6 on markedness relations between various settings of the CC parameters.
csThis and subsequent terms which I will be using as descriptive labels are not necessarily the same terms used elsewhere in the literature. For example, McCarthy (1982) apparently refers to any ludling which involves some form of reversal as 'transposition', while the typology of ludling operations presented in Laycock (1972) employs somewhat different terminology from my own. The operations which I recognize here are largely the same as those catalogued in Davis (1985); these were arrived at independently, and on the basis of a somewhat different data base.
sevowel qualities in some of the Zande ludling forms may change unpredictably.

67Exchange applies only to segments within the root; prefixes have been omitted from the transcriptions of Hanunoo used in this paper. See Chapter 4 for a discussion of the relevance of morphological information to ludling processes from a cross-linguistic perspective.
©I have modified the transcriptions in Haas (1969) in the following ways: nasalization, which Haas writes with a postvocalic $n$, is indicated here with a tilda over the vowel; Haas' tone marks, consisting of postvocalic symbols such as $v$ and $x$, are written here as superscripts.
${ }^{69}$ One possible candidate is a transposition ludling in Buin reported in Laycock (1969) which moves the first two syllables (=a foot?) to the end of the word. This could also be viewed as the application of initial transposition twice. Without a detailed description of the stress system of this language, however, it is impossible to evaluate this case, which in any event appears to be an isolated occurrence.

70Dne way to distinguish inversion of nucleus nodes vs. vowel segments would be to examine the behaviour under reversal of a structure such as (i): (i)


If this is reversed as $a b$, it would provide evidence that nucleus nodes are being accessed, while if it appeared as ba it would indicate that the segmental level is being targeted. Now, in the segmental reversals of English described in Cowan and Leavitt (1982), Cowan, Leavitt, Massaro, and Kent (1982), and Cowan, Braine, and Leavitt (1985), diphthongs are consistently not reversed: Davs > save 'mouse', dzorn > nordj 'join', arland >danəla工 'island'. To the extent that a structure for English diphthongs as in (i) is well-motivated within the phonology (cf. Halle and Mohanan 1985), this would appear to constitute good evidence for the necessity of accessing nucleus nodes. The case is not as straightforward as this, however: the ludlings in question are otherwise regular segmental reversals, and it is not clear how reference to both syllabic (i.e. nucleus) and
segmental levels can be incorporated into the formal description. One possibility, suggested to me by Pat Shaw, is that this might follow from the sequencing of the syllabification algorithm. Specifically, there is a welldefined level of analysis in the application of such an algorithm (in virtually any version) in which only nucleus nodes are available. The initial step in syllabification is to erect nucleus nodes; this is followed by incorporation of onset material, and then incorporation of coda material. The output of the first stage, interpreted in terms of the maximal or highest node (cf. Archangeli and Pulleyblank (1986) and our discussion of 'maximal projections' below, gives the appropriate input to the luding reversal. Alternatively, since this luding operates at a fairly late (postlexical) level (see Chapter 4), it could be that the two-timing-unit representation of diphthongs has been reduced within the NL representation to a single skeletal slot more appropriate to its phonetic realization, in which case reference to the nucleus is not in fact necessary.
${ }^{71}$ The skeletal level has been skipped in this discussion since in nearly all cases reversal of skeletal slots (with their associated segments) would be indistinguishable from reversal of root nodes. The only way to differentiate the two would be in the case of a contour segment with the structure of (i):


If this is reversed as $a b$, then it would appear that the skeletal tier is being accessed, while reference to root nodes would be indicated if it appeared as ba. According to Sagey (1986) this is not in fact a well-formed representation since it involves branching of root nodes rather than
terminal features (which is expressly prohibited in her framework); Hualde (1987) has recently challenged this assumption, though. A test case in backwards languages might be furnished by prenasalized stops in Javanese, which are reversed in the luding as stoptnasal Cunlike affricates, which retain the internal ordering of stop+fricative) (Sadtano 1971). In Chapter 4 I show that NL sequences of nasal+stop do indeed function as contour segments in other ludlings of this language; this would therefore seem to provide explicit support for accessing melodic structure rather than skeletal structure (and by extension, for Hualde's refutation of the 'no branching of class nodes' constraint). If, furthermore, it can be shown that the feature [nasal] attaches directly to the root node (cf. Piggott 1987; McCarthy, to appear), then this would indicate that the root node, rather than any other class node under the melodic hierarchy, is being accessed. Pending full resolution of this case, I will assume for now that only root nodes may be referenced.

72These data are problematic even for a framework such as McCarthy and Prince's (1986) which does not recognize a skeletal level per se, since reversal of syllables would still entail movement of the weight-determining properties of the representation (i.e. the morae).

TOThis problem could perhaps be overcome if we construed the mora or timing properties of the representation to occupy an independent tier which is not subordinate to the syllabic level (i.e. not intermediate between segments and syllables). Then, one could specify reversal of syllable nodes while conserving the mora structure. However, if this level were truly autonomous, one would predict that the timing properties could be independently manipulated, i.e. we should find ludlings which reverse mora count (and only mora count) between syllables: taame > tamee, tasella >
tamela. This type of reversal is not, to my knowledge, found. Moreover, there are a number of difficulties in formally implementing such an approach. A form such as Luganda kisuli > Ii»uki 'flower' can be derived straight forwardly by assuming left-to-right linking of segments to morae after reversal of syllable nodes: ( $\mu=$ mora)
(i)


However, an item in which the heavy syllable is not final cannot be derived under such an account without additional stipulations. Consider, for example, the Luganda form kinaugulu > Luguunukj 'owl': (ii)


The only way to get the correct result here would be to join the second and third morae together as a constituent. But this would simply duplicate the syllabic constituency information already present on the other tier. It is even less clear how this could be implemented to derive a form with consonant gemination, such as kiwojjolo > lojowwoki 'butterfly': (iii)


Presumably we could specify that the second syllable must remain heavy (bimoraic) following reversal, but again this would simply encode information about mora structure on the syllable tier. Thus, it seems that even if we set up a separate mora tier, we are still forced to access non-
contiguous levels simultaneously.
74This is because Goldsmith's (1976) original formulation is not simply a statement that ALs cannot cross; rather, the CC is defined more precisely in terms of what he calls a projection function and an inverse projection, with the requirement that these functions preserve connectedness. According to Sagey (1986:), "Goldsmith's formalism will allow (32a) [our (10)] because (32a) has the 'ordered sequence of pairs" ( $A, d$ ), ( $B, C$ ), ( $C, b$ ), ( $D, a$ ), "the 'projections' of which are 'connected'".

73An NLLT reviewer has pointed out that the formal implementation of the "maximum crossing" setting is potentially problematic if viewed as a procedural algorithm which governs the assoriation conventions in a step-bystep fashion. Consider the Javanese form following dissociation in (12b). The first step in reassociating with maximum crossing would be to take the leftmost segment $b$. Since there are no ALs present in the representation yet, the maximum crossing parameter cannot in fact dictate where $b$ should associate. Assuming that in some way it associates correctly to the desired rightmost skeletal slot, the following structure results:
(i)


The next step would be to associate the leftaost free segment o, but in this case asociation to any of the free skeletal slots would create maximum crossing at this stage in the application of the association conventions. Therefore, seen as a derivational algorithm, the 'maximum crossing' setting cannot achieve the desired results.

However, in this case it is reasonable to view the 'maximum crossing' setting as an output filter on the association conventions. Association applies freely (ALs may either cross or not cross, and to any degree), but
the output of the association conventions is then checked by the parameter setting which is operative at the time. If the 'no crossing' setting is in effect, any representation which has crossed ALs will be ruled out. If the 'maximum crossing' is in effect, any representation in which fewer than the maximum possible number of crossed ALs have been added will be ruled out. This is analogous to the operation of syntactic constraints such as subjacency, in which it is assumed that movement applies freely, with the output then checked by various principles. Subjacency cannot check a representation each tise a bounding node is crossed in wh-movement, since it is only the sum total of bounding nodes crossed which determines whether the representation is ill-formed or not.

In fact, it is a general characteristic of the association conventions that the well-formedness of their output can only be determined once association is completed. Consider, for example, the requirement (in skeletally-driven association) that every skeletal slot be associated to at least one melodic element. The satisfaction of this constraint can only be checked after all association has taken place, since at each stage in the linking procedure except the last, there will be skeletal slots which remain free. See also Yip (1988), where it is argued that the OCP may function as an output condition on phonological derivations, and Steriade (1988), where template mapping in reduplication is argued to consist of the imposing of several independent output filters (determining e.g. syllable weight) on a copied syllable.

Moreover, the problems with a procedural view of crossing only arise when the 'maximum crossing' setting is implemented through the asociation conventions, i.e. when no ALs from the NL word are retained in the luding form (via dissociation). In cases where a ludling rule adds a single AL to

ALs that are already present in the $N\left(\begin{array}{l}\text { representation, maximum crossing can }\end{array}\right.$ be computed immediately (see the discussion of exchange processes in section 3.4).

76 Thanks to several NLLT reviewers for suggesting this parallel between Uncrossing and Plane Conflation. See also note B6.

T7In NL reduplication, if we follow McCarthy and Prince's (1986) account, conflicts in linear precedence are also introduced through (minimum) crossing of ALs. In this case, though, they are resolved by copying the segments involved. Thus, movement (ludiings), copying (NL reduplication), and Plane Conflation can all be seen as related processes.

70Although I am assuming a skeletal (CV) representation in this derivation, this is not crucial for my analysis. As (i) illustrates, the correct form can also be derived using a moraic theory of the skeleton with no prosody-independent timing units (as in McCarthy and Prince 1986).
(i)


Such an approach may in fact be preferable, since it allows the false syllable reversal of vowel-initial words to be derived straight forwardly. That is, if in (141) we had cupga instead of luugga, a moraic theory of the skeleton would allow the onset of the second syllable to be switched while maintaining the long vowel of the first syllable: (ii)


In contrast, an approach which posits skeletal slots would predict that the
first syllable should lose its length in order to accommodate the onset of the second syllable, i.e. uugga > ggauu. (iii)


Although the relevant forms are not available in any of the false syllable reversal data provided in Hombert (1973), Seppänen (1982), and Clements (1986), the reversal illustrated in (ii) strikes me as more plausible than that in (iii).

7\%Hombert (1986) has proposed that whether or not tone moves in a ludling is a function of whether tone is represented suprasegmentally in that language. Thus, tone is predicted to behave uni formly across all ludings in a given language. Aside from the fact that this approach entails substantial weakening of phonological theory (since it requires rejection of a universal suprasegmental representation for tone), it is empirically inadequate: in the Thai ludlings described in Surintramont (1973), tone may be both reversed or nonreversed. For an analysis of these ludlings which appeals to syllable (rather than rime) reversal, cf. Section 3.4.2.
© The fact that reversal of segments within syllables without reversal of the syllables themselves is so rare cross-linguistically may be attributed simply to a dependency between the two settings of the parameter involved. That is, maximum intrasyllabic crossing always implies maximum intersyllabic crossing. The speaker reported in Cowan, Braine, and Leavitt (1985) was exceptional, then, because her luding did not conform to this dependency. See section 3.6 for further discussion of markedness relations between the parameter settings.
ail assume that once constituent movement has taken place, uncrossing
serves to merge the original syllable node and the affixed syllable node, since no further movement of skeletal slots will remove their crossed ALs: (i)



In this respect, transposition differs crucially from McCarthy and Prince's (1986) account of reduplication, since the number of syllable nodes in the final output is less than the number following affixation.
$0^{2}$ As one MLLT reviewer noted, this account differs from McCarthy and Prince's in one further respect. In transposition, it does not appear possible to have mismatches in syllabification between the NL word and the affixed syllable (which is a crucial feature of their account of reduplication). That is, there are no parallel cases to the Fula example in which the first syllable is open and where the affixed maximal syllable takes the onset of the following syllable as well, moving it to word-end: (i)


The inability of ludling affixes to change syllabic constituency in this case can probably be ascribed to a kind of structure preservation which prevents NL syllables from being split apart without the original constituency being recoverable elsewhere in the word. In NL reduplication, where copying of melodic elements is involved, the original syllabic constituency is always preserved in the base form, and no NL syllables must be divided in half in the reduplicative process. For example, even though in
a reduplicated word such as Ilokano ag-bas-basa the $s$ changes its syllabic constituency in the reduplicated portion (it becomes tautosyllabic with the preceding vowel), there is still an occurrence of the $s$ in the NH word which remains in onset position. In transposition, however, there is no copying involved, so that movement of the $f$ in the hypothetical case above would entail complete loss of the original constituency, as well as splitting of the second syllable node of the NL word.

00 I am grateful to an anonymous NLLT reviewer for drawing this to my attention.

04This rule cannot actually be written in a standard format because the number of ALs crossed will vary depending on the particular word: A parametric formulation such as that presented in Archangeli and Pulleyblank (1986) is called for in this case. However, I will continue to use standard rule-writing formats throughout this section for those aspects of rules which can be so depicted, adding statements about the settings of particular parameters where necessary.
asIt might be hypothesized that this is simply due to functional considerations: the purpose of a ludling is often to disguise a word by making it as different from its NL form as possible. Thus, when the regular luding rule will not create a distinct form (as in this instance), one could appeal to some sort of dissimilation process to render the ludling form in sone way different from its NL counterpart. However, this kind of principle of 'maximal distinctness' between NL and ludling forms is not generally operable in other ludlings: one frequently finds that NL forms to which a ludling process has no effect are left unaltered in their N. form. To give just one example, in interchange ludlings the reversal process is inapplicable to monosyllabic words, since it requires at least two syllables
to create a form which is distinct. Yet in many (if not all) such ludlings, monosyllables retain their ML for within the ludling (cf. Coupez (1969) for an example in Sanga).
alike Plane Conflation, the ourtput of Uncrossing is subject to the merging effect of the OCP (rather than the blocking effect which is operative in phonological rules; cf. McCarthy (1986)).
© Prunet (1986) has analyzed Fula as having separate tiers for consonants and vowels even though they do not constitute distinct morphemes. Even under such an account the analysis presented here would predict some exceptional behaviour. The consonant exchange rule in (156) actually specifies three distinct operations: spreading, delinking of doubly-linked root nodes, and simplification of a timing unit with two segments linked to it (the latter operation probably does not need to be stipulated as part of this rule, but can be made to follow from more general structural constraints in the language). If we have a segment on the consonant tier which is linked to two skeletal slots, as Prunet's analysis would require, the delinking portion of this rule would still be applicable:
(i)


This leaves the second C slot empty, thereby allowing the default segment [n] to be inserted.

For other languages, if mo defant segment is available within the Iuding system, I assume that the empty slot would be filled by spreading from the adjacent consonant (with crossing). In this case, the ludling form would be identical to its NL shape with respect to the segments which have been reversed.
© John McCarthy (p.c.) has pointed out a potential drawback for a linecrossing analysis of ludling systems which combine reversal with infixation. Conklin (1956) explicitly orders transposition before infixation in Tagalog in order to account for forms such as the following, where the infixed -pUndUpu- copies the NL vowel which is closest after g reversal: siya > - reversal > yasi > infixation > yasipindipiy, \#yasipandapay. McCarthy notes that this explicit ordering can be eliminated if we appeal to the Crossing Constraint, since in this case $i$ is the only vowel that can spread without crossing lines. However, this is not actually a problem for the account I am developing in this section, for three reasons. First, the 'crossing' setting of the CC is invoked only for individual ludling operations. Thus, while o reversal utilizes crossing, regular processes of affixation (i.e. adding a wholly or partially specified unit) do not have recourse to the crossing setting (and hence a could not spread in the example above). Second, in Tagalog it does indeed appear that reversal must be explicitly ordered before infixation, since this ordering occurs regardless of whether the infix contains empty $V$-slots that could be filled through spreading. For example, ludling words may be derived by infixing -un- before the first vowel of the NL word: tinapay 'bread' > tuminapay. As the following item illustrates, -um- Infixation must follow reversal, since the infix lodges in the syllable which is initial after reversal: saqan 'where' > reversal > qansa > -um- infixation >quansa > -Vminfixation > qumansama. Howver, since no spreading is involved in the specification of this infix, we cannot appeal to the CC to account for its ordering with respect to reversal. Third, ludlings in other languages manifest particular orderings of reversal with respect to infixation which cannot be ascribed to the CC. For example, in Fula there is a ludling which
transposes the initial syllable and infixes -gV-after the first and last syllables: bakari '(name)' > transposition > kariba > infixation > kagaribaga (Noye 1971:61-2). Crucially, the infixation location must be determined after transposition has taken place, yet this ordering does not follow in any obvious way from the prohibition on crossing of ALs.
© The intersyllabic setting, though not actually required for the Sanga case (since it has only open syllables), is necessary to insure that coda consonants do not switch with onset consonants.
*oThe prevocalic consonants in these transcriptions are actually complex segments (labialized, prenasalized, etc.): in Sanga such sequences usually arise through compensatory lengthening processes, and the language has only open syllables (cf. Sagey (1986) and Clements (1986) for discussion of similar distributions in Kinyarwanda and Luganda).

DI am ignoring here the fact that this luding picks out only 'full vowels', i.e. it bypasses syllables containing [Ө] (cf. Haas 1969).

2zAlternatively, one could assume the framework of prosodic morphology developed in McCarthy and Prince (1986), in which there are no skeletal slots. This would then entail the prefixation of individual light (monomoraic) syllables in this instance, and no stray skeletal positions would be involved; cf. the discussion below in the context of onset consonants in Kontti kieli.
osago (1985) argues that this luding must move skeletal slots and cannot in fact be operating at the segmental level. The sole basis for this argument is the assumption that vowel harmony autosegments link directly to the skeleton: if segments are then moved, he claims, we would not expect the vowels to reharmonize in their new positions, when in fact they do. However, aside from the fact that it is probably not necessary to assume that vowel
features link directly to the skeleton, the reharmonizing can be achieved simply by having the vowel harmony rules apply (again) after the luding operation (according to Campbell (1981), vowel harmony must be able to reapply postlexically in the N anyway).
©4According to SeppAnen (1982:10), onset clusters occur only in loanwords in Finnish.
owforms in which there is a mismatch between melodic elements and skeletal positions are somewhat problematic for this account. They can be derived, however, by consonant spreading accompanied by delinking of both the original associations of the geminate (vowels are omitted in these derivations):
(i) a. 5aman > masas

b. kattab > tabbak


For more on the interaction of Permutation with medial gemination (seen in (i.b) above), see Chapter 4, section 2.2.1.2.2.

ORLefkowitz and Weinberger (1987) propose a somewhat different account of the French facts. They argue that metathesis (i.e. a ludling operation of 'Reverse') applies to branching structures at various levels of the phonological hierarchy, with the highest branch taking precedence. Although this approach is certainly very elegant, there are a number of considerations which argue against it: 1) it relies on the erection of ad hof metrical structures on ludling forms with more than two syllables in order to create the desired level of branching; 2) it does not extend to the
full range of reversal types surveyed in this paper, most notably exchanges and total reversal; and 3) there are independent reasons for rejecting a ludling operation of 'Reverse', enumerated in section 3.1 of this chapter. $\infty^{\circ}$ A line-crossing analysis can probably also be extended to other examples of phonological movement such as speech errors (spoonerisms) (see Davis 1985), as well as to cases of morphological metathesis such as Clallam (cf. Bagemihl 1984). I will leave these topics to a future work.

Chapter Four: TOMARDS A UNIFIED THEORY OF ALTERNATE LINGUISTIC SYSTEKS

## 0. Introduction

In the previous two chapters I have separately examined the properties of ludling and surrogate systems in considerable detail. An obvious question is whether these two forms of alternate language have anything in common. Superficially, surrogate languages and ludlings are radically different: instrumental and whistle languages adopt an alternate sound-producing mechanism and thereby transcend the vocal articulatory apparatus, while ludlings (like ordinary languages) are confined to that apparatus. Surrogate systems are purely phonological and phonetic modifications of ordinary languages, while ludlings involve morphological manipulations as well (insertion of empty affixes, mapping onto templates). The sociolinguistic functions of the two types are often disparate as well: surrogate languages are rarely used as a form of play or speech disguise, while ludlings are not generally used as a means of long-distance communication.

In this chapter $I$ will explore the possibility that surrogate languages and ludiings may share one or more (alternate) grammatical components. In section 1, I enumerate a number of formal properties which are shared by surrogates and ludlings. Some striking similarities, particularly in the segmental modifications found in whistle systems and ludlings, suggest that perhaps the last module of the surrogate component is shared with ludings. In order to determine if this is the case, in section 2 I pinpoint the
location of the ludling component within the grammar. By examining the interaction of ludling conversion with a number of critical derivational checkpoints within the lexicon and postlexicon, I am able to arrive at a tri-modular model of the luding component. One module is located at the output of the last level of the lexicon, another takes the surface syntactic structure as its input, while the third is located at the division between the Syntactic and Postsyntactic components of the postlexical phonology. In section 3 I show that, although the location of the latter two conversion sites is shared with surrogate systems, this is probably a reflection of the general salience of these levels of representation within the grammar rather than of a combined ludling-surrogate module or modules.

1. Formal Sinilarities Between Ludlings and Surrogates

In spite of the obvious differences between surrogate languages and ludlings, a number of authors have pointed to some possible lines of connection between these forms of alternate language. Isola (1982), for example, draws a parallel between the isolation of speech tones which occurs in Yoruba drum language and the stability of tones in reversing language games. Cowan (1976) suggests that there might be a fundamental unity between a phonation modification such as whispering (utilized in some ludlings; see section 1.4) and whistle languages: "The question aight well be asked, if whistled Tepehua should not be considered a style of speech (as whisper is, for example), rather than a substitute for language, since it is used by the same person and involves the same physiological mechanism and linguistic system to achieve the same cultural purpose" (p.1407). Busnel and Classe (1976) express a similar sentiment. In this section 1 will take these suggestions further by considering what formal properties are shared by
ludling and surrogate systems. The similarities which are manifested in these two types of alternate languages may be grouped into four categories: reversal/reconstruction, manipulation of syllable and timing structures, extrasystemic modifications, and loss or destruction of information. I will also examine a number of cases of vocal surrogates, i.e. alternate languages which appear to combine some of the properties of both ludlings and surrogates.

### 1.1. Reversal and Reconstruction

Many different types of reversal are encountered in various forms of alternate language, cutting across the distinction between surrogates and ludlings. As we saw in Chapter 2, surrogate languages reverse the priority between head and nonhead nodes when selecting between them: tones (nonhead) are selected over segments (head), the direct oppposite of what occurs in spoken languages. Ludlings may utilize the opposite setting of the Crossing Constraint parameter, thereby effecting the reversal of segments or syllables (see Chapter 3). Many ludlings incorporate rules of dissimilation, which are essentially the opposite of processes of assimilation, and relatively rare in NL systems; see Yip (1982) for some examples in Chinese ludlings, and the discussion of Samoan in Chapter 3, note 53. Pulmonic ingressive airstream, which as we saw in previous chapters is found in both ludlings and whistle languages, can in a sense be considered a reversal of the overriding airstream direction utilized in ordinary languages. Finally, semantic reversals are characteristic of a number of alternate linguistic systems. So-called 'opposite speech' is reported as a feature of some ludlings in Hanunoo (Conklin 1959:296), and al so occurs in Warlpiri (as noted in Chapter 1), Kuma and other languages of
the New Guinea Highlands (Laycock 1975:137), and Cheyenne (Tsistsistas) as well as several Interior Salishan languages (Schlesier 1987:68; Ray 1945).

In both ludlings and surrogates we find processes which reassociate floating segments to the skeletal tier, allowing them to be pronounced. In Tigrinya -gV- Infixation, for example, the rule of Floating Segment Realization allows a segment delinked in the NL phonology to reappear in the ludling system. This is strikingly similar to the rules of tonal reconstruction posited for Akan and Efik surrogate speech in Chapter 2: in these cases, floating tones are relinked to the skeleton and are realized in the surrogate utterance. Rules of this type are virtually unattested in NL phonologies, and one may hypothesize that this is because these, too, are forms of reversal. Reconstruction processes 'undo' what has been accomplished by an NL rule, either relinking a segment that has been delinked by an assimilation process or reassociating a low tone that may have been set free by a downstep creation rule. Furthermore, in the Tigrinya case, we find essentially a reversal of the 'skeletally-driven' association which is characteristic of most NL phonology. McCarthy and Prince (1986:94) point out that in most cases association is driven by the availability of free skeletal positions, such that melodic elements are left unlinked if there are no available docking sites. In contrast, a rule such as Floating Segment Realization is 'phoneme-driven', in that a free skeletal position is created in order that an unlinked melodic element be realized.

[^3]chapter, for example, is its use of templates of different sizes, resulting in variations in timing and length for the segmental elements which are mapped onto them. Similarly, Akan surrogate speech incorporates a number of processes which adjust the timing of spoken syllables through the addition or deletion of skeletal positions.

In Chapter 3, we saw that the whistle languages of Mazateco and Gurma make use of rules of syllabic restructuring, which essentially group together two adjacent nuclei into the same constituent. This process is formally very similar to a number of syllabic regrouping processes found in ludlings. For example, in Cuna Sorsik Sunmakke, there is a ludling-specific process which reassigns an $s$ in coda position into the onset of the following syllable. Most speakers reverse aswe 'avocado' as weas, indicating that $s$ and $w$ are heterosyllabic. Some speakers, however, have reanalyzed the $s$ as belonging to the following syllable, and reverse this word as shea (Sherzer 1970:350). Similarly, in section 2.2.3.1.2 of this chapter I will discuss a case in Burmese which shows that the prevocalic glide $w$, which in the NL behaves as part of the onset, has been reassigned to the nucleus in some luding forms.

### 1.3. Extrasystemic Modifications

A characterisitic of luding and surrogate systems alike is their use of 'extrasystemic' modifications, that is, elements which fall outside of their own particular ordinary language phonologies (and in some cases, outside of any ordinary phonological system). One example of this is in the phonation types used in alternate languages. Surrogate systems, of course, represent the most drastic modifications in this regard, taking their soundproducing mechanism from even beyond the vocal apparatus in the case of
instrumental languages, and employing a nonlinguistic vocal configuration in the case of whistle languages. Ludlings, too, often utilize extrasystemic phonation mechanisms. The occurrence of pulmonic ingressive airstream has been documented extensively in Chapter 3; additional phonation types are found in Hanunoo ludling speech. Several different modes of vocal production, in addition to the paha:gut, are recognized in Hanunoo; each involves the superimposing of a characteristic phonation modification (sometimes with other changes) over an entire ludling utterance, similar to the mapping of a whistle articulatory configuration over an entire utterance. Among these modifications are yanas, barely audible whispering; padiqitun or falsetto (see Catford (1977) for a description of the laryngeal configuration characteristic of falsetto); and paliksih, which includes (among other things) articulation with increased glottal tension (Conklin 1959:296).

Another very common manifestation of extrasystemic behaviour in ludlings and surrogates is the violation of structure preservation. As we noted in Chapter 2, section 4.2.4, a typical feature of surrogate phonological rules is that they create structures, configurations, segments, etc. which do not exist at the lexical level in their source languages. As I will document more fully in section 2.2.3.1 of this chapter, structureviolating operations are also a hallmark of many luding systems (and this is also true of other types of empty morphology/alternate languages; see, for example, Sapir (1915)).
1.4. Loss or Destruction of Information

With the heavy articulatory constraints imposed on surrogate languages, as well as through the operation of formal constraints such as the Principle
of Surrogate Selection, a tremendous amount of information is lost in conversion to a surrogate system. Ambiguity is rampant in such alternate languages, as we noted in Chapter 2, and there is often extensive neutralization of spoken language contrasts. Many examples of 1055 or destruction of information and resulting ambiguity are also attested in ludling systems, and these will be discussed more fully in section 2.2.3.3 below. For now, I will mention some of the most striking cases, which involve what I will call 'Replacement' ludings. In these systems, all or most of the vowels or consonants in an NL utterance are replaced by one or two segments in the luding form. Examples of Vowel Replacement include the Hebrew Ah Language, in which all vowels are replaced by a, and a Dutch luding, in which the sequence edi replaces each vowel. These ludlings, along with several other examples, are illustrated in (1). In this and all subsequent examples, the symbol ">" will be used to indicate the effects of a ludling operation, while '--->' will be reserved for the effects of NL rules.
(1) V-Replacement Ludlings
a. Hebrew (Yakir 1973:32)
ani roza lalekhet 'I want to go' > ana raza lalakhat
b. Cuna (Sherzer 1970: 24)

| pia | 'where' | $>$ pii |
| :--- | :--- | :--- |
| nuka | 'name' | $>n i k i$ |
| tanikki 'he's coming' | $>$ tinikki |  |

c. Dutch (Otsikrev 1963:4)
goeden dag 'good day' $>$ gedidedin dedig
kom binnen 'come in' $>$ kedim bedinnedin
d. Cantonese (Laycock 1972: 19)
$\eta^{2}$ fa:n hoey kwai iok $>$ ja fa ha kwa la
The ludling forms in this instance are considerably impoverished when compared to their NL sources: words are reduced to their consonantal outline as a result of the ludling acquiring essentially a single-vowel system.

Consonant Replacement ludlings are also attested. In Chaga, for example, one ludling uses only the consonants $k, r$ and $j$, with all NL consonants lost in favour of one of these: sinde 'let us go' $>$ rije, ninatembea 'I am taking a stroll' (from the Swahili) > rirarekera (Raum 1937:221). In one Urdu ludling, the first consonant of each word is replaced by either $k, n, r, p$, or $b$ according to an arbitrary set of rules (Laycock 1972:19,99), while English Barracuda Language replaces the initial consonant of each word with $b$ (along with other modifications) (Berkovits 1970:150-1). In a Vietnamese ludling, each syllable is reduplicated, with the first occurrence of the initial $C$ replaced by $b$ and the second occurrence by $s$, so that the N $N$ consonant is lost entirely: tôi $\dot{d} i>b \hat{o} i-s \hat{o} i \quad b i-s i$ (Cheon 1905:59-60). Many different patterns of consonant substitution are also
found in Gurage and Amharic ludlings (Leslau 1964:10-11).
One of the more interesting patterns of consonant replacement involves the substitution of glottal stop for NL consonants. This is reported for ludings of Kuma and Chimbu (Laycock 1975:134) and a secret brother's language in English described in Applegate (1961), in which the second of two identical stops in a ML word is replaced by 7. Recall from Chapter 3 that whistle languages often impose glottalization on consonants in an across-the-board fashion, with 7 actually substituting for stops in Kickapoo surrogate speech.

### 1.5. Vocal Surrogates

One final clue to possible connections between ludlings and surrogates concerns a class of alternate languages which seem to share characteristics of both. I will call these systems 'Vocal Surrogates' because, like surrogate languages, they drop segments in favour of tones, but unlike instrumental and whistle systems they still use the larynx as the fundamental sound source. In the descriptive literature these are known variously as 'Call Languages', 'Yell Speech', 'Shouting-at-a-Distance Languages', etc. Characteristics of vocal surrogates include one or more of the following: use of alternate laryngeal phonation mechanisms (often ones which are not found in natural languages), which are mapped across entire utterances; loss or weakening of consonants, or else use of a highly impoverished segmental system (e.g. one or two consonants, a single vowel of variable quality); and preservation of suprasegmental features such as tone and stress at the expense of segmental ones coften accompanied by extensive manipulation of timing), with a concomitant increase in ambiguity.

Several vocal surrogates are found in the Piraha language in addition
to its whistle surrogate (Everett 1985:413). In one system, a single vowel quality such as /a/, nasalized and laryngealized, carries the tone, intonation, timing, syllable patterns, and stress of a given ordinary language utterance; no other consonants or vowels are used. In another variety, a single variable vowel quality (lightly nasalized but not laryngealized) is used with a falsetto phonation mechanism.

A number of vocal surrogates have also been reported for the New Guinea Highlands area, among languages such as Mountain Arapesh, Wom, Yambes, and Medlpa. According to Laycock (1975:138-9) they are used for transmittinbg messages over long distances, usually across valleys (like many whistle languages): "acoustically, they give the impression of yodelling", with "vowels held for abnormal lengths, especially finally" and simplification of consonant clusters. Wurm (1972:617) describes how in some systems "the vowel of the most important word is prolonged and shouted at maximum loudness", although the correct relative length and pitch are maintained. Consonants are often lost as well.

In a Lokele vocal surrogate, the segments in all low-toned syllables are replaced by $1 E / K E$ and the segments of all high-toned syllables are replaced by li/ki, where choice of the initial consonant apparently depends on rhythmic considerations (Carrington 1953:687). Similar systems are reported for Mbae (where cu represents high-toned syllables, co low-toned syllables) and baNgombe (where gu is used for high-toned sylables, go for low-toned) (Carrington 1949:654). Jabo is also said to have a vocal surrogate which represents higher and lower speech tones (Herzog 1945:566).

A formal analysis of these systems would draw upon aspects of the derivations of both ludlings and surrogates. Ordinary phonological representations would first be stripped of their segments via the Principle
of Surrogate Selection. Rather than being mapped onto a whistle pitch or external resonator (as in true surrogates), the structures would then receive new segmental articulations drawn from a drastically reduced inventory, with specification of certain segments dependent on the original tones. Following that, tones might be eliminated, additional phonation modifications imposed across-the-board, and/or timing modifications (such as vowel prolongation) effected, depending on the particular system.

### 1.6. Summary

We have seen in the preceding discussion that, although surrogate languages and ludlings differ in many respects, there are a number of threads of similarity running through systems of both types. Several possible explanations for these similarities suggest themselves. They could be merely fortuitous, in the same way that two words in unrelated languages may come (through the operation of regular historical processes) to have the same form (e.g. Mbabaram tgudaga > gudoga > doga > dog 'dog'; Dixon 1980: 196,202). They could be the result of a common conversion lacation for separtate luding and surrogate components. For example, if the ludling component is located in the postlexical phonology (as is the surrogate component), then a number of characteristics shared by both might simply be attributed to properties held in common by all postlexical processes (in ordinary and alternate languages alike). This could explain, for example, the tendency towards non-structure-preserving operations in both ludlings and surrogates. Finally, at least some of the similarities might be due to an actual shared grammatical component between ludlings and surrogate languages. One could conceive a single module, for example, where consonant substitution in both whistle languages and ludlings is effected.

In order to assess whether the latter two explanations are even possible, however, we need to determine on independent grounds where the ludling component is located. If it is indeed the case that at least some ludlings operate at the postlexical level (and more particularly, at the same level where the Whistle Module is located), then these proposals can be addressed with greater certainty. In the next section, therefore, I will develop a detailed model of the ludling component and its relation to the NL phonology, and then return in the following section to explore the implications of this for possible connections between ludlings and surrogates.

## 2. Locating the Ludling Component

### 2.1. Previous Proposals

Although many descriptive and theoretical accounts of ludlings are available, there are few definitive statements regarding where in the grammar ludling conversion is hypothesized to take place. The most explicit proposal is that of Mohanan (1982), which I tentatively adopted (with revisions) in Chapter 3. Recall that Mohanan places the ludling component between the lexical and postlexical phonology. He argues for this on the basis of two fundamental observations: on the one hand, he claims, all ludlings follow morphological operations and lexical phonological rules, while on the other hand, all ludlings precede postlexical phonological rules. In this section I will show that, although Mohanan's proposal is correct in its essence, the facts are considerably more complex than his model would indicate.

A number of other authors have made passing statements about which level (s) of representation they consider to serve as input to the particular
ludling they are examining. A sample of these statements is presented in (2).
(2) Hypotheses about the location of ludling conversion
a. "...it is very important to know at what level the word game rules apply, that is, whether at the surface phonetic level or at deeper, possibly lexical levels." (Hombert 1986:183)
b. Mandarin, May-ka Language
"...the secret language is apparently generated at some level intermediate between underlying forms and the phonetic surface, probably after the application of lexical phonological rules. It then applies phonological rules, which may include all or some of those of the base dialect as well as some of its own." (Yip 1982:640).
c. Moroccan Arabic, Permutation
"...different speakers in effect 'guess' differently about the place of the transposition game in the lexical phonology" (McCarthy 1986: 229)
d. English, Total Segwent Reversal
"In general, then, the units [accessed by the ludling] can be described as intermediate in their level of abstraction. They are more abstract than surface phonetic or 'taxonomic' phonemic categories, but less abstract than the systematic phonemes of Chomsky and Halle (1968)." (Cowan, Braine, and Leavitt 1985:687)
e. Cuna, Sorsik Sunsakke
"...speakers are sometimes using underlying forms as input to the rules of the game, but are using more or less surface forms as input at other times. There is even the possibility...that some stage of
the phonological derivation intermediate to the underlying representation and the phonetic representation could be the input to the rules of the game." (Churma 1979:90)

What these different viewpoints seem to share is the observation that ludling conversion may take place at some intermediate level or levels within the phonology. Some of the authors also hypothesize that either quite shallow or surface representations as well as fairly deep (lexical or under lying) representations may also serve as input. There is no overall consensus, however: as we will see in the following discussion, this is understandable, given that the range of evidence is often quite confusing and conflicting when a comprehensive survey of ludlings and NL phenomena are taken into account.

In spite of the often bewildering array of evidence relevant to the location of ludling conversion, though, it is possible to discern a number of patterns in the data. In the model I arrive at, the essential insight of Mohanan's and others' observation about an intermediate location for the ludling component is preserved. However, within the ludling component I posit a highly modularized organization which accounts for the cross-ludling variations which are observed. Before I examine the structure of this model in detail, I will present a comprehensive survey of all of the various types of evidence for different conversion locations.

### 2.2. Derivational Checkpoints

In this section $I$ will draw together a broad range of evidence which bears on the location of the ludling component. The strategy employed is essentially that of Mohanan (1982): for each component or aspect of the NL grammar which is considered (e.g. lexical phonological rules, the
phonosyntactic subcomponent, structure preservation) I will ask two questions: which ludlings require conversion before that point in the grammar, and which ludlings require conversion after that point in the gramar. In section 2.3 I will then attempt to synthesize these results by determining if there is any consistency in conversion sites across as well as within individual languages.

This survey encompasses a much wider range of ludlings and ML phonological (and in some cases, nonphonological) phenomena than Mohanan (1982) was able to consider. Ludlings in more than fifty languages will be examined with respect to the critical derivational checkpoints diagrammed in (3):
(3)



This model incorporates the elaboration of the postlexical component presented in Chapter 2 (with a renumbering of levels beginning in the lexicon), as well as the location of Plane Conflation between the Lexicon and Postlexicon adopted in Chapter 3. More detailed discussion of the organization of this model will be found in the following sections, which are organized around three topics: derivational checkpoints within the lexicon, derivational checkpoints within the postlexicon, and general structural constraints (e.g. Geminate Integrity, Structure Preservation) which in some cases span the lexical/postlexical distinction.

### 2.2.1. The Lexicon

The interaction of ludling conversion with three elements of the lexicon will be examined in this section: morphological operations, Plane Conflation, and lexical phonological rules.

### 2.2.1.1. Morphology

Part of Mohanan's (1982) original motivation for placing the ludling component after the lexical phonology was that, as he claimed, "all secret codes...operate on words, not on morphemes" (p.88). That is, no ludling crucially takes place before an NL morphological operation such as affixation. This hypothesis is indeed confirmed for the overwhelming majority of ludlings which I have surveyed. In virtually every case, luding conversion is essentially a word-level phenomenon, in that it occurs after all other morphological operations. A particularly graphic illustration of this ordering relative to morphology can be found in French Verlan 3, in which various reversal processes apply to fully inflected forms. As the items in (4) (taken from Lefkowitz 1987:186) illustrate, masculine and feminine forms of adjectives and nouns differ only in their final segments in the NL items; the ludling forms are much more radically differentiated, however, and clearly indicate that reversal applies after affixation of the feminine suffix (I am assuming an analysis along the lines of Prunet (1986), in which the feminine suffix consists of an empty skeletal slot onto which the floating final consonant of the masculine form docks).
(4) French, Verlan 3 (Lefkowitz 1987)
a. lur 'heavy (m.)' > rolu
b. lurd 'heavy (f.)' > dalur
c. Ša 'cat (m.)' > as'


In these cases the inflectional suffix (the realization of the stem-final consonant) shows up at the beginning of the ludling word, owing to the operation of segment and/or syllable reversal (coupled in some instances by a-epenthesis and truncation). Examples in other ludlings are readily found and too numerous to cite here; ludling forms given in subsequent sections will all be seen to involve conversion after NL morphology.

Nonetheless, two potential exceptions to the generalization that no ludling processes precede NL morphological processes are worth mentioning here. These are only 'potential' exceptions, however, because the data are sparse and subject to alternative interpretations. The first involves Burmese VC Exchange, which Haas (1969) claims to apply to both syllables of a reduplicated word (normally it exchanges rimes of only the first syllables of adjacent words). As the following form indicates, the ludling does indeed
 'very foolish' (literally 'dogs-to surpass', i.e. 'little better than dogs') > Khна" $\theta$ ey* ${ }^{*}$ Sey* (Haas 1969:280). If exchange took place after reduplication, we would expect the form *日ey*§a" for 'to surpass'. Furthermore, if the ludling operation did take place prior to reduplication, this case would be extremely problematic, since the ludling operation is clearly postlexical (it operates between words), and thus would entail ordering a postlexical process before a morphological one. Although such 'loops' are not unattested (cf. Kiparsky 1982, Pulleyblank 1985), they do appear to be highly marked, and one must ask whether it is really necessary to invoke such an ordering in this case. In fact, it appears that this example, rather than illustrating a productive aspect of the NL-ludling interface in Burmese, is simply an instance of a fixed expression (in both ludling and NL). In addition to its clearly idiomatic meaning, this item is
the only example supplied by Hass to illustrate the interaction of NL reduplication and ludling exchange, and it is explicitly referred to as a disguised "expression" (ibid., p.278). It may safely be concluded, then, that this is a case of a fossilized luding form which must simply be listed in the (ludling) lexicon.

Somewhat more problematic are two forms in Tagalog. According to Conklin (1956: 138), for most ludling operations "inflectional affixation can be added to the changed forms; in $R_{s}$ [total syllable reversal] baliktád words it is never done otherwise." Only one example is provided, given here in (5) (q $=$ [7]. .
(5) a. ka:kJ:qin'will eat' > qisqígka
b. $N L$ derivation
kázqin 'eat' ---durative/contingent reduplication---) ka:kásqin
C. Ludling derivation (operating prior to $N L$ morphology)
$k a ́: q i n>g$ reversal $>q$ figka -ML reduplication---> qi:qSagka
d. Ludiing derivation (operating after NL morphology)
kaská:qin> $\quad$ reversal > *qinkáakaz
As the derivation in (5b) shows, the NL form consists of a stem which has undergone reduplication. If ludling conversion operates prior to NR reduplication, as in (5c), the correct form can be generated, whereas if ludling conversion operates after NL reduplication, the incorrect output in (5d) results. A similar case is given by Laycock (1972:21, 40; citing Garcia 1934), shown here in (6). These foras are supplied in the Tagalog orthography, which does not represent the glottal stop, stress, or vowel length; the underlying root is the same as in (5), "eat".
(6) a. kumakain 'will be eating' > umeenka
b. NL derivation
kain 'eat' --reduplication-->> kakain ---progressive infix---> kumakain
c. Ludling derivation (operating prior to NL morphology)
kain > $\sigma$ reversal \& vowel change > enka - -NL reduplication-->

> eenka ---progressive infix---> umeenka
d. Ludling derivation (operating after $N L$ morphology)
uneenka > reversal > *kaenneu
It is not clear whether this is a fossilized form: for example, the vowel change of $i$ to $e$ in the ludling form does not appear to be motivated by any independent NL or ludling process. ${ }^{2}$ Furthermore, it is striking that both sources should independently use the same example to illustrate the ordering of ludling operations before NL morphology, and that both this and the Burmese example involve reduplication. I will tentatively conclude that Tagalog Syllable Reversal may require conversion before the addition of NL inflectional morphology, whereas for all other cases no such ordering is possible. This is diagrammed in (7), where the line belonging to each ludling indicates the potential conversion sites delimited by the property in question (in this case, ordering relative to NL morphology). I assume, in this case, that Tagalog inflectional morphology would be added at a late lexical stratum. (These and subsequent examples to be given in this section will be compiled on a language-by-language basis in section 2.3). (7)


[^4]

### 2.2.1.2. Plane Conflation

A number of ludlings show clear evidence of having to apply either before or after Plane Conflation. This evidence takes two forms: access to morphological information, and behaviour of geminates.

### 2.2.1.2.1. Access to Morphological Information

As we noted in the previous section, the interaction between ludlings and NL morphology is minimal, leading Mohanan (1982) to conclude that ludlings "are blind to the internal structure of words" (p.88). However, a few ludlings do appear to require access to a limited amount of morphological information, and in particular to a distinction between the stem (or root) and affixes. In some cases only stem segments/syllables are affected by the ludling operation, with affixes still appearing in the ludling forms. For example, in Tagalog Total Segment Reversal prefixes are ignored (in the folowing transcriptions, affixes have been underlined): pagsimba 'attend Mass' > mag-gabsis, 3 not *abwisgaw (Conklin 1956;137). The same is true for Hanunoo CV Exchange (ka-tagbuq > ka-bugtaq, not *butagkaq; cf. rignuk > nugrik), mapping onto a CVnsuwayb template (ka-tagbuq >katansuwayb, not *kansuwayb; cf. rignuk $>$ rinsuwayb), and Syllable Reduplication (ka-tagbuq > ka-tata tag sa bubuq, not *kakatata...) (Conklin 1959: 295). Finally, Bedouin Hi jazi Arabic Permutation affects only root consonants: difa9-na 'we pushed' > fida9-na, 9afad-na, etc., but not
 *tiheaaf, *tihfaay (McCarthy 1982: 197-8).

The ludling forms just cited could be derived by having ludling conversion apply before affixes are added, as for the Tagalog case described in the preceding section. However, unlike the Tagalog case, another analysis is available: ludling conversion can apply after all affixes have been added
but prior to Plane Conflation. In this way, the morphological distinction between stems and affixes is still available, and can be directly accessed by the luding rule without having to order ludling conversion prior to any morphological operations. This is of course only possible under the assumption that Plane Conflation does not occur until the end of the lexicon (see Chapter 3, section 2.3.1.2), since otherwise the stem/affix distinction would be obliterated at the end of each stratum. In fact, access to the stem/affix distinction which is required in these ludlings also appears to be a hallmark of many of the examples cited by Cole (1987) as evidence for postponing Plane Conflation until the end of the lexicon in NL systems. For example, the English suffixation constraints which she discusses require knowledge of whether an adjacent morpheme is an affix or not, one condition on Seri /k/-Epenthesis which she notes is that a triggering segment not be in a root, while Sekani Perambulative Reduction requires "being able to identify whether the adjacent morpheme was an affix or a bare stem" (ibid., p.206). This convergance in the type of trans-stratal morphological information required in both $N \mathbb{N}$ and ludling derivations supports a unified account: both are the result of scanning the morphological representation prior to Plane Conflation.

Further evidence for conversion after the morphology but prior to Plane Conflation is provided by cases where affixes are not only ignored by the ludling operation, but also onitted in the final output of the ludling. For example, mapping onto the ludling Cay(C)(C)CəC template of Amharic eliminates affixes: t-wəllagəd 'stagger' > $\mu a y l g d ə d, ~ n o t ~ * t a y w l g t d ə d, ~$ manklya 'spoon' > maynkək, not *maynkyдy (McCarthy 1985:310). Similarly, Hanunoo mapping onto a qayCVC template onits prefixes: ka-tagbuq > qaytag, not *gaykat (Conklin 1959: 295). Unlike the preceding cases, these cannot
be analyzed as the result of ludling conversion operating prior to NL affixation. If mapping onto the template occurred prior to the point where affixes were added, then nothing would prevent the ludling output from receiving the NL morphology. Rather, these examples indicate that a fully inflected form is submitted to the ludling component, but then the ludling operation simply picks out only stem segments.4

### 2.2.1.2.2. Behaviour of Gepinates

Another way in which ludlings interact with Plane Conflation is in their treatment of geminate consonants. As we saw in Chapter 3, section 2.3.1, in Tigrinya -gV- Infixation, heteromorphemic geminates may be split by epenthesis within the ludling component while tautomorphemic geminates cannot. This indicates that luding conversion must take place prior to Plane Conflation, since otherwise the two types of geminates would be indistinguishable. A second example is provided by Moroccan Arabic Permutation (McCarthy 1986:228-9). In one dialect of this ludling, identical consonants across vowels behave as single melodic units (as in Bedouin Hijazi Arabic Permutation; cf. McCarthy 1982): hbib 'maternal uncle' >bhih, not \#bbih or *bhib. In a second ludling dialect, long-distance geminates behave like two distinct melodic units: bbib >b^bib ("^y indicates a separate release). This difference follows if we assume that luding conversion for the first dialect occurs prior to Plane Conflation, when only one melodic element is available for the geminate straddling the vowel (8a), whereas conversion for the second dialect takes place after Plane Conflation, when the long-distance geminate has been split into two melodic elements (8b):
(8) a. Morrocan Arabic, Perwutation 1 (conversion before PC)

NL form Permutation Plane Conflation

b. Morrocan Arabic, Permutation 2 (conversion after PC)

NL form Plane Confl. Permutation


The domains for ludling conversion established in this section are summarized in (9):
(9)


Hanunoo, CV Exchange: Prefixes ignored
Hanunoo, CUnsauayb Teaplate: Prefixes ignored
Hanunoo, Syllable Reduplication: Prefixes ignored
Tagalog, Total Segnent Reversal: Prefixes ignored


〈------------------|
Bedouin Hi jazi Arabic, Persatation: Long distance geninates=1 unit Moroccan Arabic, Peratation 1: Long distance geainates=1 unit Tigrinya, -gl-Infixation: Epenthesis in heterogeninates

Moroccan Arabic, Persatation 2: Long distance geainates=2 units


### 2.2.1.3. Lexical Phonological Rules

Many examples of ludiing conversion taking place after lexical phonological rules are attested. Some of the best documented cases are in English and Malayalam, where detailed Lexical Phonology analyses of the source languages allow a precise location of the NL rules in question to be determined. I will begin with the English examples, comprising five different ludings.

For Total Segment Reversal 1, Cowan and Leavitt (1981:53) state that the distinction between [i] and [E] in serene vs. serenity is found in the reversed forms of these words (see the Appendix for a descriptive catalogue of the ludlings surveyed here). This shows that reversal applies after Trisyllabic Shortening (rSS), since in the reversed form the affected syllable is no longer antepenultimate and therefore would not meet the structural description of TSS if conversion took place before this rule. Since Halle and Mohanan (1985:100) and Kiparsky (1982:133) assign TSS to stratum 1 of the lexical phonology, this indicates a conversion location somewhere after this level. Similarly, the distinction between [d] and [ $\frac{y}{2}$ ] in divide vs. division also appears in the ludling forms, indicating that conversion takes place after the lexical rule of Palatalization (assigned to stratum 2 of the lexicon by Mohanan (1986:44) and stratum 1 by Borowsky (1986:130)). Finally, it appears that reversal takes place after the assignment of stress. Although there is some variation between speakers, Cowan, Braine, and Leavitt (1985:688) and Cowan, Leavitt, Massaro, and Kent (1982:51) note that the most frequent pattern is to superimpose the forward stress pattern on a reversed segmental representation. For this to be the case, stress assignment must precede reversal, since stress in English is sensitive to syllable weight: the location of heavy and light syllables
after reversal would not allow the forward stress pattern to be derived if conversion took place before stress assignment. (Additionally, this is a clear demonstration of the independence of stress from segmental features.) According to Kiparsky (1982:133) and Halle and Mohanan (1985:100), stress rules in English apply at stratum 1, indicating that luding conversion must take place at some point after that level.

The location of Segment-within-Syllable Reversal can be pinpointed with respect to two lexical processes: stress assignment and sonorant syllabification. According to Cowan, Braine, and Leavitt (1985:690), "in each reordering, a normal forward stress...pattern seemed to be superimposed on the reordered phoneme string", the same as for Total Segment Reversal 1 noted above. This is illustrated in (10), where it can be seen that primary stress remains on the penultimate syllable in each of these reversals (also included here are the total segment and syllable reversals performed by the same speaker). 3
(10) a. NL form
b. Segment-withinSyllable Reversal
c. Syllable Reversal
d. Segment Reversal

```
èl.I.fənt.táI.tIs 'elephantitis'
leqItnIf?áItsIt
    tIstaIfont?Írel
    sIfaItnIfíic
```

Again, this argues for conversion after stress assignment, since syllable shape changes in the reordering without altering the location of stress. Secondly, Segment-within-Syllable Reversal appears to recognize the syllabicity of sonorant consonants: 'communism' is reversed according to the syllable divisions kam.mjun.Iz. (Cowan and Leavitt 1981:55). According to Mohanan (1986:34), Sonorant Resyllabification (which makes the . in comsunise syllabic) applies at stratum 4 of the lexical phonology, indicating that conversion applies after this point.

The English Ayb Language (-ayb- Infixation), as described by Mohanan (1982:89), can be shown to apply after at least four lexical rules. Infixation of -ayb- occurs after the rule of CiV Lengthening, assigned by Halle and Mohanan (1985:100) to stratum 1: kənéydian 'Canadian' > kaybonaybéydaybiayban (in these examples the affected vowel has been underlined). If CiV Lengthening applied after Infixation, it would bleed

 *daybivaybídiaybon), and after Velar Softening (an early lexical rule according to Halle and Mohanan (1985:100) and Borowsky (1986:130)): krîtisizan 'criticism' > kraybîtaybisaybizaybən, not *kraybítaybikaybizaybon. Finally, infixation must apply after stress assignment, since in all cases stress is retained on the NL syllable it was assigned to: díymən 'demon' > daybíyaaybon V 5 . dimáanik 'demonic' > daybisaybáanaybik (see also the examples above). As Mohanan notes, if stress were assigned after infixation, it would in most cases fall (incorrectly) on the last ayb. Moreover, even secondary stress patterns are unaffected by the ludling operation (in this orthographic transcription, raised numerals indicate the degree of stress, where $1=$ primary): $a^{9} r$ tificiciallity $>$ ayba9rtaybifaybi-caybiaybaylaybitayby.

Total Segment Reversal 2 also takes place after Palatalization: $\overline{z k} \int \bar{\pi}$ 'action' is reversed as nífkz. Finally, Kaisse and Shaw (1985:7,8) note that ludling conversion for Pig Latin also takes place after TSS: pēnal > enalpay, not *enalpay.7

Two examples of luding conversion following lexical rules in Malayalam are presented in Mohanan (1982:90). Vowel Sandhi, an NL rule whose domain is strata 1-3 (Mohanan 1986:101), applies to coalesce vowels at the juncture of
certain compounds: kala 'art' + «lsanam 'festival' - -
'festival of art'. The ludling form of this word in the Pa Language is pakapaloopalsapawam, indicating conversion after Vowel Sandhi (if infixation preceded the NL rule, we would get *pakapalgayupalsapawan). Ludling infixation also takes place after the lexical rule of Stem-initial Gemination, assigned to stratum 2 (Mohanan 1982:104; 1986:90). Obstruents geminate when they are initial in the second member of a subcompound: kutira 'horse' + kutti 'child' --> kutirakkutti 'baby horse'. As Mohanan points out, if ludling conversion applied prior to this rule, the incorrect form *pakupatiparapakupatti would result (with nongeminate $k$ on kutti): presumably this is because the obstruent is no longer stem-initial (being separated from the compound boundary by the ludling infix pa), or else the NL morphological information has been lost once the ludling form returns to the NL phonology. Only by assuming that infixation applies after Steminitial Gemination can the correct form pakupatiparapakkupatti be derived.

As we have seen, there are quite a few instances of ludling conversion being crucially ordered after lexical phonological rules. I have only been able to locate two examples where luding conversion appears to take place before a rule of the NL lexical phonology. One is in the -lfir- Infixation luding of Fula, as described by Noye (1975:87). Consider the following form:
(11) /yah-en/ 'let's go' —— [njehen] > njalfiren, \#njel firen The luding infixes -Ifir- after the first CV(V) of an N. word, with medial consonants of the NL word being dropped (hence the loss of the $h$ in this item; see also section 2.2.3.3). The NL form is subject to a rule which converts the stem vowel a to $e$ before suffixes beginning with $e$ or $i$, and it appears that luding conversion applies prior to this rule, since the
ludling form shows up with the vowel a rather than e. This is clearly a lexical rule, since as Noye (1970:8B) points out, only the irregular verb stem yab-is affected (see also McIntosh (1984:272, fn.15) for more on the irregular nature of this verb). This is only a single item, however, and it is not clear whether we can draw any firm conclusions on the basis of this.

A second example of ludling conversion apparently applying before a lexical rule is supplied by Bedouin Hijazi Arabic Permutation. As described by McCarthy (1982:197), scrambling of root consonants in this ludling respects the medial gemination in second and fifth binyanim forms: kattab may be permuted as battak, kabbat, takkab, etc., but not as *batkak, *kabtat, *takbab, etc. According to McCarthy (1981:392), medial gemination in the NL forms is derived by a rule of 'Second, Fifth Binyanim Erasure' which delinks the association of the penultimate C -slots in these binyanim, followed by spreading of the adjacent consonant:
a. UR: 2nd binyanim template and consonantal melody (vocalic melody omitted)

CVCCVC $k t b$
b. Association Conventions

c. 2nd, Sth Binyanim Erasure

d. Spreading


Erasure is certainly a lexical rule (it only applies to specific morphemes,
viz. the second and fifth binyanim), and therefore it would seem that in this case the output of ludling permutation is similarly subject to the same rule. However, there are a number of alternative interpretations which do not require that conversion occur prior to the NL rule. First of all, this ludling is not reported to require conversion before any other lexical rules. It is conceivable, then, that this one rule could be specified as having the ludling component within its domain of application (recall from Chapter 3, section 2.1 that certain NL rules may be assigned to apply within the ludling component). Alternatively, as McCarthy (1986) suggests, it could be that the ludling operation of permutation simply respects the gemination of NL forms (i.e. it merely scrambles root nodes without affecting association lines). This latter approach is incompatible with the analysis of permutation as repeated crossing of association lines presented in Chapter 3 (although, like the latter analysis, it treats ALs as linguistic objects which have an existence independent of the elements they join). However, as this appears to be a marked form of reversal in any case, I will leave open for now the question of whether this is actually a counterexample either to the theory of ludling reversal presented in Chapter 3, or to the otherwise robust generalization that ludling conversion occurs after all lexical phonological rules.

The interactions between ludlings and lexical rules presented in this section are summarized in (13). Because different authors have proposed different numbers of strata within the lexicons of the languages in question, in this diagram I am simply employing a distinction between early lexical strata and late lexical strata. This distinction can be thought of as referring to an imaginary half-way division within the lexicon, i.e. 'early' = strata 1-2 in a four-stratal system like Halle and Mohanan (1985)
for English or Mohanan (1986) for Malayalam, but only stratum 1 for a twoor three-stratal system such as Kiparsky (1982) or Borowsky (1986) for English. (Recall that the vectors in this diagram indicate not the domains of the NL rules in question, but rather the possible domains for luding conversion required by the luding interaction with those rules.)
(13)


English, Segyent-within-Syllable Reversal: Sonorant Resyllabification


### 2.2.2. The Postlexicon

In this section I will examine the location of ludling conversion with respect to three areas of the postlexical component: syntax and intonation, pause insertion and the construction of phonological phrases, and postlexical phonological rules.

### 2.2.2.1. Syntax and Intonation

For a number of ludlings it is quite clear that conversion must take place after words have been assembled into sentences within the syntactic component. For example, a ludling operation may take place across word boundaries (which can only occur in the postlexical component), or a it may treat NL. words differently depending on their position within a sentence.

### 2.2.2.1.1. Application Between Mords

Many ludlings, particularly those of the exchange type, operate across word boundaries. The following examples (some from ludlings discussed in Chapter 3, section 3) illustrate switching of segments between words, and indicate that these ludlings mast apply at least after the syntactic component.
(14) a. Finnish, Siansaksa (Campbell 1981:176-77)
kenkänsg polki 'his shoe kicked (it)' > ponkansa kelki saksalaisia hatyytettiin 'the Germans were attacked" > haksalaisid satuutettion
b. Thai, Khampuan (Surintramont 1973)
paj wád 'attend temple' > pád waj càb hưa 'touch head' > cưa hàb
c. Burmese, VC Exchange (Haas 1969:278)
beyn* hyudev 'to smoke opium' $>$ buhyeyn"der be`gow" $\theta w a \times$ 'go where?' > baxgow" $\theta w e^{x}$
d. Bahnar, UC Exchange (Guilleminet 1960/62:124) if bat ko' po'ma pang di 'I like to talk with him" > at biff ko* po*mo pi dang
e. Hebrew, C Exchange (Yakir 1973:32-3)
eshkoliyot vetapuzim 'grapefruit and oranges' >
eshkoziyot vetapulim
zipor hirbena > hipor zirbena
f. French, Verlan 2 (Sherzer 1976:26-7)
je vois'I see" > ve jois
je te pissais à la raie 'I pissed in your face" > je te sipais à ralaie

An additional example in French Verlan 2 concerns the behaviour of consonants belonging to pronouns and definite articles. These segments are most commonly exchanged only when they have been elided with the following word: l'école 'the school' > qu'élole, $j$ 'entends 'I hear' $>$ t'enjends (Sherzer 1970:25-6). Regardless of whether one regards elision as a postsyntactic phonological rule (cf. Tranel 1981), or as a kind of postlexical allomorphy (Zwicky 1987), it is clear that the consonants of these elided particles can only be exchanged with the following word once they have been placed adjacent to each other in the syntax. ${ }^{\text {a }}$
2.2.2.1.2. Access to Sentence Position

Several ludlings involve what $I$ will call 'serial infixation'. In the English Alfalfa Language, for example, the syllables al, fal, or fa are infixed after each syllable of an NL utterance, in that order starting from the beginning of the sentence (Laycock 1972:69):
(15) better late than never $>$ betalterfal latefa thanal nefalverfa In other words, the choice of infix depends on where in the sentence the NL word occurs. This indicates that ludling conversion must occur after the syntactic component, since the ludling needs to have access to the sentential position of each word in order to determine which infix to use. Exactly the same situation obtains in a Burmese ludling described by Has (1969: 282-3). In this case, an infix is added after the onset of each NL syllable, but the choice of infix alternates across an utterance between -avt- and -e?t- (with the former infix beginning the sequence):
(16) shax yu* 'bring the salt" > sha"tax ye?tu

When individual words are monosyllabic, as in this instance, the only way to select the appropriate infix is by scanning the preceding word in the sequence. Once again, this requires having access to the whole sentence,
indicating that ludling conversion here follows the syntax.
Another way in which ludlings require access to sentence position is in the addition of particles between ludling words. In Sanga, for example, one ludling involves reduplication of each syllable of a NL word, with insertion of na betwen each doubled syllable (Centner 1962:345):
(17) mukwetu twaya ku madimi 'My friend, let's go to the field' >
mumu na kwekwe na tutu na twatwa na yaya na kuku na mama na didi na mimi Notice that na is only added between the ludling words: this indicates that the ludling must know whether a given syllable occurs sentence-finally in order to determine whether to add na. This is only possible once words have been concatenated into sentences in the syntax.

### 2.2.2.1.3. Intonation

Very little information is available concerning luding intonation and its interaction with NL intonation systems. The various segmental reversals of English are among the handful of systems to be described from this standpoint. In general, it appears to be the case that in these ludlings the intonation of ordinary English sentences is preserved and is not affected by the ludling operations. Cowan, Leavitt, Massaro, and Kent (1982:51) note that one speaker "produced a falling, English-like intonation contour across each 'backward' declarative utterance (in which words remained in the original order). Interrogative intonation also was maintained in backward questions." Similarly, Cowan, Braine, and Leavitt (1985:687-88) remark that "sentence-length intonations were never produced in reverse: Most subjects preserved the forward sentence intonation contour, superimposing it on their backward speech." Segment-within-Syllable reversals exhibit the same tendency (ibid., p.690). Since the ludlings in question operate below the word level, however, the preservation of NL
intonation in these cases is consistent with ludling conversion taking place either before or after the assignment of pitch-accents in the NL grammar, and therefore cannot be used to narrow the range of possible conversion sites.

One possible example of ludling conversion taking place prior to NL pitch-accent assignment is provided by the Babibu ludling of Japanese. According to Haraguchi (1982:66), following infixation of -bV-after each NL syllable, ludling phrases are gathered together into intonational groups and undergo the same tonal assignment rules as NL utterances. Assuming that full specification of tones in Japanese occurs postlexically, this would argue for conversion prior to pitch-accent assignment at Level 4 in our model. ${ }^{\text {a }}$

Finally, in the Saramaccan Akoopina 5, ludling utterances are given their own intonation pattern, distinct from the NL system: "whole sentences (or long phrases) have a general falling tone contour; that is, they begin high and descend gradually" (Price and Price 1976:47). Although this is neutral with regard to the location of NL intonation assignment (it could be regarded as either destroying a previously-assigned NL intonation, or precluding a subsequent assignment), it does at least indicate that conversion follows syntax. That is, in order for the ludling to supply its own intonation, it must have access to entire sentences at a time. This is schematized in (18), along with all of the other cases considered in this section.
(18)


Bahnar, UC Exchange: Between vords Burnese, VC Exchange: Betveen vords Finnish, Siansaksa: Between vords French, Verlan 2: Betveen words, after elision Hebrew, C Exchange: Between vords Thai, Khappaas: Between words
|-------------------------------------------------->
Burnese, -a"t-l-e?t- Infixation: Choice of infix English, Alfalfa Larguage: Choice of Infix Sanga, Syllable Redaplication: Insertion of na Saramaccan, Aloopina 5: Ludling-specific intonation


### 2.2.2.2. Pause Insertion and the Construction of Phonological Phrases

Within the elaborated theory of syntax-phonology inter facing developed by Selkirk (1985, 1986), among others, the phonosyntactic subcomponent of the grammar is seen as responsible for mapping phrase-markers from the syntax onto a hierarchy of purely phonological prosodic categories. In addition, pause insertion and other complex adjustments in timing and rhythm take place at the end of this component, which in our model occurs between levels 6 and 7. A number of ludlings evidence conversion prior to this point in the grammar, in that their outputs are incorporated into the phonological hierarchy along with NL words. Still other ludlings evidence conversion after this point, in that they are sensitive to certain prosodic categories and/or phrase boundaries constructed in the phonosyntactic subcomponent. I will examine each of these cases in turn.

### 2.2.2.2.1. Ludling Words

Ludlings can create new word boundaries and add entire words to NL utterances. As McCarthy and Price (1986:75) note, ludlings often separate ML syllables and treat each as a distinct word, assigning it the characteristic prosody of an NL word. In Hebrew -gdV- Infixation, for example, "the tendency [is] to treat each syllable plus the insertions that followed it [as] a word unit and to pause before pronouncing the following syllable. Thus, baboquer [is] pronounced as if it were three words: bagda bogdo quegder" (Vakir 1973:31). This indicates that ludling conversion must take place prior to pause insertion. Similarly, in Tagalog more than one ludling word may be formed out of a single NL word: "two or more baliktád [ludling words] are formed from the original Tagalog word... For example, hindíq 'no, not' > higísdin digí:din and tajhá:liq 'noon' > tagk:day hagkida Iig1: diq, using the infix formula -Vg'́:d- in each case" (Conklin 1956:137). In Burmese, -ay?t- Infixation likewise treats NL syllables as separate words: be"gow" > baypte" gay?tow". Yoruba has two ludlings in which NL syllables act like separate words, -gV - Infixation and -ntiri- Infixation: délé $($ name $)$ ' > dégé légé; soko >óńtì̀̀̀ kóntìì̀̀ (Isp̣la 1982:46-9). In one Hanunoo ludling, the initial CV of each NL syllable is isolated and reduplicated, and treated like a separate word (tag sa then being inserted between the resulting ludling words): rignak 'tame' > riri tag sa nanaq (Conklin 1959:295). A similar case in Sanga was described in the preceding section. Other examples of NL syllables becoming separate words are reported for English and German Chicken Language, German Goose Language, and Spanish -rosa- Infixation in McCarthy and Prince (1986:74); ${ }^{10}$ the same tendency is also observable in Tigrinya -gV- Infixation. All of these examples indicate that the ludling output is subject to pause insertion and the other timing
adjustments attendant to the mapping of sentences onto the prosodic hierarchy.

A particularly interesting example of manipulation of word units is provided by the Ellipsis ludling of Javanese, described in Sadtano (1971:3B). Following truncation of each NL word (probably mapping onto to a single heavy (closed) syllable template), the resulting ludling syllables are regrouped into several new polysyllabic word units:
(19)
a. NL form: aku arep tuku klambi karo sepatu kembaran karo bot jah akeh
b. Truncation: ak ar tuk klam kar sep kem kar bot jak
c. Regrouping: akartuk klamkarsep kemkar botjak

Gloss: 'I want to buy a dress and a pair of shoes which are identical with my friends.'

Again, this indicates that the output of luding conversion is subject to the prosodic identification of word units effected in the phonosyntactic subcomponent. It also indicates that conversion follows the syntactic component, since here syllables from separate words are being recombined into a number of new word units.

A similar phenomenon of regrouping is attested in some Tagalog ludings. In Total Syllable Reversal, for example, separate monosyllabic particles are often treated as belonging to one word for the purposes of a particular ludling operation. The phrase busúg ka na bá 'are you full?' is reversed as sugbú banak'́, i.e. the particles ka 'you', na 'already', and ba '(interrogative)' form a single word in the luding (Conklin 1956:137-8). Similarly, the sequence ...na bá'already?' may be treated as a single word for the purposes of -um- Infixation: the ludling form is numa:baba (with the addition of a final -CVCV suffix, where the consonants are spread from the last specified syllable; cf. bá'(interrogative particle)' > bumásará).

Finally, many ludlings introduce separate words into the utterance, often in the form of a word template which is compounded with an NL word and then subject to segment exchange. This is found, for example, in Finnish Kontti kieli (which adds the word kontti), English Pig Latin (which adds the word (ey), and the various Chinese and Vietnamese secret languages analyzed in Yip (1982) and Zhiming (1988), which add word or syllable templates after each NL word. In all of these cases, the added word needs to be incorporated into the phonological phrases of the languages, demonstrating that conversion occurs prior to level 6. 2.2.2.2.2. Clitic Groups and Phrase Boundaries

The prosodic hierarchy proposed by Hayes (1984) consists of the following categories: word, clitic group, phonological phrase, intonational phrase, and utterance. The clitic group is a well-defined constituent comprising a content word and any adjacent function words (where incorporation of elements into the clitic group may be defined on a language-particular basis). While most ludlings operate strictly on the phonological word, several ludlings appear to take the clitic group as their domain. For example, in Fula there is a luding which transposes the initial syllable and infixes $-g \mathcal{V}$ - after the first and last syllables: bakari '(name)' > transposition $>$ kariba > infixation > kagaribaga (Noye 1971:612). Pronominal clitics and other particles associated with nouns and verbs are always treated as part of a single word in this luding, as the examples in (20) show. (For the status of these clitics as separate words, as opposed to suffixes, see Arnott (1970:140-41) and Noye (1970:7).)
(20) Fula, Transposition $+-g V^{-}$Infixation (Noye 1971)
a. mi waran'I will cone' > wagaranmigi
b. Paccu mo 'leave it' > cugumo?agac
c. paatuuru ma do 'your cat here' > tuugurumadopaaga
d. parewal ma do 'your door here' > regewalmadopaga

This indicates that ludling conversion follows construction of phonological phrases, since it is accessing a prosodic constituent (the clitic group) which only arises at that point in the grammar. ${ }^{2}$

Several other examples of ludlings operating on clitic groups can be found. Another Fula luding infixes -gg- after each syllable and then transposes the initial syllable (nasalization of vowels and other modifications also take place; see section 2.2.3.1): nasara 'white' > infixation > nãjgsãjgrãjg >transposition > sãggrãjgnãjg (Noye 1975:91). As the following form indicates, the genitive clitic 7ay '(1 singular possessive)' is incorporated into the ludling word, although it does not itself receive the infix - $\boldsymbol{y g}^{-:}$sumdu 7an 'house of mine' > infixation > süngdüng 7av > transposition >dũgg?awsügg. This ludling must therefore access two prosodic constituents: the clitic group delimits the domain of transposition, while only syllables of the phonological word receive the infix. In Sanga -shi- Infixation, the ludling operation incorporates into a single word various grammatical particles which according to Coupez (1969:37) belong phonologically with a following full word but are syntactically independent. That is, the domain of the ludling operation is the clitic group: bà: má kó:ngò > bá:shìu:shikó:shingô: (in this case, we know that the particles bà: and súu are not being treated as separate words by the ludling because word-final syllables receive a falling tone and do not take the infix). Finally, in French Verlan 2, consonant exchange across
word boundaries is limited to elements within the clitic group (personal pronouns, definite articles, etc.) (Sherzer 1970:26-7; cf. the examples in (14f) above).

Several ludlings require access to phonological phrases, in that they insert elements only at the ends of pause groups, or only between words within pause groups. For example, in Hanunoo Syllable Reduplication, the particles tag sa are added between words (which consist of reduplicated NL syllables) only within pause groups: phrase final words or words in isolation are not followed by these particles. In addition, -q- is suffixed to words at the ends of pause groups (Conklin 1959:295). This is illustrated in (21): (a) shows a ludling citation form while (b) illustrates an entire sentence ( $\mid$ demarcates pause groups).
(21) Hanunoo, Syllable Reduplication
a. rignuk |'tame' >riri tag sa nunuq |
b. ba:raj | may bu:ja qa:san | sa kanta | katagbuq |
'Perhaps the people we have just met have some areca nuts' > baba tag sa raraq | may bubu tag sa jaga tag sa qaqa tag sa sasaq | sa kaka tag sa tataq | katata tag sa bubuq |

In Yoruba -gV- Infixation, pauses are marked by inserting the syllabic nasal - $\boldsymbol{p}^{-}$- before the ludling syllable which immediately precedes the pause:
(22) Yoruba, -gU- Infixation (Isola 1992:46)
bí mo bá dé $\mid$ mo fẹ́é lo sóko | 'when I return, I want to go to the farm' > bígí mogo bágá déníge | mogo fégé logo s6g6 kongo |

Similarly, in Saramaccan Akoopina 4, a ludling suffix -at is used to mark phrase endings, while in Akoopina 6, the suffix -oto performs the same function (Price and Price 1976:46). These ludlings require conversion after level 7, since they need to access the phonological phrasing constructed
prior to that point.
The diagram in (23) summarizes the conversion points delineated in this
section. (Although the domain between levels 6 and 7 is mnemonically
labelled 'Pause Insertion' in this diagram, it should be kept in mind that
this actually refers to the entire mapping procedure which assigns
hierarchical prosodic constituents to syntactic structures.)
(23)


Burnese, -aypt-lifixation: r's as separate vords Cantonese, la-nj langagee: Separate word teaplate English, Pig Latin: Separate word teaplate Finnish, Kontti kieli: Separate word teaplate fuzhou, la-zi langage: Separate word teaplate Hanunoo, Syllable Reduplication: r's as separate words Hebrev, -gdV-Infixation: r's as separate vords Mandarin, May-ka Language: Separate vord teaplate Mandarin, Hey-ka Language: Separate vord teaplate Sanga, Syllable Redaplication: r's as separate vords Tagalog, - Vgld- lafixation: r's as separate words Taivanese, Ma-sa language: Separate vord teaplate Tigrinya, -glV-Infixation: r's as separate words


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### 2.2.2.3. Postlexical Phonological Rules

The vast majority of ludlings apply before the operation of postlexical phonological rules, which (as we noted earlier) Mohanan (1982) accounted for by placing the ludling component before the entire postlexical phonology. Given the elaborated model of the postlexical component which we now have at our disposal, a much more precise characterization of the location of these rules can be given. In particular, most of the cases considered by Mohanan as well as the examples which I will examine in this section consist of various allophonic, low-level rules-- in other words, rules belonging to the postsyntactic module ('P2 Rules') or later. As such, ludlings whose outputs are subject to such rules provide evidence for conversion prior to Level 7.

### 2.2.2.3.1. Postsyntactic Rules

English Total Segment Reversals occur before a whole host of allophonic phenomena. For example, words which undergo Flapping in the NL phonology are typically reversed with unflapped alveolar stops, suggesting that the ludling has access to the representation prior to the application of this rule: lafy 'ladder' $>$ rodxl, lafz 'latter' $>$ rotal (Cowan, Braine, and Leavitt 1985:687). NL Flapping is blocked by pauses (Mohanan 1986:150); therefore it belongs in the postsyntactic module, and conversion must take place before this level. Similarly, reversal occurs prior to Aspiration, since voiceless stops in luding forms are aspirated (or nonaspirated) depending on their position after reversal: $\rho^{\beta}$ ir 'peer' > rip but dif 'deep' $>p^{\infty} i d$. In addition, "the affrication that occurs in words such as 'tree' did not occur in the reversals, but was added for words such as 'art', whose phonemic reversal includes an initial /tr/ sequence" (Cowan and Leavitt 1981:51-2). There is also some evidence that reversal takes place before the insertion of predictable $\boldsymbol{7}$ before vowels in word-initial position. In
the ludling forms, $?$ is generally allowed in non-initial position and occurs in all sorts of environments prohibited in NL English (see section 2.2.3.1.1 for some examples). However, underlyingly vowel-initial words never show up with a final glottal stop: allənd island' $>$ dənəlal, not *dənalal?; aI 'eye" > al, not *al? (Cowan, Braine, and Leavitt 1985:684). This indicates that ludling reversal cannot follow ?-insertion. The same holds for Segment-within-Syllable Reversals, where e.g. IntalstIy 'interesting" is reversed as nIrətsIyI rather than nIProtsInI, the latter being the expected output if conversion followed ?-Insertion.

Finally, reversal takes place before the postlexical insertion of [ə]. According to Yip (1987:464), "...post-lexically the epenthetic vowel [in Englishl is schwa, as can be seen from the pronunciations of unsyllabifiable foreign words like k[O]vetch, optional insertion of vowel features before sonorants, as in buttn/batton, and fully reduced (and thus featureless) vowels, like alternətive." This also accords with describing such vowels as excrescent, according to the criteria enumerated in Levin (19B7) and discussed previously in Chapter 2, section 3.3.3. The items in (24) illustrate the application of [ə]-Excrescence to the output of ludling reversal. Dptional schwa excrescence is also reported for Total Segment Reversal 1 (Cowan, Braine, and Leavitt 1985).
(24) English, Total Segment Reversal 2 (Cowan and Leavitt 1982)

| Antal ${ }^{\text {p }}$ untiep $>$ alt ${ }^{\text {n }}$ ( | bijand 'beyond" > dzna?ib |
| :---: | :---: |
| ent 'ant' > tane | bold 'bold' > d ${ }^{\text {a }}$ (ob |
| Infent 'infant' > $t^{\boldsymbol{\theta}} \mathrm{nIf} \mathrm{nI}$ | prezant 'present (n.)' > tinezerp |
| tent 'tent' $>t^{*} n \in t$ | pradzekt 'project' > t'kEdz?arp |
| haznt 'hasn't' > $t^{\text {anzem }}$ |  |

Several other ludlings are specifically reported to take place prior to
the rules determining stop allophones in English. The output of Pig Latin may undergo Flapping or Glottalization of word-final stops (?iyt 'eat') 7iyt? 7ey, 7iyd ey; McCarthy and Price 1986:76-7), while it is also subject to the "rules governing aspiration and release of stops" ([tnapr] 'top' > [?ap`tej]; Kaisse and Shaw 1985:7). The Ayb Language in English applies before the aspiration of voiceless stops (which, according to Mohanan (1982:99), only occurs in stressed syllable-initial position): pméyntar 'painter' > paybéyntaybor, not xphaybéyntaytor (ibid., p.89). Finally, in the Brother's Language described in Applegate (1961:192), luding rules which convert fricatives to stops apply before the $N \mathcal{L}$ rules which determine the allophonic realization of those stops.

Another clear instance of ludling conversion taking place no later than Level 7 is provided by the Pa Language of Malayalam, as described by Mohanan (1982:90-1). Infixation of -pa- before each NL syllable occurs prior to the NL rule of Intervocalic Voicing; this rule applies across word boundaries and is blocked by pauses, and so is clearly a rule of the postsyntactic module (Mohanan 1982:78; 1986:65-6, 100). Thus, the ludling form of kuatti 'increased' is pa[g]uu[b]atti and that of kaastam 'excrement' is pa[g]aa[b]astan, with intervocalic voicing of the stops. Ludling conversion also occurs before an NL rule of glide insertion: ulsawas 'festival' > payupalsapanam. In this case, the rule has inserted $y$ between the first pa and the initial a of the ML word. Like Intervocalic Voicing, Glide Insertion in the NL. is blocked by pauses and therefore is assigned to the postsyntactic component (Mohanan 1986:76); again, this argues for conversion before Level 7.

Finnish has a postlexical rule of 'Final Gemination' (FG): some words trigger gemination of the initial consonant of the following word, as
illustrated in (25a) (based on Campbell 1981:161). This can be analyzed as spreading of the initial consonant of the second word onto an empty C-slot at the end of the first word, as shown in (25b).

| (25) a. ota | 'take (imperative 2 nd person sg.)' |
| :--- | :--- |
| otal lasi | 'take the glass' |
| otak kaikki | 'take all of it', |
| ota? 2itse | 'take it yourself!' |


This rule is clearly postlexical, since spreading applies across word boundaries. Moreover, it can also be shown to be postsyntactic. As we will see in section 2.2.3.1, within the postlexical component only postsyntactic rules are free to violate structure preservation by creating novel segment types or sequences. As the last item in (25a) shows, FG has the effect of creating geminate glottal stops when the second word is (underlyingly) vowel-initial. Since the glottal stop (either single or geminate) is not a member of the underlying inventory or lexical alphabet (cf. Mohanan 1986) of Finnish, it follows that this rule is assigned to the postsyntactic module. What is of particular interest to us, however, is the fact that the Kontti kieli ludling of Finnish applies before FG. We know this for two reasons. First of all, the output of the ludling exchange process is subject to spreading: terve 'hello, well' > ludling compounding and exchange >korve tentti ---FG---> korvet tentti. Secondly, the input to the luding cannot already have undergone Final Gemination, as shown in (26). The correct ludling form can only be derived from the NL representation as it appears prior to this rule.

```
(26)
a. NL form: \(\infty\) kiltti --FG---> ook kiltti 'be good!' b. Conversion before FG:
```

input:
compounding with kontti: CU exchange

7-Insertion, FG
c. Conversion after F6:
input:
compounding with kontti: CV exchange, ?-insertion: *kook Pontti koltti kintti

Conversion prior to FG is also found in the Siansaksa ludling: sene sinne > exchange > sine menne --FG--> sinem menne, not *sines menne. Furthermore, both Kontti kieli and Siansaksa ludlings apply before NL vowel harmony: mita 'what' > kontti kieli > kota aintti, saksalaisia hatyytettion 'the Germans were attacked' > siansaksa > hâksalagisia satuctettion (Campbell 1981:158,177). According to Campbell (1981:157), vowel harmony "applies across word boundaries in fast speech", i.e. it is a rule of the postsyntactic component. Although vowel harmony also applies lexically in Finnish, the assignment of this rule to the postsyntactic component sets an upper bound on the location of ludling conversion: in order for the ludling output to undergo vowel harmony, conversion can take place no later than Level 7.

Another example, this time from Tagalog, concerns a rule of nasal place assimilation. The outputs of all ludling operations are subject to a process which assimilates the velar nasal to the place of articulation of a following obstruent (Conklin 1956:139). According to Yap (1970:81), in the NL nasal assimilations "across word boundaries are commonly observed, but
they may or may not take place, depending upon factors like rate of speech, length of pauses betwen words, emphasis, etc." This clearly establishes nasal assimilation as a rule of the postsyntactic component, and indicates that conversion occurs prior to that point. 12

The Thai ludling of Khampuan applies prior to two postsyntactic NL rules, Tone Neutralization (TN) and Vowel Shortening (VS). In NL Thai, syllable-final 7 is optionally deleted in a short unstressed (= nonfinal) syllable, with that syllable then assuming a mid tone (transcribed as a
 'cigarette' --> [burìi] (Surintramont 1973:128-136). Two considerations indicate that the domain of this rule is the postsyntactic module: it is limited to applying in 'rapid' or 'conversational' speech (a hallmark of P2 rules; cf. Kaisse 1985), and it creates forms which violate certain tone/syllable shape co-occurrence restrictions in the language (see section 2.2.3.1.1 for more detailed discussion of these restrictions). As the items in (27) indicate, the correct ludling forms can only be derived by taking the ML words prior to TN as input.

NL
Lubling

|  | Before TN | After TN | Conversion: Before TN |  |
| :--- | :--- | :--- | :--- | :--- | After TN

The ML rule of Vowel Shortening shortens vowels in unstressed (= nonfinal) syllables. Like TN, it applies "in the conversational or rapid style speech" and creates outputs which violate the tonal restrictions on syllable shapes (Surintramont 1973:137-B), indicating that it, too, is a postsyntactic rule. Once again, ludling conversion must take place prior to the application of
this rule:


#### Abstract

(28)


NL
LUDLING

| Before VS | After VS | Conversion: |  |  | Before VS | After US |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| a. knâajsSaj | khâgsamj | 'left | side" | $>$ | kháajsâay | *kháajsậ |
| b. náamchaa | námchaa | 'tea' |  | > | naachaam | *naarhám |

(VS does not itself apply to the output of the ludling because, as Surintramont notes, each syllable in the ludling form is given full stress, and US only targets unstressed syllables).

A final example of ludling conversion taking place before a postsyntactic rule is furnished by the Mandarin May-ka Language. As Yip (1982:640) and Zhiming (1988: 16) point out, the output of the ludling is subject to the regular tone sandhi rules of NL Mandarin. Kaisse (1985) originally hypothesized that tone sandhi in Mandarin was a Pi rule, requiring direct access to the syntax. However, more recent accounts such as Cheng (1987) have shown that a direct-syntax approach is inadequate, while a prosodic domain analysis which accesses purely phonological constituents can handle the facts more successfully (see also Chen 1987). This places tone sandhi in the postsynatctic component, and once again shows that ludling conversion occurs no later than Level 7 in this instance.

### 2.2.2.3.2. P1 or P2 Rules

For a number of NL rules it is not possible to determine their precise location within the grammar beyond the fact that they are postlexical (they may also apply lexically). For ludlings which operate before the application of such rules, this indicates conversion no later than Level 7, while for the few examples of ludlings which operate after such rules, this indicates conversion no earlier than level 6.

In NL Tagalog, all vowels in stressed, nonfinal syllables are
predictably lengthened (Conklin 1956:137). In a number of ludlings, words are given a distinctive stress pattern not found in the NL words: stress is assigned on every second syllable from the beginning of the word. Crucially, the vowels which have been stressed in the ludling component undergo the allophonic lengthening of the NL system (provided they are nonfinal), while vowels which are lengthened in the ML form appear in their short form in the ludling if they happen to fall in a (now) unstressed syllable:
(29) Tagalog (Conklin 1956)
a. tiná:pay 'bread' > tumí:naply (-um- Infixation)
b. saqán 'where' > qumá:nsamá (r reversal, -um-, -Vm- infixes)
c. qak' 'I' > koqá:pandáan ( $\sigma$ reversal, -VpVndVp-infix, - $\quad$ suffix) Similarly, in Total Syllable Reversal, stress is often carried with the moved syllables. If a final stressed syllable in the NL word becomes nonfinal in the luding, it is lengthened (qit' 'this' > to:qi), whereas if a nonfinal stressed syllable in the NL word becomes final in the ludling, it 'reverts' back to its short form (qú:las > lamqu) (Conklin 1956:137). This indicates that conversion occurs prior to the process of vowel lengthening; assuming (plausibly) that this is an allophonic, i.e. postlexical rule, this means no later than Level 7.

Bakwiri False Syllable Reversal occurs before two processes which are arguably postlexical/allophonic, Vowel Nasalization and Glide Insertion. In NL. Bakwiri, vowels are predictably nasalized before prenasalized stops, although not before pure nasals: kốnà 'to take care' vs. kónà 'to pick up', *kốmà (Hombert 1973). Ludling conversion takes place before this process:
 Similarly, underlyingly monosyllabic words with vowel sequences undergo an NL rule which inserts a transitional glide between the two vowels: /tèi//
'small' ---> [tè̀yí], /m̂bóà/ 'village' ---> [m̂bówà ]. False syllable reversal occurs prior to this rule: tè̂̀ > tès, not \#yité; nóà > Dbsà, not *wánb (ibid., pp.229-30) (since these words are monosyllabic, they are unchanged in their luding forms).

In Amharic luding template morphology, at least one form evidences the application of an NL rule of epenthesis: birc'ik'o 'drinking glass' > mapping onto Cay(C)(C)CaC template > bayc'rkzk ---NL Epenthesis---> bayc'zrkek (McCarthy 1985:312). Epenthesis is a postlexical rule, since it applies across word boundaries (as in and găn 'one day' $-\cdots$ andə găn, cf. and anst 'one year) (Hetzron 1964:185). 23

The output of French Verlan 3 is subject to the NL. rules which determine the allophonic realization of schwa and other vowels: $18 /$---> [8] in open syllables, [oe] in closed syllables (Lefkowitz 1987:140, 209), and /e/ ---) [ 6 ] in closed syllables (see Schane 1968:42 for more on 'closed syllable adjustment'). This is illustrated in (30).
(30) French, Verlan 3 (Lefkowitz 1987)

b. $\quad$ Ek 'guy' > epenthesis > $\quad E k \Rightarrow>\sigma$ reversal \& truncation > kə ---> [koem]
c. nike 'fornicate' > $\sigma$ reversal >keni > truncation >ken $-->$ [kEn]
d. bufe 'eat' $>\sigma$ reversal $>$ feba $>$ truncation $>f e b-->[f \in b]$

These rules are presumably postlexical, indicating that Verlan operates prior to Level 7.

Another example of a general allophonic rule applying after ludling conversion concerns the tonally-conditioned vowel alternations of Fuzhou Chinese. According to Yip (1982:646-7), in the La-mi luding i alternates withey just as in the ML. This alternation is but one of a whole series of changes in vowel quality induced by tone changes (Chan 1983). A number of
things point to the postlexical nature of these alternations in the NL. First, they are conditioned by tone sandhi, which itself applies postlexically. Second, the alternation appears to be a purely allophonic phenomenon, having no lexical exceptions (though it is distinguished from a more phonetic, low-level alternation in so-called 'non-alternating' vowels; cf. Chan 1983:23). Finally, native speakers consider pairs such as inss eyjess to be "tonal variations of the same vowel" (Chao 1934:384). In other words, alternating pairs are allophones of the same phoneme, considered identical at the lexical level (=the output of the lexicon; of. Mohanan 1986 for evidence that this level serves as the representation accessed by speakers to determine contrastiveness).

In Cuna Sorsik Sunmakke, transposition operates prior to a rule of epenthesis which inserts $i$ between $r$ and $g: / b i r g a / ~ ' y e a r ' ~--->~[b i r i g a] ~>~$ gabir, not *rigabi. Three things indicate that this vowel is probably excrescent, i.e. inserted postlexically (cf. Levin 1987): 1) it is ignored by other phonological rules, in particular, stress assignment; 2) its insertion is specific to the consonants $r$ and $g$, suggesting a transitional, coarticulatory function; and 3) its insertion is not triggered by unsyllabifiability, since both $r$ and 9 must be fully syllabified in order for transposition to apply (cf. the analysis of transposition in Chapter 3, section 3.2). Assuming, then, that this vowel is inserted postlexically, this argues once again for conversion no later than Level 7.

Finally, as we noted in Chapter 3, the output of Tigrinya -gVInfixation is subject to the NL rule of Spirantization: /mfrak-ka/ 'your (m.5.) calf' > migiragakigikaga $\rightarrow$ migiragaxigixaga. Spirantization is postlexical, since it can apply across word boundaries (7Iti kalbi 'the dog' --> クIti xalbi) (Kenstowicz 1982).

I have found only two examples of ludling conversion taking place after what are ostensibly postlexical rules. In NL Bakwiri, a glottal stop is inserted before vowel-initial words (this is the only environment where it appears in the NL): /ikwa/ 'salt' ---> [?ikwa]. False Syllable Reversal operates after this rule, since the glottal stop shows up in the reversed
 the glottal stop in the luding form cannot be "due to a sequential constraint against vowel sequences in the language since there are words" which permit such sequences: maidza 'blood'. Assuming, then, that 7 insertion is postlexical (i.e. a P1 or P2 rule), this indicates that conversion occurs at least after Level 6.

A second example is provided by the Luganda ludling of Ludikya (false syllable reversal). Ludling forms incorporate the effects of various rules of compensatory lengtening, which according to Clements (1986:53,75) are postlexical (since they apply betwen words): /ba-genda/ 'they are going' -prenasalization and compensatory lengthening---> [bageenda] > false syllable reversal > ndageeba, not *ndageba.

### 2.2.2.3.3. Phonetic Implementation

A number of the postsyntactic rules considered earlier could plausibly be regarded as processes of the phonetic implementation component (e.g. English tr affrication, Malayalam transitional glide insertion, etc.). Beyond these, however, there are two cases which clearly demonstrate that ludling conversion occurs prior to phonetic implementation. The first concerns a process of onset shortening in Malayalam (Mohanan 1982:90-1). Branching onsets in NL Malayalam are phonetically shorter when preceded by by a long vowel, athough still not as short as single consonants (in Malayalam all intervocalic clusters form onsets; cf. Mohanan 1982:102). For
example, the geminate $t$ in kuutti 'increased' is shorter than the geminate in kutti 'child'. Infixation of -pa- occurs prior to this timing adjustment: in the ludling form of 'increased', paguupatti, the geminate $t$ is phonetically longer than in its NL counterpart since (after luding conversion) it no longer follows a long vowel.

Similarly, English segmental reversals occur prior to the articulatory and timing adjustments which are effected in the phonetic implementation component (cf. Cowan and Leavitt 1981:50; Cowan, Braine, and Leavitt 1985:680). A graphic illustration of this is provided by some wordrecognition experiments conducted by Cowan, Leavitt, Massaro, and Kent (1982) in which ludling (reversed) words were recorded and then played backwards to see how closely they matched their NL forms. If ludling conversion took place after phonetic implementation, reversed words would be expected to incorporate the subsegmental sequencing and other phonetic details of the NL words, and ther fore would be predicted to sound exactly like the forward forms when played backwards on the tape recorder. However, when reversed words were played backwards, "they sounded like distorted versions of the original model ", and only $15 \%$ of the words could be correctly identified by a group of seven subjects (ibid., p.51). This is not unexpected, assuming that reversal occurs prior to phonetic implementation. Consider an English word such as tab: as is well known, the primary phonetic cue for the voicing of the final consonant is not the voicing of that consonant itself (it is nearly identical to the final voiceless unaspirated $p$ in tap), but rather the lengthening of the preceding vowel (cf. Ladefoged 1982:48-9). Hhen this word is reversed as bat, the vowel no longer precedes a voiced consonant and therefore is not lengthened. Consequently, this word, when itself played backwards, sounds like tap.

The location of ludling conversion indicated by these two cases is diagrammed in (31), along with a summary of all the other rules considered in this section.
(31)



Tigrinya, -gl- lofixation: Spirantization

Luganda, Ladikya: Coapensatory lengthening

```
<---------------------------------------------------------------------------------------------
English, Iotal Segnent Reversal 1: Phonetic details
English, Total Segrent Reversal 2; Phonetic details
English, Seguedt-within-Syllable Reversal: Phonetic details
Malayalan, Pa Language: Onset Shortening
```



### 2.2.3. General Structural Constraints

In this section I will explore the interaction of ludling conversion with a number of constraints which have been proposed as universal organizing principles within the phonological, morphological, and phonosyntactic components. The principles to be considered are Structure Preservation (SP), the Dbligatory Contour Principle (OCP), Geminate Integrity (GI), the Principle of Morphological Opacity (PMD), and the Principle of the Categorial Invisibility of Function Words (PCI). The domains of these various principles are diagrammed in (32); as can be seen, many of them straddle the lexical/postlexical distinction, and for this reason discussion of their effects on ludlings has been postponed until this section. A fuller account of the locations given in this diagram will be found in each of the following sections.
(32)


### 2.2.3.1. Structare Preservation

Structure Preservation (SP) is a constraint which prevents rules "from creating structures or introducing features that are not used distinctively as part of lexical entries" (Rice 1987). The following definition is taken from Borowsky (1986), who has revised Kiparsky's (1985) original formulation to include reference to higher order prosodic structure in addition to
features.
(33) Structure Preservation (SP)

Lexical rules may not mark features which are non-distinctive, nor create structures which do not conform to the basic prosodic templates of the language (i.e. syllable and foot templates). (Borowsky 1986:289)

I will adopt this revised definition here, because as we shall see, many violations and enforcements of SP in ludlings refer to prosodic structure, in particular to permissable syllable shapes within the language.

Structure Preservation in its classical form is considered to hold only of lexical processes (cf. Kiparsky 1985, Mohanan 1982); hence the well-known property of postlexical rules that they may violate phonotactic constraints, feature co-occurrence restrictions, etc. I will refer to this as Classical Structure Preservation (CSP). Recent work, fueled in part by the richer conception of the postlexical component, has shown that the domain of SP may be more finely tuned to the modularization within each of the lexical and postlexical components. I will refer to this version as Revised Structure Preservation (RSP).

RSP encompasses two modifications to the basic schema of CSP. On the one hand, it appears that violations of SP within the postlexical phonology can in fact only be incurred within the postsyntactic component. For example, Kaisse and Zwicky (1987) note that of the two classes of postlexical rules proposed by Kaisse (1985), P1 and P2 rules, only the latter exhibit the properties typically asociated with non-lexical phonological rules. These include "gradience, ability to create novel segrents, sequences and syllable types, sensitivity to length of constituent and to rate of speech, and sensitivity to location of focused elements and
to pauses" (ibid., p.7; emphasis mine). Recall that P2 rules are assigned to the postsyntactic component. Furthermore, Mohanan (1986:28-9) argues that novel segments cannot be introduced until the postsyntactic module, where 'novel segment' means one other than an underlying segment or a member of the lexical alphabet (=the output of the lexicon). In the same vein, he states that "enhancement features are made available only at the implementational module", where an enhancement feature is defined as "one that is not required to make phonological distinctions at the level of lexical representations" (ibid., p.172). Similarly, rules which create new clusters or violate syllable structure restrictions belong in the implementation module (which can be taken to mean the postsyntactic component in our integrated model, since Mohanan does not differentiate any levels internal to that component) (ibid., pp.175-6). This indicates that SP is operative within the postlexical phonology up to Level 6 (at least within the phonosyntactic subcomponent), 24 but is turned off after that point. (See also Archangeli and Pulleyblank (1986:31) for other examples of postlexical rules which are structure-preserving.)

On the other hand, a number of considerations point to a relaxing of the effect of SP within at least the later strata of the lexical phonology. Borowsky (1986), for example, proposes that SP is turned off at Level 2 of the lexicon (=the word level; she adopts a two-stratal model for English). She argues for this on the basis of the non-structure-preserving (though still lexical) application of rules such as sonorant syllabification, velar nasal assimilation, and coda syllabification. Similarly, Mohanan and Mohanan (1984) and Mohanan (1986) show that a strict version of SP cannot be in effect throughout the lexicon, since lexical rules are able to create a variety of non-underlying segments (to yield what they call the lexical
alphabet).
As the diagram in (34) illustrates, RSP encodes a fundamental symmetry between the lexical and postlexical domains of SP.
a. Classical SP

LEXICON


POSTLEXICON

b. Revised SP

LEXICON

| Early Strata <br> SP in effect <br> late Strata <br> SP turned off <br> Gmanmmuna |
| :---: |
|  |  |
|  |  |

POSTLEXICON


That is, the domain of CSP originally mapped out for the lexical and postlexical components in their entirety is now mirrored within each of them in RSP: early levels are stucture-preserving (P1 rules in the postlexicon, early strata in the lexicon), while later levels are non-structure preserving ( P 2 rules in the postlexicon, late strata within the lexicon). In this way, the fundamental insights of CSP are incorporated into the model with a sensitivity to the more articulated conception of the internal organization of the two primary components of the grammar (lexical and postlexical).

Given this revised view of $S P$, it is possible to develop a more precise
map of potential ludling conversion sites than is possible with CSP. As we noted earlier (and will document more fully in this section), there are both structure-preserving ludlings and structure-violating ludlings. According to the classical conception of SP, a ludling which does not observe SP would be considered to apply simply anywhere after the lexicon, while a ludling which respects SP would apply potentially anywhere before the postlexicon:
(35)


In contrast, RSP places additional restrictions on where conversion could in principle take place. In order to see this, we need to take a closer look at what happens to a luding form when it undergoes an operation which is nonstructure preserving.

Suppose luding conversion occurs somewhere between Levels 1 through 5, i.e. in an area where RSP is not in effect:
(36)


Ludling operations taking place betwen these levels are free to create forms which violate, for example, the phonotactic restrictions of the NL. What happens when the ludling representation (now containing a non-structurepreserving sequence) is returned back to the NL phonology in order to
continue its derivation? There are two possible views of the effect of SP on such ill-formed (from the point of view of the NL) representations, which I will call Point-of-Origin SP (POSP) and Derivational SP (DSP). POSP is formulated in (37)
(37) Point-of-Origin SP (POSP)

Ludling structures are affected by SP only at the point where ludling conversion takes place.

That is, if ludling conversion applies in a structure-preserving domain, impermissable sequences will not be permitted, whereas if conversion occurs in a non-structure-preserving domain, impermissable sequences will be allowed to arise and moreover will not be altered even if the representation is subsequently passed through a domain where SP is in effect. So, for example, if ludling conversion occurs between levels 1-5 and creates a violation of SP, that violation will be allowed to surface even though the representation is later passed through the structure-preserving domain between Levels 5 and 6.

A second hypothesis concerning the effect of SP on ill-formed representations is formulated in (38).
(38) Derivational SP (DSP)

Ludling structures are affected by SP whenever they pass through a domain where SP is in effect.

In this case, violations incurred by ludling conversion between Levels 1 and 5, though emerging from the ludling component unaltered, will be affected by SP when they pass through Levels 5 and 6. Consequently, they will not be allowed to surface. The POSP and the DSP make different predictions regarding where ludling conversion can take place depending on whether the ludling either allows or prohibits forms which violate SP. These predictions
are illustrated in (39).
(39) a. Conversion sites for ludlings whose surface forms violate SP.

b. Conversion sites for ludlings whose surface forms do not violate SP.


I will adopt the DSP for three reasons. First, it provides a more restrictive characterization of where non-structure-preserving ludlings can occur. According to the POSP, a ludling operation which violates SP can take place either between Levels 1 and 5 , or after Level 6. In contrast, the DSP limits ludlings which violate SP to after Level 6. Second, the DSP captures the original intuition of Classical SP that there is a single point in the grammar beyond which SP is no longer relevant. That is, according to the DSP, SP is relevant to ludlings in a continuous domain up to Level 6, after which it has no effect. In contrast, the POSP claims that SP can exert an influence on ludlings in a discontinuous fashion at several points in the grammar, since structure-preserving ludlings may occur either between Levels 0 and 1, or between Levels 5 and 6. Finally, DSP can readily accommodate the repair strategy function of SP which has been invoked in a number of
recent studies. SP in its original conception was hypothesized to have only blocking effects: it prevented illicit structures from being created at the point where they would arise. A number of researchers have subsequently demonstrated that another interpretation of SP is also warranted: it can serve to repair ill-formed structures after they have been created (cf. Rice 1987; Paradis 1988a,b; Borowsky 1986:233) In a number of ludings to be discussed below and in section 2.3.3, we seem to observe this same phenomenon: ludling operations are allowed to create ill-formed sequences; these are subsequently altered at a later point in either the NL or ludling phonology so that they conform to the well-formed representations of the language. This is entirely what the DSP predicts: SP can exert an influence on the ludling representation following the introduction of structural violations. In contrast, POSP claims that SP should only be relevant at the point where such violations might arise. ${ }^{15}$

### 2.2.3.1.1. SP Violations

The SP violations found in ludlings can be grouped into two types: syntagmatic (phonotactic violations) and paradigmatic (novel segment types/features). Many ludings create forms which violate the phonotactic constraints of their NL, producing impermissable consonant or vowel clusters, deviations from canonical syllable shapes, and/or prohibited wordinitial or word-final sequences/segments. Javanese C Exchange, for example, creates a number of sequences which are not allowed in the NL, e.g. wordinitial prenasalized stop+liquid clusters (klambi) pblaki) and au sequences (aku 'I' ) käu) (Sadtano 1971:35; cf. Suharno 1982:6,9 for the illformedness of these sequences in ML Javanese). Moreover, NL Javanese does not allow voiced stops in word-final position (Suharno 1982:6); this restriction is violated by Javanese Total Segment Reversal: botjah 'boy' >
hatjob, dolanan 'play' > nanalod (Sadtano 1971:35). Similarly, no consonant clusters are allowed in word-final position in the NL, yet the ludling is not affected by this restriction: klanbi > ibsalk.

Fula Transposition + -Jg- Infixation results in nasal + stop sequences in syllable-final and word-final position, which are not allowed in the NL (Arnott 1970, McIntosh 1984): håde Ptoday" > ofegghãgg (Noye 1975:91). The Transposition ludling also creates word-final obstruents, which do not occur in NL Fula: nagge 'cow' $>$ genaq (Noye 1971). NL Cantonese has a cooccurrence restriction forbidding syllables with coronals followed by high back vowels, e.g. *t'an. However, the La-mi ludling regularly produces forms which violate this restriction: cin $>\operatorname{lin}$ cun; lin>k'in lun (Yip 1982: 657). Saramaccan Akoopinas 3 and 4 create syllables of the shape VC, which are non-existent in the NL (Price \& Price 1976:45). Kekchi Jerigonza 2 results in forms which have $C\left\{b^{\prime \prime}, s^{3}\right.$ clusters, which are not allowed in the NL (Campbell 1974:276). In NL Buin, the "phoneme /g/ does not occur wordinitially" (Laycock 1969:1). The output of the transposing ludling, however, Can have initial g: kupogui 'he set out' $>$ guikupo; tonugoko 'many things' > gokotona (ibid., p. 15).

Many examples of phonotactic violations can be found in English segment reversels. Some of these were apparent in ludling forms cited earlier in this chapter and in Chapter 3; a more complete catalogue is provided in (40), (41), and (42) (impermissable sequences are underlined in the ludling forms).

## (40) English, Total Segwent Reversal 1: (Cowan, Leavitt, Massaro, and Kent 1982; Cowan, Braine, and Leavitt 1985)

a. Impermissable initial sequences/segments

| gost | $>\mathrm{tsog}$ | 'ghost' |
| :---: | :---: | :---: |
| torn | $>$ nrat | 'turn' |
| $r \mathrm{I} g$ | $>\mathrm{g}^{\text {Ir }} \sim \mathrm{gnIr} \sim \mathrm{ganIr}$ | 'ring' ${ }^{\text {c }}$ |
| and | $>\mathrm{dn} E$ | 'and' |
| k^lt $\int \mathfrak{r} z$ | > $\operatorname{zrut} \int 1 \wedge k$ | 'cultures' |
| gara3 | > zarag | 'garage' |
| 'bold' | $>$ dlob |  |
| 'content' | $>$ tnetnak |  |
| 'project' | > tikGdzarp |  |
| 'spasm ${ }^{\text {P }}$ | > mzxps |  |

b. Impermissable medial sequences
kantrast > tsertnak 'contrast'
c. Impermissable final sequences/segments

| we | > ew | 'weigh' |
| :---: | :---: | :---: |
| juz | > zuij | 'use' |
| Int $\begin{aligned} & \text { Istig }\end{aligned}$ | $>$ gItspatnI | 'interesting' |

(41) English, Total Segsent Reversal 2 (Cowan and Leavitt 1982)
a. Impermissable initial sequences/segments

| ziraks | > | ksa?irz | 'xerox' |
| :---: | :---: | :---: | :---: |
| marz | > | zram | 'Mars' |
| $m \in n z$ | > | 2nEm | 'men's' |
| held | > | dl $E^{n}$ | 'held' |
| 510 | $\rangle$ | $7^{15}$ | 'sing' |

b. Impermissable medial sequences
balalədzi > idzila?alb 'biology'
c. Impermissable final sequences/segments

| hav | $>$ wah | 'how' |
| :--- | :--- | :--- |
| wekfon | $>n \wedge j k z$ | 'action' |

(42) English, Segsent-within-Syllable Reversal (Cowan, Braine, \& Leavitt 1985)
a. Impermissable medial sequences

b. Impermissable final sequences/segments

Intfistly $>$ nIratsIgI 'interesting'
A number of other ludings exhibit syntagmatic SP violations in their outputs. The Sanga false interchange ludling of Kinshingelo, for example, creates CGVC sequences: this violates the surface true generalization of NL Sanga that a vowel following a consonant-glide sequence will always be long (due to a pervasive process of compensatory lengthening) (Coupez 1969:35). Furthermore, two other ludlings of Sanga infix the sequences -pa:ske:- and -zavo: tre-: these violate the phonotactic restrictions of NL Sanga, which allows only nasal+stop consonant sequences within words. In NL Bakwiri, "glottal stops occur only before a vowel in word-initial position" (Hombert 1986:176). In reversed forms, however, ? shows up intervocalically, as we noted earlier. In the Katajjait ludling analyzed in Chapter 3, representations are created which include long and overlong vowels (in some cases vowel qualities may be held over six or more timing units). Such sequences do not occur contrastively in NL Inuktitut. The Mo-pa luding of Kunshan generates syllables consisting of an obstruent followed by a syllabic nasal, which are non-occurring in the NL: $P$ >o (Zhiming 1988:47). Finally, Verlan 3 produces many sequences which violate the phonotactic restrictions of NL. French. Some of these forms are illustrated
in (43).
(43) French, Verlan 3: SP Violations (Lefkowitz 1987)

| bafiol | $>$ | nolba | 'car' |
| :---: | :---: | :---: | :---: |
| lif | $\rangle$ | neli | 'line' |
| etraxze | > | Zeetrã | 'stranger' |
| apartamã | > | t2 mâapar | 'apartment' |
| fikse |  | ksefi~ksef | 'fix' |

For several ludlings, SP violations take the form of structures which are paradigmatically ill-formed: impermissable segment types or feature combinations. In Fula Transposition + -クg- Infixation, for example, vowels are heavily nasalized (Noye 1975:91); NL Fula does not have contrastive nasalization on vowels (Noye 1971). Sanga infixing ludlings introduce a number of segments not found in the NL, such as $r$ and $v$ (Coupez 1969:35). As we noted in section 1.3, a number of different phonation mechanisms may be superimposed on ludling utterances in Hanunoo, among these, barely audible whispering, falsetto, and pulmonic ingressive airstream (Conklin 1959:296). None of these is contrastive in the NL, and the latter two cases are not even used contrastively in any NL. Finally, as we pointed out in Chapter 3, the Katajjait ludling introduces a number of features not found contrastively in NL Inuktitut: voiceless vowels, pulmonic ingressive airstream, and a register tone system.

Assuming the DSP, all of the cases considered in this section necessitate conversion after Level 6.

### 2.2.3.1.2. SP Enforcements

The influence of $5 P$ on ludlings manifests itself in two ways: 1) in some instances, SP may block a ludling process if that process would otherwise create a structure which is ill-formed in the NL phonology;
occasionally, SP will also force a modification in the representation prior to the operation of the ludling in order to avoid a SP violation; or 2) SP may repair an ill-formed structure once it has been created by a luding process; such repairs may be effected by the NL phonology or by a ludlingspecific rule.

Blocking effects of SP are found in the ludlings of Thai, Burmese, and Cantonese. In NL Thai, syllables group into two types: so-called 'live' syllables (open and with a vowel sequence, or closed by a nasal or glide) and 'dead' syllables (single vowel (=[VP]) or closed by a stop). Any of the five tones (high, mid, low, falling, rising) may occur on a live syllable, but a dead syllable can only bear a low, high, or falling tone. The Khampuan ludling of Thai obeys these co-occurrence restrictions (Surintramont 1973: 125-7). Recall from Chapter 3 that there are two versions of Khampuan: in one dialect, tones are reversed along with rimes, in another they are left behind. However, if leaving the tones behind would result in an impermissable tone falling on a dead syllable, the derivation is blocked (i.e. in such cases only the reversed-tone form is allowed). This is illustrated in (44), where L=live syllable, $D=d e a d$ syllable, and unmarked tone=mid.
(44)

NL

$$
\begin{array}{cc}
\text { Khampuan } 1 & \text { Khampuan } 2 \\
\text { (reversed tone) } & \text { (nonreversed tone) }
\end{array}
$$

| a. duu L | nax | 'see movie' | > | dă | nuu | $\underset{L}{\text { daj }}$ | $\underset{\text { nǔu }}{\text { y }}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| b. khàb D | $\underset{D}{\mathrm{r}} \mathrm{~d}$ | 'to drive' | > | $\begin{aligned} & \text { khód } \\ & \text { D } \end{aligned}$ | $\begin{gathered} \text { rà } \\ \mathrm{D} \end{gathered}$ | khòd D | $\begin{gathered} \text { ráb } \\ \text { D } \end{gathered}$ |
| c. purad <br> D | hya $L$ | 'headache' | > | pua | hùad D | *pùa $\mathrm{L}$ | $\begin{gathered} \text { hưad } \\ \text { D } \end{gathered}$ |
| d. wan L | $\operatorname{sùg}_{\mathrm{D}}$ | 'Friday' | > | wùg | $\begin{gathered} \text { san } \\ L \end{gathered}$ | $\underset{\text { D }}{\text { * wrug }}$ | $\begin{gathered} \text { sàn } \\ L \end{gathered}$ |

In Burmese, SP affects ludling derivations in two ways. First, NL.

Burmese prohibits reduced syllables (those with [ ]) in word-final position. VC Exchange respects this restriction, in that reversal is not performed if it would result in a reduced syllable in final position. Accordingly, words such as thomin* 'cooked rice' and kolathayn* 'chair' cannot be reversed (Haas 1969:280). Second, the same ludling observes an NL constraint which prohibits *Cua sequences. 17 Normally, as shown in (45a-b), prevocalic glides are not reversed (i.e. they do not group with the nucleus). However, when a reversal would potentially result in a * Сни sequence, the glide is regrouped with the nucleus and undergoes reversal, as shown in (45c-d). $1=$
(45) Burmese UC Exchange: SP Enforcements


In the Cantonese La-mi luding, SP affects the operation of a ludingspecific rule of dissimilation. This rule changes the second of two i's to u: pin > lin pin > dissimilation > lin pun. NL Cantonese has a co-occurrence restriction forbidding a round vowel from being followed by a labial consonant in the same rime. ${ }^{19}$ The ludling dissimilation rule is blocked when its output would violate this constraint (i.e. in the sequences /im/ and /ip/): $t^{\prime}$ is > lis $t^{\prime}$ in > dissimilation >blocked. This form eventually surfaces as lis $t^{\prime \prime}$ in following the application of another ludling dissimilation process, Labial Dissimilation; crucially, it does not surface as *lis t'un, the form that would be expected if i-Dissimilation had not been blocked by SP (Yip 1982:657-8).

The repair effects of SP are attested in ludlings of Tagalog, Javanese, Hanunoo, and Tigrinya (additional examples in Mandarin will be discussed in
section 2.3.3). In a ludling of Tagalog, metathesis is used as a repair strategy to correct *nu sequences (which are not allowed in the NL) (Conklin 1956:139). As the following form indicates, regular infixation of -umbefore the first vowel of the NL word (along with -Un- infixation before the second vowel) results in an illicit sequence: walag 'none' $>$ *humálamáq. By exchanging the first two consonants, the violation is eliminated: numa:lanag.

In both Javanese and Hanunoo, SP exerts an influence in cluster simplification in ludling forms. As the items in (46a-b) illustrate, one Javanese ludling infixes -s- after the first vowel of the NL word and -sUafter every remaining vowel. If the first syllable is closed, however, the onset of the second syllable is deleted (46c-d). (ng=[ $\eta$ )
(46) Javanese, -5-/-sV- Infixation (Sadtano 1971)

| a. opo | $>0$ osposo | 'do' |
| :--- | :--- | :--- |
| b. ngluyur | $>$ nglusyusur | 'to come' |
| C. parkir | $>$ pasrisir |  |
| d. ngrangkul $>$ ngrasngusul |  |  |

The deletion of the consonant in the latter two cases can be explained as the effect of an NL constraint on word-medial clusters. Although NL Javanese permits sequences of up to three consonants within a word, the last two in such a sequence must be a permissable word-initial onset. As the derivations in (47) illustrate, ludling infixation results in illicit combinations, for Javanese does not allow $r k$ or ngk clusters word-initially (Suharno 1992:7B). These are rectified in the ludling form by deleting the last member. (47)

| a. $N L$ | opo | parkir | ngrangkul |
| :--- | :--- | :--- | :--- |
| b. Infixation | osposo | pasrkisir | ngrasngkusul |
| C. Clustersimplification | -- | pasrisir | ngrasngusul |

In another Javanese ludling, the effect of an NL constraint prohibiting complex segments (prenasalized stops, affricates) in syllable-final position can be seen. This ludling consists of two operations (cf. section 2.2.2.2.1): first, individual words are mapped onto a CVC (closed syllable) template. As shown in (48b), this operation is itself not structurepreserving, since it yields final complex segments. Following truncation, however, separate words are recombined with adjacent words in the ludling string; this is illustrated for two-word sequences in (48c). In contrast to truncation, this operation is structure-preserving: the syllable-final prenasalized stops are simplified by deleting the stop portion of the prenasalized stop. $20 \quad(t, j=[\notin])$
(48) Javanese, Ellipsis (Sadtano 1971)

| a. NL mords | bot jah akeh | klambi karo | kembaran karo |
| :---: | :---: | :---: | :---: |
| b. Truncation | boti ak | klamb ka | kemb ka |
| c. Regrouping | bot jak | klambka | kembka |
| d. Simplification | --- | klamka | kemka |

We know that sequences of nasal+stop are complex segments because they behave as single units with respect to the cluster simplification process detailed above for $-5-/-5 V$ - Infixation. As the items in (49) illustrate, $b$ is not simplified when the infixed $s$ is added, indicating that both the nasal and stop portions are dominated by a single timing unit (on the distributional restrictions for prenasalized stops, cf. Suharno 1982:6,8). (49)

| a. $H L$ | klambi | kembaran |
| :--- | :--- | :--- |
| b. Infixation | klasmbisi | kesmbasarasan |
| c. Cluster simplification | - |  |

If the nasaltstop sequences in these forms were indeed clusters and not prenasalized stops, we would expect the ludling forms *klasmisi and

## *kesmasarasan.

In the Hanunoo language, cluster simplification is also used to repair structural violations incurred by ludlings. The forms in (50) illustrate a ludling which suffixes -y to each NL word. When the word is vowel-final, nothing further happens (50a-b). When the word ends in a consonant, however, that consonant is deleted (50c-d). As M Hanunoo does not allow complex codas, this can be explained simply as the effect of the NL constraint on the ludling output.
(50) Hanunoo, -n Suffixation (Conklin 1959)
a. kanta $>$ kanta
b. bu:ja $>$ bu:gaŋ
c. rignuk $>$ rignug 'tame'
d. bi: jaw $>$ bi:gaŋ 'thick'

Finally, in the preceding chapter we saw that the output of Tigrinya -gVInfixation was subject to a rule of $i$-Delinking which repaired word final iCi sequences, since these are not allowed in the NL. Since this ludling respects SP, a conversion site prior to Level 6 is indicated (assuming the DSP); this is schematized in (51), which also summarizes all of the other SP violations and enforcements (and the conversion sites they require) which have been detailed in this section.
(51)
 Cantonese, La-ni language: SP violations ( $\mathrm{t}+\mathrm{corla}$ la sequences)
Fula, Iransp. + -ge- Infix:: SP violations (final ng sequences, nasalized Vs) fula, Iransposition: SP violations (vord-final obstruents)
Javanese, C Exchange: SP violations (abl, ad sequences)
Javanese, Total Segrent Reversal: SP violations (final voiced Cs, clusters) Kekchi, Jerigonza 2: 5P violations (C\{b, ${ }^{\prime}$ ) sequences) Kunshan, Mo-pa langage: SP violations (obstruent + syllabic nasal sequences) Mandarin, Hey-ka language: SP violations (gVy sequences, ky sequences) Saranaccan, Akoopisa 3: SP violations (VC syllables)
Saranaccan, Akoopina 4: SP violations (VC syllables)


Hanunoo, -n Saffixation: SP enforcements (*coaplex codas)
Javanese, -5-/-sV-Infixation: SP enforcenents ( ${ }^{(4 C C C}$ clusters)
Javanese, Ellipsis (regrouping): SP enforceaents (*r-final conplex segaents)

Thai, Khaspaan: SP enforceaents (syllable/tone co-occurrence restrictions)
Tigrinya, -gV-Infixation: SP enforcenents ( P iCill sequences)


### 2.2.3.2. The Obligatory Contour Principle and Gesinate Integrity

The Obligatory Contour Principle (OCP) and Geminate Integrity (GI) are two representational constraints which are generally considered to hold at all levels of the phonology. (GI will be used as a cover term for the various principles which have been proposed to account for the fact that true geminates cannot be split, e.g. Hayes' (1986b) Linking Constraint, Levin's (1985) Condition on Structure Dependent Rules, Schein and Steriade's (1986) Uniform Applicability Condition, etc.) With the more precise delineation of the organization of the postlexical component that we have been using, however, it is possible to provide a somewhat more specific characterization of their domains. Certainly the OCP and GI hold within the lexical phonology. Within the postlexical phonology, however, there is some evidence that these principles might be inoperative-- or at least relaxed-in the postsyntactic component. In the phonetic implementation component, for example, we can safely assume that both the DCP and GI are irrelevant. Following the proposal of Mohanan (1986), I assume that in this domain hierarchical structures are destroyed and segmental boundaries dissolved as overlapping articulatory gestures and timing adjustments are implemented. Since the OCP and GI depend crucially on the intactness of the geometries of nonlinear representations (single vs. doubly-linked geminates) as well as the distinctness of segments (to determine if there are one vs. two adjacent identical melodic elements), it follows that neither could be effective when phonetic implementation takes place.

There is also some evidence that the OCP and/or GI may be weakened even within the pre-phonetic implementation component of the postysyntactic module, i.e. between Levels 7 and 8 in our model. McCarthy (1986:249-53), for example, draws attention to a number of rules in several languages which
apparently are not subject to the antigemination blocking effects of the OCP or to GI. Although McCarthy classifies these rules as processes of phonetic implementation, many of the characteristics which they exhibit are also consistent with rules of the P2 type, i.e. phonological postsyntactic processes. Among the characteristics which he enumerates are gradience, variability, dependence on rate of speech, non-structure preserving effects, and lack of interaction with the phonology-- all hallmarks of rules assigned to the domain between Levels 7 and 8. It is understandable that McCarthy might classify these as phonetic implementation rules, simply because the model of the postlexical phonology-~ particularly the finer distinctions between modules within the postsyntactic domain-- had not been sufficiently elaborated. In our model, however, such characteristics are not confined only to the final component of the postsyntactic derivation, and it is reasonable to consider that violation of certain structural constraints may be a general trait of the phonology after Level 7.

Levin (1987) offers a somewhat different perspective on the relevance of the OCP and GI to late postlexical rules. Recognizing that processes of excrescence often seem to violate GI and/or the GCP, she proposes that all representational constraints are turned off at a well-defined point in the postlexical derivation. Since excrescence involves insertion of a vowel whose quality is not specified through redundancy rules, she hypothesizes that at the point in a language where redundancy rules are no longer. applicable, structural constraints on phonological representations (comprising at least the DCP and GI) also cease to be operative (her 'Parallel Rule Structure Hypothesis'). As we noted in Chapter 2, it is reasonable to regard excrescence as a phenomenon of the postsyntactic module; Levin's proposal entails, then, that between Levels 7 and 8 it is
possible for the OCP and GI to be violated.
I will therefore consider the OCP and GI to be in full force up through Level 7 and no longer in effect after Level 8; between those levels, one or the other or both of these representational constraints may be inoperative. This is illustrated in (52). The precise characterization of the behaviour of these constraints in the postsyntactic module can be viewed in two ways: as a complete turning-off which varies as to its precise location on a language-particular basis (as Levin proposes), or as a more general weakening of the constraints which pervades the entire module and is shared by all languages. I will leave open for now the question of which of these is the proper characterization.
(52)

The mapping of the boundaries of the OCP and GI is relevant to our discussion because there are a number of ludings which provide clear evidence for either the violation or enforcement of these constraints. With regard to the OCP, three cases considered in Chapter 2 indicate that this principle is operative within the luding phonology. In the Katajjait luding, we saw that the OCP blocked the insertion of [-vce] on ludling templates when this would result in two adjacent slots with the same specification. In Tigrinya -gV- Infixation, the OCP enforced the merger of a floating segment with the prespecified portion of the luding infix. Moreover, tautomorphemic geminates in NL words could not be split by epenthesis in the ludling component, indicating that GI was in effect at the time when ludling conversion occured. Finally, Fula C Exchange showed
evidence of the operation of the OCP in merging two identical melodic segments which became adjacent following movement (uncrossing). All of these cases argue for a conversion site before Level 8, and possibly before Level 7.

A number of ludings violate GI by infixing elements within geminates. In the Swedish RBvarspraket ludling described in Chapter 3, section 2.3.3, -oC- is inserted after every consonant: det > dodetot, bra >bobrora (Seppanen 1982:31). If the NL word contains a geminate, it is split by the infix: att > atottot; kunna > kokunonnona. In Estonian, -pi- is infixed after the first CV of the ML word: laulus 'in the song (inessive sg.)' > lapialus. If the first syllable contains a long vowel, the infix is added after the first $V$-slot, spliting the geminate and transferring the length to the infixed syllable: sata 'send!' > sapiida (Lehiste 1985:491). Finally, in the Finnish Her Language, the sequence her is inserted after every syllable: suowen > suohermenher. Dnce again, geminate consonants are split by this infixing process: hyvalle > hyhervalherleher (Seppanen 1982:7). These cases indicate a conversion site somewhere after Level 7, as diagrammed in (53).
(53)

 Inuktitut, Ratajjait: OCP enforcesents (feature insertion) Tigrinya, -gV-lofixation: OCP/6I enforcenents (floating g, ludling epenthesis)


### 2.2.3.3. The Principle of Norphological Opacity

In ordinary languages, one rarely finds examples of entire morphemes dropping out of the representation, or of essential information being deleted or suppressed. In ludling systems, in contrast, such phenomena are commonplace. What can account for this difference? It could be that this is simply a reflection of the general non-structure-preserving tendencies of ludlings. However, it is possible to point to a more specific NL principle which is violated by ludlings when they induce the destruction of NL information. According to Yip (1982:646), "McCarthy [1982] has suggested that there exists a 'functional principle of morphological opacity" which blocks deletion of information-- a kind of recoverability principle." McCarthy invokes this principle to prevent segments belonging to root morphemes from being lost when consonantal melodies are mapped onto templates in the NL nonconcatenative morphologies of Arabic and Gta?.

I will refer to this as the 'Principle of Morphological Opacity' (PMD) and hypothesize that ludings which allow NL information to be lost are not constrained by this principle. Of course, in one sense all ludlings entail a loss of information, since by their very nature they strive for unintelligibility (as pointed out by, for example, Yip (1982) and Sherzer (1982)). However, unintelligibility can be achieved in a number of different ways, and it is possible to make a principled distinction between the deletion of information as opposed to the obscuring of information. Many ludlings disguise NL forms without necessarily eliminating any segments, syllables, morphemes, etc. from the representation-infixing ludlings, for example, simply add elements to the representation while reversing ludlings rearrange them, and typically in each case all the basic elements of the NL word are still present in the ludling output. I would suggest that such
ludlings are in conformity with the PMD. On the other hand, some ludlings perform wholesale deletions of segments or syllables which are not phonologically-induced, and these would appear to constitute canonical cases of unrecoverable destruction of information, unconstrained by the PMO.

I will consider the PMO to be in force only during the phonological and morphological operations of the lexicon, i.e. up through Level 2. After that, it seems not to be an overriding principle of the grammar: Plane Conflation, for example, is (by definition) destructive of morphological information, while postlexical processes such as cliticization, reduction, etc. often result in significant chunks of phonological material dropping out of the representation in ways that would not be sanctioned, were the PMO in full force. Accordingly, I consider ludlings which invalve deletion of extensive amounts of M. material to take place after Level 2. In this section I will survey three manifestations of ludling operations which. violate the PMD: creation of homophonous forms, truncation/morpheme deletion, and segment/tone loss.

### 2.2.3.3.1. Homophony

A graphic illustration of the loss of information accomplished by some ludlings is the fact that ludling operations often create homophones out of words which are distinct in the NL. This is illustrated in (54) for three languages: Amharic, Kekchi, and French.
(54) Ludling Homophony
a. Amharic, Cay(C)(C)CəC Template (Bender and Teshome Demisse 1985)
birr 'dollar' $>$ bayror
bərr 'door' $>$ bayrər
bira 'beer', $>$ bayrar
b. Kekchi, Jerigonza (Campbell 1974)

```
    tu:l 'witch' > tupul
    tul 'banana' > tupul
c. French, Verlan 3 (Lefkowitz 19B7)
pãs 'think' > sap
pis 'piss' > s0p
pas 'pass' > sop
pds 'lesbian' > sop
```

In the Amharic case, homophony results because only consonantal melodies are mapped onto the ludling template, while in kekchi it is a result of a process of vowel shortening in the ludling. In French Verlan 3, words are optionally subject to a process of truncation following $\theta$-epenthesis and syllable reversal: pas $>\partial$-epenthesis $>p a s \partial>$ syllable reversal $>s \partial p a>$ truncation $>\operatorname{sep}$. As the items in (54c) show, this has the effect of eliminating the original vowel contrasts in a number of words. 21

Another graphic illustration of loss of information in Verlan is provided by the phenomenon which Lefkowitz (1987:46) calls 'reverlanization'. NL words which have been 'verlanized', i.e. subject to the ludling operations of reversal (along with epenthesis and truncation), are often adopted into the NL lexicon and after a period of time become regular words of French. This is the case, for example, with the word baer, which is originally the ludling form for NL French arab 'Arab' but which now is also an NL term for 'Arab'. When a verlanized word is adopted into the N, the ludling is then forced to come up with a new disguised form for the same item. Quite often, this is accomplished by reapplying the ludling reversal processes to the original verlanized form, hence 'reverlanization'. As the items in (55) illustrate, because a significant amount of information
is lost each time the ludling operations apply, the reverlanized form is never the same as its original NL form.
(55) French, Reverlanization (Lefkowitz 1987)

|  | NL | Verlanized |  |  | Reverlanized | Gloss |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| a. | arab | $>$ | boer | > | roeb | 'Arab' |
| b. | fan | $>$ | ตLC f | $>$ | fcemb | 'woman' |
| C. | flik | $>$ | koef | $>$ | foek | $' \operatorname{cop}{ }^{\prime}$ |
| d. | $\frac{1}{2} y^{\prime} \mathrm{f}$ | $>$ | foek | $>$ | zoef | 'Jew' |

If no loss of information were involved, the NL and reverlanized forms would be identical.

### 2.2.3.3.2. Truncation and Morpheme Deletion

Processes of truncation are commonplace in ludlings; in NL systems they are considerably rarer, and are often involved in the derivation of specialized vocabularies (nicknames, expressive speech, etc.; see McCarthy and Prince 1986 for some examples). Two truncation ludings are reported for Finnish. In the Aiverinkieli ludling, each word is truncated after the first vowel and the suffix -Vyer is added: kanssani>kaaver (Anttila 1975;

Campbell 1981; Seppanen 1982). The Mullika ludling drops all segments after the first CV of an NL word and adds -IIi: kanssani>kalli (Campbell 1981). Hanunoo also has a number of truncation ludlings. One involves mapping each NL word onto the template qayCUC, so that all non-initial syllables are lost (along with vowel length in the initial syllable): rignak 'tame' > qayrig; bi:jaн 'nick" > qaybiy; sa > gaysa (Conklin 1959:295). Another ludling maps polysyllabic words onto templates of the form CUnsin or CVnsumayb, again resulting in a loss of non-initial syllables and vowel length. For examples of a truncating ludling in Javanese, see the discussion in section 2.2.2.2.1.

Finally, in a ludling used as a form of poetic speech in Buin, only the first two or last two syllables of an NL word are retained: the remainder is truncated, and one of a series of suffixes is added (in these examples the portion of the AL word which is retained has been underlined): kugunia '(male name)' > niakoto; migiti 'type of onu shell money' > mitigai; tirasai 'small bat species' > tirauto. In a few cases, the first two syllables are reduplicated and the remainder of the word is lost (no suffix is added): iogai 'palpal species' > ioio; kamuai '(male name)' > kamukamu (Laycock 1969:11). As Laycock states, "it will be readily apparent that the poetic vocabulary carries less information than the underlying forms, in that it is not usually possible, given the transformed poetic word, to be sure what the original word was" (p.13).

Cases of whole morpheme deletion were cited earlier in section 2.2.1.2, in which affixes are lost in the ludlings of Aaharic and Hanurnoo. Another example is provided by French Verlan 1, in which function words are commonly eliminated entirely from the ludling utterance prior to processes of syllable reversal and $C$ exchange (Sherzer 1970:25). All of these cases indicate conversion after Level 2, where the PMD is no longer in effect.

### 2.2.3.3.3. Segrent/Tone Loss

Less drastic deletions than truncation are also attested in ludings, involving systematic elimination of selected segments and/or tones within NL words for no apparent (phonological) reason. In Fula -lfir-Infixation, for example, all $N L$ segments except the initial $C V(V)$ and the final (V)V(C) are lost: yejjiti 'forgotten' > yelfiri; kuacen 'let's return' > kuulfiren; mako 'of him' > malfiro (Noye 1975:86-7). In another Fula ludling, wordfinal consonants are deleted following transposition and -ntUna- infixation: baalte 'morning' > transposition >tebaal >infixation >tentenabaal >c-
deletion > tentenabaa (ibid., pp.90-1). Dne Buin ludling involves deletion of stops between identical vowels (along with other modifications in some cases): kagatokui > kaatokui; topokarei > tookarei (Laycock 1975: 135).

In a number of Sanga infixing ludlings, the original tone patterns of NL words are lost, being replaced by a number of ludling-specific tone sequences: infixation of -shi- causes each preceding syllable to become lowtoned, insertion of -passke:- before the final syllable causes all preceding NL syllables to become low-toned, while the infix -zavostre- results in the immediately preceding syllable becoming high-toned and all other syllables becoming low-toned (Coupez 1969:35). All of these cases can probably be analyzed as the spreading of tones from the ludling infix onto NL syllables, delinking the tones already there. In a Taiwanese exchange ludling described in Yip (1982:641), tones of NL words are lost entirely (replaced by a uniform sequence on the ludling forms), while in Saramaccan Akoopina 1, reduplication of NL syllables plus infixation of -IUIV- is accompanied by deletion of NL tones (along with loss of vowel length and other modifications) (Price and Price 1976:41).

Other examples of ML segment 1055 were described in section 1.4 for V/C-replacement ludlings. All of these cases violate the PMO, and indicate a conversion site after Level 2. This is diagrammed in (56), which also summarizes the other cases considered in this section.

## (56)



> Aaharic, Cay(C)(C)CoC Teaplate: PMO violations (vovels and affixes lost) Buin, Poetic Speech: PMO violations (truncation) Finnish, Aiverinkieli: PHO violations (truncation) Finnish, Mallika: PMO violations (truncation) French, Verlan 1: PMD violations (FHs deleted)
> French, Verlan 3: PMO violations (truncation)
> Hanunoo, gayCUC Tenplate: PMO violations (truncation, affixes lost)
> Hanunoo, CUnsin/CUnsumay leaplates: PMO violations (truncation) Javanese, Ellipsis: PMO violations (truncation) Kekchi, Jerigonza: PMO violations (V shortening)

Buin, Dog Speech: PMD violations (C deletion) Fula, -Ifir-Infixation: PHO violations (segeent loss) Fula, Transposition + -atUna-: PMO violations (C deletion) Sanga, -shi- lafixation: PMo violations (tone loss) Sanga, -paske:- Infixation: PMO violations (tone loss) Sanga, -zavo:tre- lafixation: PMO violations (tone loss) Saramaccan, Akoopina 1: PHO violations (tone loss) Taivanese, Ha-sa Langage: PMO violations (tone loss)

Cantonese, $V$ Replacesent: PMO violations (V5 replaced by a) Chaga, ( Replacerent: PMO violations (Cs replaced by k/r/j) Chiabu, C Replacesent: PHO violations (Cs replaced by 7 ) Cuna, V Replacesent: PMO violations (Vs replaced by i) Dutch, $V$ Replacesent: PHO violations (Vs replaced by edj) English, 8arracada Langage: PMO violations (initial Cs replaced by b) English, Brother's Langaage: PMD violations (Cs replaced by 7) Hebrev, U Replacesent: PMO violations (Vs replaced by a) Urdu, $C$ Replacesent: PMO violations (initial C5 replaced by b/p/k/a/r) Kua, C Replacenent: PMO violations (Cs replaced by ?)

### 2.2.3.4. The Principle of the Categorial Invisibility of Function Mords

In a number of ludlings, function words (FWs) are systematically exempt from ludling operations (i.e. they surface in their NL forms in a ludling utterance). The most explicit accounts of the differential application of ludling processes to various categories of words are provided by Sherzer (1970:32-4) and Lefkowitz (1987:179,181,184) for French Verlan. In Verlan 1 and 2, only major or content words (nouns, verbs, adjectives, adverbs)
undergo reversal, while articles, prepositions, object pronouns, emphatic pronouns, and the negative particle pas are ignored; variation exists for subject pronouns, possessive pronouns, and demonstrative adjectives. In Verlan 3, the same content words are reported to be affected, while most pronouns, prepositions, articles, and the negative particle ne are not; variation is present for disjunctive pronouns and pas. Ignoring of FWs has also been reported for Saramaccan Akoopinas 3, 4, and 5 (Price and Price 1976:45). In Fula Transposition + - 79 -, FWs such as conjunctions, pronominal subjects, and same adverbials like don 'here' are exempt (Naye 1975:91), while in the Japanese Nosanosa language briefly described in Otsikrev (1963:7), grammatical particles such as wa and ga do not undergo ludling conversion.

In principle, it is possible to provide an account of the exemption of FWs no matter where ludling conversion is assumed to take place. Within the lexicon, for example, it has been suggested that only major lexical categories are made available to the morphological and phonological processes; see Kaisse and Shaw (1985:9) for some discussion. If this is a viable cross-linguistic generalization (and, as these authors point out, it is not clear that it is), then ludling conversion within the lexicon would automatically overlook FWs. Similarly, within the early levels of the postlexical phonology (pre-Level 7), it might be possible to access a syntactic differentiation between major and minor class words (see, for example, Abney (1985) for one recent characterization of this distnction and its relevance within the syntax). Finally, within the postsyntactic component, one could access the characteristic prosodic and/or phonological properties of $F W$ : unstressed, often monosyllabic, and frequently incorporated into the prosodic domains of other (content) words.

A preferable approach is to exploit a principle of NL phonology which has been independently proposed by Selkirk (1984) to account for a range of exceptional behaviours exhibited by FWs. Selkirk notes that FWs (comprising, under her account, elements such as prepositions, determiners, conjunctions, personal pronouns, modals, auxiliary verbs, etc.) are systematically exempt from a number of processes which are localized within the phonosyntactic subcomponent. Among these are the addition of a word-final silent demibeat (which otherwise applies uniformly to all words), and the acquisition of a third-level main word stress. She hypothesizes that "these and other ways in which function words are not treated like 'real' words in the grammar are to be attributed to a single principle, the Principle of the Categorial Invisibility of Function Hords (PCI)" (pp.336-7), which essentially makes FWs invisible to rules within this component by erasing their categorial labels. Although Selkirk invokes the PCI primarily in the context of the mapping of syntactic structures onto prosodic units, it is striking that the exemption of FWs which this principle yields is exactly what appears to occur in the ludlings cited above.

Accordingly, I will assume that the failure of FWs to be affected by ludling operations is to be attributed to the influence of the PCI. As the PCI is only available within the phonosyntactic subcomponent, it follows that ludlings which take advantage of this principle require conversion at some point between Levels 5 and 7, as diagrammed in (57). I assume, though, that a ludling may choose not to exploit the PCI even if its conversion site is within the phonosyntatctic component. Thus, (57) illustrates only those ludlings which, by their positive incorporation of the PCI, require conversion at the levels indicated.
(57)


French, Verlan 1: PCI effects (FH5 ignored) French, Verlan 2: PCI effects ( $\mathrm{FH}_{5}$ ignored) French, Verlad 3: PCI effects (FWs ignored) Fula, Iransposition + -gg-: PCI effects (FHs ignored) Japanese, Mosanosa Language: PCI effects (FWs ignored) Saramaccan, Aloopina 3: PCI effects (FWs ignored) Saranaccan, Aloopina 4: PCI effects (FWs ignored) Saranactan, Akoopina 5: PCI effects (FWs ignored)

### 2.2.4. Summary

In this section $I$ have tested a significant number of ludlings against a full range of derivational checkpoints as well as against several wideranging structural constraints within the grammar. In this way, it has been possible to elucidate the potential domains of ludling conversion in a much more systematic and comprehensive fashion than earlier attempts to address this question could. The pirture which emerges is considerably richer than previous authors' proposals would suggest. As the table in (58) indicates, for many of the derivational checkpoints considered, both ludlings whose conversion precedes and ludings whose conversion follows a given location within the grammar can be found. ('*' indicates that no example of a given conversion location is attested, disregarding the questionable cases considered earlier, while '---' indicates that there is no relevant evidence one way or the other.)
(58) Summary of Derivational Checkpoints

|  | BEFORE | AFTER |
| :---: | :---: | :---: |
| a. Morphological Operations | * | French, Verlag 3 |
| b. Lexical Phonological Rules | * | English, Ayb Language |
| c. Plane Conflation | Tigrinya, -gV- lofixation | Horoccan Arabic, Pernutation 2 |
| d. Syntax | --- | Javanese, Ellipsis |
| e. Intonation | Japanese, Babibu Language | --- |
| f. Pause Insertion | Hebrev, -gdl- Infixation | Yoruba, -gll-Infixation |
| g. Postlexical Phonological Rules | Thai, Khaspuas | Luganda, Luditya |
| h. Phonetic Iapleaentation | Malayalan, Pa Language | \# |
| The patterning of ludlings with respect to the structural constraints |  |  |
| considered in this section | is summarized in (59) |  |
| (59) Summary of Structural Constraints |  |  |
|  | ENFORCEMENTS | VIOLATIONS |
| d. Structure Preservation | Buraese, VC Exchange | English, Iotal Segrent Reversal |
| b. Obligatory Contour Principle | Fula, C Exchange | --- |
| c. Geainate Integrity | Tigrinya, -g ${ }^{\text {V- }}$ Infixation | Finnish, Mer language |
| d. Principle of Morphological Opacity | --- | Hanunoo, gayCUC Teaplate |
| e. PCI | French, Verlan 3 | --- |
| In the following section I will piece together these diverse forms of |  |  |
| evidence and develop a detai | iled model of the lu | component. |

### 2.3. A Model of the Ludling Component

Superficially, the distribution of conversion sites indicated by each type of evidence considered in the previous section is quite chaotic: in some cases a fairly late conversion point seems to be required (e.g. for structure-violating ludlings) while in other cases a fairly early location appears to be warranted (e.g. for ludlings which access a limited amount of morphological information). In many instances it appears that several different levels of representation are relevant to the conversion process. These apparent conflicts regarding conversion locations are not readily countenanced by previous models of the ludling component which posit a single conversion location (e.g. Mohanan 1982), and a number of alternative hypotheses concerning the nature of the relationship between the NL and ludling phonologies need to be entertained. At one extreme is the hypothesis that there is no consistent conversion location or locations utilized by all languages. Under this view, conversion at potentially any level of representation would be possible, with languages essentially free to choose from among the eight or so well-defined levels of the phonological derivation which we have been using in our model. Alternatively, a much more restrictive hypothesis is that there is only a limited number of sites within the grammar where conversion can take place. Under this view, the ludling component is hypothesized to consist of two or three discrete modules, each taking a different level of representation as its input.

When the different types of evidence are examined on a language-bylanguage basis, a number of patterns in the ludling/NL interface emerge, indicating that the latter hypothesis is indeed the correct one. In this section I will examine these patterns in detail, and propose a tri-modular model of the ludling component.

### 2.3.1. Characteristics of the NL/Ludling Inter face

Far from being random or idiosyncratic, the relationship of the ludling conversion process to the NL phonology is in fact highly structured and relatively invariant across languages. A number of general characteristics of this relationship may be identified.

### 2.3.1.1. Continuity

The ludling/NL interface exhibits continuity, in that no aspect of the NL phonology may be by-passed once ludling conversion is initiated. In the overwhelming majority of cases, the phonological representation is returned to the NL system at precisely the point where it was taken in order for the ludling operations to apply. For example, we never find an instance of a ludling which requires conversion before certain postlexical rules but whose output then fails to undergo those rules. Such a luding would be discontinuous, in that it would require a sector of the NL phonology to be skipped. Rather, what we find is the pattern exemplified by Finnish Siansaksa and its interaction with the NL rule of Final Gemination: the input to the ludling cannot already have undergone this rule, but neither can the output escape the effect of this rule (see section 2.2.2.3.1). 2.3.1.2. Consistency

The NL/ludling interface is consistent: if a given ludling applies after Rule $X$ of the $N L$ phonology, it will also apply after all other rules which either precede Rule $X$ in the NL phonology or are located at the same level as Rule $X$; similarly, if a given ludling applies before Rule $Y$ of the NL phonology, it will apply before all rules which occupy the same or later levels as Rule $Y$. For example, no ludling applies after some lexical rules but not others. English segmental reversals follow the operation of not just Trisyllabic Shortening, but also Palatalization, stress rules, and

Sonorant Resyllabification. The same ludlings precede not the single postsyntactic rule of Flapping, but all postsyntactic processes of English such as Aspiration, tr affrication, ?-insertion, $\partial$-excrescence, and the operations of phonetic implementation.

### 2.3.1.3. Unidirectionality

The NL/luding interface is by and large unidirectional: an NL rule cannot apply to both the input and the output of a ludling operation, nor can the output of a ludling undergo a rule which precedes the point at which ludling conversion takes place. For example, the input to the Malayalam Pa Language undergoes the rule of Vowel Sandhi, but the ludling output is not then subject to the effects of that same rule. Similarly, no ludling which takes place between words (i.e. following the syntax) requires conversion before any lexical rules.

One exception to unidirectionality in ludling conversion concerns the interface with the construction of phonological phrases: a number of ludling operations which follow or are sensitive to the output of the phonosyntactic component must themselves undergo the effects of pause insertion. This will be discussed in more detail in section 2.3.2.3.

### 2.3.1.4. Nonperipherality

The NL/ludling interface is nonperipheral, in that no ludling requires conversion earlier than Level 2 or later than Level 7. In other words, neither underlying nor surface representations are accessed by the ludling component; moreover, conversion is neither as deep as any of the strata within the lexicon, nor as shallow as anywhere within the postsyntactic component. 22

### 2.3.1.5. Uniformity

With a few exceptions, ludling conversion sites are uniforv: one and only one location is possible for a given ludling. In a number of cases, of course, there is not enough evidence available to narrow down a specific location, but where there is sufficient evidence, we never find examples of conflicting conversion domains requiring a unitary ludling operation to take place at multiple levels of the grammar. When conversion before or after a number of different points in the NL grammar is indicated, such evidence always converges on a unique location for that ludling. Apparent exceptions to uniformity fall into several well-defined patterns which follow from the architecture of the model I propose (i.e. in each case these are shown to be examples of ludlings or ludling dialects which utilize more than one module within the ludling component); see section 2.3 .3 for a full discussion.

### 2.3.1.6. Finiteness

The NL/ludling interface is finite, in that conversion is only possible at a limited number of sites within the grammar. In particular, it appears that only three conversion locations are ever utilized: one at the end of the lexicon, one following the syntax, and one at the end of the phonosyntactic subcomponent. These will be detailed in the next section.

### 2.3.2. The Three Modules

The model of the ludling component which I propose is given in (60), with representative ludlings in each module. In this section I will examine the evidence for setting up each of the three modules within this component.


### 2.3.2.1. Level 2

A number of ludlings provide clear evidence for conversion at Level 2. In Tigrinya, for example, a whole range of factors points to this as the site of ludling conversion. The diagram in (61) summarizes the conversion domains for -gV- Infixation which were presented in section 2.2. Only Module 1 is consistent with all of these locations (the areas of overlap are shaded in on each vector).
(61) Tigrinya, -gU- Infixation


Conversion prior to Plane Conflation means that epenthesis in heteromorphemic geminates will be possible, although the OCP and GI are still in force, so that tautomorphemic geminates will not be split. Conversion follows all morphological processes but precedes the entire postlexicon, so that NL rules like spirantization and insertion of pauses around NL syllables can apply to the ludling output. Finally, conversion
precedes the structure-preserving domain between 1 evels 5 and 6, and therefore the ludling output is subject to the NL constraint prohibiting iCif sequences.

The same conversion location is indicated for Amharic: as the diagram in (62) illustrates, omission of affixes in the Cay(C) (C)CoC Template ludling can only take place between Levels 2 and 3, i.e. in Module 1 of the ludling component. This location is also consistent with conversion prior to the NL rule of epenthesis, and the loss of information in this ludling which contravenes the PND.
(62) Amharic, Cay(C)(C)COC Teaplate

|naminit
PMO violations (vovels and affixes lost)

Another ludling whose conversion domains overlap in Module 1 is the Hanunoo CVnsuwayb Template ludling, illustrated in (63).
(63) Hanunoo, CVnsuwayb Tesplate



Also assigned to Module 1 are Tagalog Total Segment Reversal and Bedouin Hijazi Arabic Permutation; see the Appendix for a complete list of the conversion domains of each of the ludlings surveyed in this chapter, and their module assignments within the ludling component.

### 2.3.2.2. Level 4

Structure-preserving ludlings which apply between words are assigned to Module 2. Consider the case of Thai Khampuan, illustrated in (64). (64) Thai, Khampuan


Only conversion at Level 4 allows the ludling to operate on words strung together in the syntax while at the same time having the output subject to SP. This location is also consistent with the operation of Khampuan before the postsyntactic rules of Tone Neutralization and Vowel Shortening, and after the application of all morphological rules.

A similar example of a Module 2 ludling is Burmese VC Exchange, shown here with its overlapping conversion domains in (65).
(65) Burmese, VC Exchange


Incidentally, the existence of structure-preserving ludlings which follow the syntax argues very strongly for the revised version of SP which was adopted in section 2.2.3.1. Recall that Classical SP is considered to be in force only within the lexicon, and therefore incorrectly predicts that all postlexical ludlings should be non-structure-preserving. In contrast, Revised SP encompasses a postlexical domain where SP is in effect (namely between Levels 5 and 6), and can therefore readily accommodate ludings such as these Burmese and Thai examples.

A final example of a ludling which takes place in Module 2 is Tagalog -um- Infixation:
(66) Tagalog, -um-Infixation


As this diagran shows, the ludling must take place after the syntax to allow for the regrouping of separate words into a single word, yet it must precede the structure-preserving domain which begins at Level 5. Conversion within Module 2 accomplishes this, and also accounts for the fact that the ludling output undergoes the $N \mathbb{N}$ postlexical rules of nasal assimilation and vowel lengthening.

### 2.3.2.3. Level 7

Quite a few ludlings require conversion in the area of Levels 6 and 7, among them, Inuktitut Katajjait, Javanese C Exchange, and Luganda Ludikya (cf. the Appendix). These are assigned to Module 3. A particularly clear example is French Verlan 3, diagrammed in (67).
(67) French, Verlan 3


Before Closed Syllable Adjustnent

SP violations (imperaissable sequences)



As the overlapping conversion domains indicate, the ludling is localized around the phonosyntactic subcomponent (it is structure-violating, hence post-Level 6, yet it shows the influence of the PCI in its exemption of FWs, hence its domain does not extend into the postsyntactic component). This is consistent with a Module 3 conversion location. By assigning Verlan 3 to this module, we also account for its application after morphological operations and beyond the influence of the PMO, as well as for the fact that its output undergoes postsyntactic rules like Closed Syllable Adjustment.

English Total Segment Reversal 1 also exhibits all of the hallmarks of a Module 3 ludling: it is non-structure-preserving, it applies after all lexical rules, and takes place before all P2 rules and phonetic implementation:
(68) English, Total Segment Reversal 1


Before phonetic details


SP violations (ieperaissable sequences)

Another example of a ludling assigned to Module 3 is Fula Transposition + -ng-. As illustrated in (69), this ludling must take Level 7 as its input, since it accesses the clitic groups which are encoded in the representation at that level. Moreover, it is non-structure-preserving (hence post-Level 6), but it still incorporates the effects of the PCI.
(69) Fula, Transposition $+-n 9^{-}$


A word is in order at this point concerning the way in which Module 3 interfaces with the NL phonology. In the model I propose, Level 7 serves as the input to this module, but its output is fed back through the construction of phonological phrases immediately prior to Level 7. This constitutes a weakening of the principle of unidirectionality presented in section 2.3.1, but it is warranted on the basis of several ludings. Consider the case of the Cantonese La-mi Language, illustrated in (70). (70) Cantonese, La-si Language


SP violations ([+corla sequences)

This ludling is non-structure-preserving and hence must take place after Level 6; however, the ludling operation involves the introduction of wordsized templates which need to be incorporated into the prosodic hierarchy like any other phonological material of the language. This can be accomplished by having conversion take place off Level 7, but then subjecting the output of the ludling to the construction of phonological phrases between Levels 6 and 7. Further evidence for this sequencing is provided by ludings which introduce words as phrase terminators, such as Yoruba -gV- Infixation. Access to Level 7 is clearly required in this case, in order to determine the location of phrase boundaries, yet the fact that NL syllables are reanalyzed as words indicates that the ludling output must
be subjected to the effects of pause insertion and phonological phrase construction.
(71) Yoruba, -gU-Infixation

f's as separate vords
Phrase terainators

In the next section, I will discuss a related case in Hanunoo.
Although this conception of the interface of Module 3 with the NL phonology is not strictly unidirectional, it is not an unprincipled deviation from this generalization. A reasonable assumption to make is that all phonological material, regardless of whether it originates in a ludling or NL, must ultimately receive an interpretation in terms of the hierarchy of prosodic constituents. By recycling the output of Module 3 (the final ludling module) back into phonological phrase construction, we effectively insure that no material introduced by a ludling escapes being incorporated into the prosodic hierarchy.

### 2.3.3. Some Consequences of Polymodularity

Setting up three modules within the ludling component is not a needless proliferation of conversion sites. Rather, it represents the claim that at these specific points within the grammar, and only at these points, can the phonological representation be submitted to the ludling component. In this way, the cluster of properties which distinguish a Module 1 ludling from,
say, a Module 3 luding can be explained. These differences follow simply from the nature of the representation which serves as input to the module, as well as from the general principles associated with the domain where conversion takes place.

Beyond this, though, a number of other interesting consequences emerge from positing several distinct modules within the ludling component. For example, it predicts that it should in principle be possible to find more than one module being used in a given language and/or ludling. Moreover, the internal modularization of the ludling component can be used as a tool to pinpoint the location of various NL rules for which no other evidence is available. In this section, I will explore a number of these consequences.

### 2.3.3.1. Languages With Ludlings in Different Nodules

One of the simplest predictions of a polymodular ludling component is that a language may distribute its ludlings in more than one module. There are, of course, examples of languages in which all ludlings appear to be assigned to the same module (e.g. Sanga, Module 3). Many languages, though, do indeed have ludlings in different modules. For example, Tagalog Segment Reversal is a Module 1 ludling, while Total Syllable Reversal in the same language is assigned to either Module 2 or 3 (the exact one is not determinable on the available evidence; see the Appendix for the conversion domains of each of these ludlings). In Japanese, the Babibu Language is a Module 1 or 2 ludling, while the Nosanosa Language is a Module 3 luding. In Mandarin, the May-ka Language is assigned to Modules 1 or 2, while the Meyka Language is a Module 3 ludling.

### 2.3.3.2. Ludlings Which Use More Than One Module

A slightly more interesting consequence of having several modules within the ludling component is that the operations associated with a single
ludling may themselves be distributed across more than one module. In this section $I$ will examine cases in Hanunoo and Mandarin.

Hanunoo Syllable Reduplication is illustrated in (72).
(72) Hanunoo, Syllable Reduplication


SP Violations: Optional phonation modifications

This ludling consists of two basic operations: reduplication of NL syllables, and insertion of phrase terminators (-q on phrase-final words, tag sa between phrase-medial words). Reduplication is a Module 1 operation, because it must have access to the stem/affix distinction (prefix syllables are not reduplicated). Insertion of phrase terminators is, on the other hand, a Module 3 operation, since it of course requires access to the output of phonological phrase construction. Furthermore, in this and all other Hanunoo ludlings, a phonation modification may optioanlly be superimposed over the entire utterance. Since this is a non-structure-preserving operation (the phonations involved do not occur in the NL), it too is assigned to Module 3.

With the possibility of having ludling operations distributed across
different modules, we predict that it should be possible to find NL phonological rules sandwiched between ludling operations. This is precisely the situation found in the Mandarin May-ka Language: The output of luding conversion undergoes NL rules of a Fronting and Raising (FR) (when a is followed by a glide) and Palatalization; these rules in turn must precede a ludling-specific rule which Zhiming (1988:23) calls 'Rime Reduction' (RR), which deletes the postvocalic glide when there is also a prevocalic glide: Iya 'two' > ludling conversion > Iyay kya ---> a Fronting \& Raising, Palatalization ---> Iyey tgya > RR > Iye taga (Zhiming 1988:8,11). By assigning the ludling conversion process to Modules 1 or 2 and the rule of Rime Reduction to Module 3, this ordering can be accounted for (this in turn entails that the $N$ rules in question are $P 1$ rules of the postlexicon).

The Mandarin case is interesting in another regard. In the May-ka ludling, Rime Reduction operates in a strictly structure-preserving fashion to repair ill-formed sequences; in the Mey-ka ludling, however, the same rule (and others) operate in a non-structure-preserving fashion. This follows from assigning May-ka to Modules 1 or 2 and Mey-ka to Module 3. (At present there is not enough evidence to decide between Modules 1 or 2 for May-ka.) Let us take a look at these cases in greater detail.

In NL Mandarin, the following co-occurrence restriction is in effect (taken from Zhiming 198B:7).
(73) The pre-nuclear glide and the post-nuclear glide cannot have the same [back] specification.

This constraint rules out sequences such as *twaw, \#lyay, *lyay. In both the May-ka and Mey-ka ludlings, such sequences are allowed to be created; in the former ludling, they are all subsequently eliminated by a luding-specific rule, while in the latter luding, some of the ill-formed structures are
allowed to remain. In the May-ka Language, as we noted above, the postnuclear glide is deleted (following the application of Fronting and Raising) by RR, as illustrated in (74a). In the Mey-ka language, on the other hand, only selected instances of such sequences are altered by ludling-specific rules: 'Onset Reduction' (OR) deletes a pre-nuclear front unrounded glide when preceded by a consonant in the same onset, while 'Glide Spreading' (GS) spreads a front rounded glide onto the nucleus (along with delinking the post-nuclear glide); these rules are illustrated in (74b). Crucially, though, $\# y$ y sequences are allowed to remain in the representation, even though these are also ill-formed from the standpoint of the $M$ (ibid., p.59). (In these examples, structure-violating sequences are under lined.)
(74) Mandarin (Zhiming 1988)
a. Hay-ka Language: strurture-preserving
lya 'two' > lyay kya ---FR, Palat. $-\rightarrow$ lyey tgya ---RR---> lye tgya
yaj 'sun' $>$ yay kyaך ---FR, Palat. ---> yey tgyaŋ ---RR---> ye tgyaך

b. Hey-ka Language: non-structure-preserving

| yi | 'one' | $>$ yey kyi |  |
| :---: | :---: | :---: | :---: |
| yay | 'sun' | > yey kyaj |  |
| syan | 'before' | > gyey kyen | ---0R--> sey kyen |
| lya | 'two' | > lyey kya | ---OR---> ley kya |
| t. 59 d | 'go' | $>$ tgyey kyd | $\cdots \mathrm{GS}-\mathrm{m}$ tgyd kyd |
| ye | 9 moon' | > yey kye | ---G5---> 9d kye |

As can be seen, Mey-ka forms are allowed to surface with structure-violating sequences while May-ka forms are not. Note also that the output of the Meyka Language is not subject to the NL rule of Palatalization (which
palatalizes velar stops before $y$ ): its output therefore also contains the ill-formed sequence *ky in addition to the *yVy sequences.

This fairly complex array of structure-preserving and structureviolating effects (as well as ordering with respect to NL rules) falls out from the modular assignment of each of these ludlings. This is diagrammed in (75).
(75) Mandarin


May-ka conversion, assigned to Module 1 or 2 (in this diagram it is shown in Module 1), occurs before the NL rules of FR and Palatalization as well as before the structure-preserving domain of the P1 rules. Consequently, its output undergoes these NL rules and has its structure-violating sequences marked as ill-formed by SP. When the ludling representation is then submitted back to the ludling component in Module 3, the ludling-specific rule of RR applies to remove all ill-formed sequences. In contrast, Mey-ka conversion is located in Module 3, after the application of Palatalization and the effects of SP. It is therefore free to create structure-violating sequences such as *ky; moreover, the ludling-specific rules of $R R$, $O R$, and GS can operate in a non-structure-preserving fashion, in that they are not required to remove all ill-formed sequences from the representation. $2=$

### 2.3.3.3. Dialects of the Same Ludling in Different Modules

Another consequence of polymodularity is that we may find dialects or versions of the same ludling assigned to different modules. As our model predicts, however, one never finds more than two such varieties of a single ludling, where those varieties are distinguished by different conversion locations with respect to some NL rule or process. This is because even though there are in fact three modules within the ludling component (and hence three potential conversion sites), only a single block of NL rules intervenes between those modules (viz. the P1 rules of the phonosyntactic subcomponent). Consequently, a luding will apply before those rules regardless of whether it is assigned to Modules 1 or 2, and it will apply after those rules if it is assigned to Module 3. Similarly, a ludling which is assigned to Module 1 will apply before Plane Conflation, while a luding will apply after Plane Conflation regardless of whether it is assigned to Module 2 or Module 3.24

In this and the following section we will see that our model of the ludling component forces a number of NL postlexical rules to be assigned to the P1 component. Recent work such as Selkirk (1986) and Couper and Rice (1987) appears to challenge the existence of any rules in this component of the grammar. However, what these authors are challenging is actually the syntax-sensitivity of these rules rather than this location per se. The ludling data clearly demonstrate that two distinct blocks of postlexical rules must be recognized (P1 and P2), although neither need in fact access the syntax directly.

Let us first consider the case of Cuna, perhaps the best-known example of ludling-internal variation. As Sherzer (1970) points out, two varieties of the transposing ludling Sorsik Sunmakke exist: one systematically applies
before a series of NL rules, another applies after the same rules. The rules involved are the following: Nasal Assimilation (NA) for labial stops, which converts sequences of bs to $m$, Velar Weakening (VW) which converts $g$ to $y$ before another consonant, and Glide Insertion (GLI), which converts ia to iya and ua to uнa. The interaction of the two ludling varieties with these rules is illustrated in (76).23
(76) Cuna, dialects of Sorsik Sunsakke (Sherzer 1970)
a. Sorsik Sunsakke 1

| before NA: /gab-mai/ > maigab 'sleeping' |  |  |  |
| :---: | :--- | :--- | :--- |
| before VW: /bag-sa/ $>$ sabag | 'bought' |  |  |
| before GLI: /ia/ | $>$ ai | 'older brother' |  |
|  | /ua/ | $>$ au | 'fish' |

b. Sorsik Sunmakke 2

| after | NA: | /gab-mai/ | --NA---> gammai | > maigam | 'sleeping' |
| :---: | :---: | :---: | :---: | :---: | :---: |
| after | VW: | /bag-sa/ | --VW---> baysa | > sabay | 'bought' |
| after | GLI: | /ia/ | --GLI--> iya | > yai | 'older brother' |
|  |  | /ua/ | --GLI--> uwa | > wau | 'fish' |

This interaction follows if we assign Sorsik Sunmakke 2 to Module 3 and Sorsik Sunmakke 1 to one of the earlier modules (with the additional assumption that the $N L$ rules in question are P1 rules).

Another example of dialect variation in Sorsik Sunmakke involves NL processes of degemination and voicing. In NL Cuna, underlying geminate stops surface as voiceless nongeminates while underlying nongeminates surface as voiced: /kk/ --> [k], /k/ —-> [g]. Some speakers transpose before the degemination process, in that two units of a voiceless geminate appear (each surfacing as voiced): /dakke/ 'see' > gedag (I assume that copying of the doubly-linked melodic element $k$ occurs when Uncrossing moves one of the
skeletal slots to which it is linked; see Chapter 3, section 3 for a detailed analysis of transposition). Other speakers transpose after degemination, in that only a single stop appears: /dakke/ > geda. Within the NL phonology, voicing of stops can only aply to nongeminates, and therefore must precede degemination:
(77) a. /dakke/ -voicing--> n/a --degemination--> [dake] 'see'
b. /dake/ --voicing-> [dage] --degemination--> n/a 'come'

Voicing must be able to apply to the output of luding conversion for the dialect which precedes degemination:
(78) /dakke/ > transposition > kedak - voicing-> [gedag] 'see'

However, voicing must also apply to the output of the ludling dialect which transposes after degemination:
(79) /dakke/ --degem. $->$ dake > transp. > keda --voicing--> [geda] 'see' Thus, the following sequencing is required:
(80)


This ordering follows if degemination is assigned to the P1 component of the postlexical phonology, with voicing assigned to both P1 and P2 (assuming Sorsik Sunmakke 2 is in Module 3). One final complication is that there is no ludling variation with respect to the degemination of the rhotic /rr/ (which eventually surfaces as [1]). Ludling conversion uniformly follows degemination in this case. This can be accounted for by placing rhotic degemination in the lexical component, prior to any of the ludling modules. The interaction between the dialects of Sorsik Sunmakke and these NL
processes is summarized in (81). 28
(81) Cuna


Our model of the luding component also correctly predicts that there is no variation in these two ludling dialects with respect to the NL rule of $i$ Excrescence. Since the latter rule is assigned to the postsyntactic component and none of the ludling modules has access to a level of representation later than Level 7, it follows that both dialects will apply before this NL rule.

Another example of two luding dialects in different modules is provided by Moroccan Arabic permutation. As we saw in section 2.2.1.2, one version of this ludling applies before Plane Conflation (it treats longdistance geminates as single melodic units), while another version applies after Plane Conflation (it treats long-distance geminates as two melodic units). This indicates that the first dialect is assigned to Module 1 of the ludling component while the second dialect is assigned to one of the later modules.

An interesting case of polymodular dialects is furnished by the Kekchi ludling of Jerigonza (-pV- Infixation). As the forms in (82a) illustrate, one version of this luding (Jerigonza 1) applies after an NL rule of epenthesis which inserts a vowel copy between $b^{\prime}$ or and a preceding
consonant. Another version, however, appears to apply before epenthesis (Jerigonza 2). 27
(82) Kekchi, dialects of Jerigonza (Campbell 1974)
a. Jerigonza 1
/kwiq'b'-ank/ --Epenthesis—> kwiq'ib'ank > kwipiq'ipib'apank 'to bend it' /lekm-ak/ --Epenthesis--> lekemak > lepekepemapak 'to spoon out'
b. Jerigonza 2
/kwiq'b'-ank/ >kwipiq'b'apank -Epenthesis--> does not apply /lekm-ak/ > lepekmapak --Epenthesis--> does not apply

Infixation of -pV-in Jerigonza 1 clearly takes place after epenthesis, since the epenthetic vowel receives its own ludling infix. However, there are problems with saying that Jerigonza 2 precedes epenthesis. Although the input to this dialect apparently has not undergone epenthesis, neither does the output-- in other words, this ludling appears to represent a discontinuous derivation, since an NL rule (Epenthesis) is skipped. Recall from section 2.3.1.1. that no other luding requires discontinuity. In fact, a closer examination of the modularization of the ludling component indicates that both dialects must actually follow epenthesis, and hence no discontinuity is involved.

Jerigonza 2 violates SP, since it creates structures which are illformed in the $M\left(* C\left\{b^{\prime}, \sum^{2}\right)\right.$. This dialect must therefore be assigned to Module 3, since this is the only module where non-structure-preserving operations can take place. Assuming, then, that Jerigonza 2 precedes epenthesis, this would entail that epenthesis is a postsyntactic rule. If epenthesis were postsyntactic, however, there would be no way for Jerigonza 1 to follow epenthesis, since all ludling modules precede the postsyntactic component. This paradox may be resolved by assigning epenthesis to the
lexical phonology, Jerigonza 1 to Modules 1 or 2, and Jerigonza 2 to Module 3, as illustrated in (83).
(83) Kekchi


Why is it, then, that Jerigonza 2 fails to recognize epenthetic vowels, if it applies after epenthesis? I follow Campbell (1974) in assuming that this dialect in fact has a rule of vowel deletion which only applies to epenthetic vowels. Assuming that epenthesis consists of insertion of an empty nucleus slot, 'epenthetic vowels can be targeted by the following rule (applying before redundancy rules fill in the empty slot).
(84) Kekchi, Jerigonza 2
a. Vowel Deletion

$$
\text { (v) } \rightarrow
$$

b. lekemak > Vowel Deletion > lekmak > infixation > lepekmapak Although it might appear odd to insert a segment in the NL only to delete it in the luding, this is simply another instance of a ludling rule 'undoing' what is accomplished by an NL process (cf. the discussion of reversal/reconstruction in section 1.1).

### 2.3.3.4. Predicting the Locations of NL Rules

We have already seen several examples of how the modularization of the ludling component allows the locations of a number of NL rules to be
determined when there is no other available evidence: among these, Mandarin a-Fronting/Raising and Palatalization; Cuna Nasal Assimilation, Velar Weakening and Glide Insertion; and Kekchi Epenthesis. Several other examples may be cited.

In NL Buin, there is a rule which assimilates the velar nasal to the place of articulation of a following nasal: /kojno/ 'sago leaflet' ---> [konno]. Ludling transposition occurs before the operation of this rule: the ludling form of this word is nookoy rather than *nookon (Laycock 1969:14-15). Furthermore, there is an NL rule which changes $e$ to $i$ following a: /ia-e/ 'that-focus marker' --> iaj'that one'. Ludling conversion also operates prior to this rule: the ludling form of this word is eeia, not *iija (sequences of three identical vowels are otherwise acceptable in luding forms: ozio 'give me' > ooomi). Since Buin Transposition is a Module 3 ludling (cf. the Appendix), it follows that these must both be rules of the postsyntactic component of the NL phonology. Another example is provided by Bedouin Hijazi Arabic Permutation. This ludling applies prior to rules which alter vowel quality depending on the neighbouring consonants (McCarthy 1982:197). Since this ludling is assigned to Module 1, the NL rules in question are predicted to be postlexical. 28

In Burmese, obstruents are voiced in certain intervocalic environments, usually when not preceded by a low (glottalized) tone (symbolized here as a post-vocalic 2) (see Hass 1969 and Cornyn 1944 for further details). The VC Exchange ludling of Burmese applies after the operation of these rules: the ludling form of $\theta i$ ippinc 'tree' is $\theta$ in"pi? rather than * $\theta$ in"bip, the latter being the expected form if the ludling output were subject to voicing (Haas 1969:283). Since this ludling is assigned to Module 2, our model predicts that the voicing rule must be a lexical process. The Finnish ludlings of

Kontti kieli and Siansaksa apply after an M rule which diphthongizes long mid vowels: tee 'road' ---Diphthongization---> tie $>$ ludling conversion $>$ koo tienti (Campbell 1981:175: Vago 1985:334). If the ludling applied before diphthongization, the incorrect form $2 k o o$ tentti would be derived. Since Kontti kieli is either a Module 1 or Module 2 ludling, and Siansaksa is assigned to either Modules 2 or 3 , the NL rule of diphthongization is predicted by our model to be either a lexical or a P1 rule; it cannot be a P2 rule.

Finally, two additional rules in Kekchi deserve mention. NL Kekchi has a process which lengthens a vowel before a word-final cluster whose first member is a sonorant: $\mathfrak{y}$-kwar 'he slept' vs. kwazr-k'to sleep' (Campbell 1974:276). The output of Jerigonza undergoes this rule: b'alk 'brother-inlaw' $>b^{\prime}$ apalk --V lengthening--> $b^{\prime} a p a z l k$. Since there is no variation between the two ludling dialects with respect to this rule, it is predicted to be a postsyntactic rule. NL Kekchi also has a process which inserts an echo vowel in UPC sequences: /kwa?-k/ 'to eat' ---> [kwa?ak] (ibid., pp. 27677). Ludling conversion (infixation of -pV- after each syllable nucleus) may take place either before echo vowel formation (EVF) (85a) or after it (85b). I assume that, prior to EVF, the glottal element is incorporated into the nucleus and hence the -pU-infix follows the entire $V$ ? sequence, while after EVF the glottal occupies onset position of the echo syllable.
(85) Kekchi, Jerigonza (Campbell 1974)
a. Conversion before EVF
poit 'huipil (blouse)' $>$ infixation > po?pot --EVF-> po?opot
b. Conversion after EVF
po?t -EVF—> po2ot $>$ infixation $>$ popo?opot
As we detailed in the preceding section, the Jerigonza ludling has dialects
in both Module 3 and one of the earlier modules. The variation exhibited by this ludling with respect to EVF predicts that EVF is a PI rule of the postlexical phonology.

It is hoped that the predictions made possible by this model of the ludling component will be tested once further analyses of the NL phonologies in question become available.

### 2.3.4. Summary

In this section I have proposed a model of the ludling component which incorporates three internal modules. Although each module contains ludlings of all the major types (infixing, reversing, templatic) and many different properties are associated with each conversion location, a number of general characteristics of each module may be identified. Only Module 1 ludlings may access (a limited amount of) morphological information, usually the stem/affix dichotomy. Similarly, only ludlings assigned to this module may apply before Plane Conflation. Module 2 ludlings are often characterized by structure-preserving application between words. Module 3 ludlings are typically non-structure-preserving and may refer to constituents of the prosodic hierarchy.

In this model, no ludling has access to a level of representation earlier than Level 2 or later than Level 7. As such, this conforms in outline to Mohanan's (1982) proposal that ludling conversion takes place between the lexical and postlexical components. In the Lexical Phonology model that Mohanan was using, it must be understood that 'postlexical' corresponded to what would later be identified as the postsyntactic component, while by 'lexical' he was referring largely to the application of morphological and phonological rules within the lexicon (the location of

Plane Conflation at the end of the lexicon had not yet been identified). The model I propose differs from his, though, in that there is more than one conversion location between those two levels, as required by the complex range of luding/NL interactions which take place in that domain. This internal modularization is possible only with the recognition of several distinct levels of phonological representation within the postlexical phonology. Another difference from Mohanan's model is that it is not the output of the entire lexicon that serves as the first entry point to the ludling component, but rather the output of all phonological and morphological processes prior to Plane Conflation (=Level 2).

## 3. Ludling and Surrogate Components Compared

We began this chapter by considering the possibility that the ludling and surrogate components might share one or more modules. Now that we have a detailed picture of the organization of the ludling component, we can provide a more definitive evaluation of this hypothesis. The diagram in (86) presents a combined view of the models of the surrogate and ludling components and their relationships to the NL phonology.
(86)

LEXICON


A number of striking similarities are evident in the overall architecture of the ludling and surrogate components. Both consist of three internal modules. Both have a module which accesses Level 4 and a module which accesses Level 7.

In spite of these similarities, however, it does not appear that these two components actually share any of their modules or are in any sense 'joint' components. There is a significant amount of non-overlap between them: the Surrogate component, for example, is confined entirely to the postlexical phonology, while the Ludling component extends into the last level of the lexicon. The Surrogate component has access to a postsyntactic level of representation, while the ludling component does not extend beyond Level 7. The only modules which could potentially be shared between them are the Selection Module (surrogate) and Module 2 (ludling), and the Instrumental Module (surrogate) and Module 3 (ludling). It does not seem likely that either of these is in fact held in common, in spite of their identical conversion locations. One of the original motivations for hypothesizing a joint module was the similarity between a number of ludling procesess and the types of segmental modifications which are effected in the Whistle Module of the Surrogate Component. Since the location of the Whistle Module does not correspond to any module within the ludling component, however, this possibility is eliminated. The remaining modules which do have a common location embody sufficiently different operations on the ludiing and surrogate sides as to make a joint conversion site unlikely.

Is it merely coincidental, then, that two modules in each component should take the same levels of representation as their input (Levels 4 and 7)? We can probably conclude that this is a reflection of the general salience of these particular levels of representation within the grammar as
a whole, rather than any aspect of the alternate linguistic components themselves which is held in common. Level 4 (shared by the Selection Module and Module 2) is the surface syntactic structure prior to the application of any postlexical phonological processes: clearly this is an important level of representation within the grammar, the cusp where syntax and phonology first interface. Likewise, Level 7 is at the dividing point between the two major components within the postlexical phonology (the syntactic and postsyntactic)-- again, this is a definitive level of representation. Nevertheless, a number of formal similarities between ludings and surrogates remain to be accounted for, similarities which cannot be ascribed, for example, to properties of the NL postlexicon (as can extrasystemic modifications and destruction of information). Most notable among these are the various types of reversal enumerated in section 1.1, as well as the manipulation of syllable and timing structures which were mentioned in section 1.2. The fact that these recur in both ludlings and surrogates suggests that, while each of these components is independent of the other, they are part of a common alternate linguistic component. This is schematized in (87).
(87)

ORDINARY LANGUAGE
alternate language


Thus, reversal is a property of the alternate linguistic component as a whole, though it is manifested in different ways within each of the ludling and surrogate components (as well as in other alternate languages like argots, and in speech modifications, which would also be assigned to the alternate linguistic component).

In conclusion, then, ludings and surrogate languages represent distinct and autonomous alternate linguistic systems. These systems nevertheless share access to a number of salient levels within the postlexical component, and belong to a common alternate linguistic component. The fact that they are independent systems, though, is not surprising, since nothing in principle should rule out the possibility of having a surrogate form of a ludling or vice versa. Although neither of
these combinations is in fact reported in the literature, it does not appear that this should be attributed to some facet of the organization of the alternate language component. Rather, one may surmise that this is simply a consequence of the fact that combining surrogate with ludling modifications would result in too great a loss of information. Individually, each of these alternate languages already imposes an enormous strain on comprehension, and therefore one would not expect to see them used together.

## 4. Conclusion

It is obvious that many uncertainties exist around our understanding of alternate languages. In addition to the fact that data are often quite sparse, we know very little about the acquisition of ludling and surrogate systems, and even less about precisely how extralinguistic components interface with these systems. In spite of these uncertainties, though, alternate linguistic systems have much to offer when analyzed from a theoretical perspective. In this thesis I have shown that, by subjecting alternate languages to rigorous theoretical analysis, significant insights can be gained into the organization of the alternate languages themselves, of their source languages, of linguistic theory, and of the nature of language in general. Perhaps the most important result is that a theoretical analysis can point the way towards what needs to be done to fill the gaps in our knowledge of these systems. For example, the analyses I have proposed make a number of empirically testable claims which can help direct further data collection. Ultimately, though, the details of the particular analyses presented in this thesis are unimportant. Much more significant is simply the fact that a theoretical analysis has been initiated. If this thesis makes any contribution, I would hope that it is to open up a dialogue on the serious linguistic analysis of ludings,
surrogates, and other alternate languages.

## APPENDIX

The following is a list of the principal ludlings surveyed in this chapter, with sources, module assignments, descriptions of luding operations (in some cases), and conversion domains. I have used traditional names of ludings wherever possible, or else names given by researchers studying the ludlings. In these cases, I provide a brief description of the ludling operations. Chinese exchange ludlings are named after the ludling form for the syllable ma. Other ludling names are self-explanatory. Sources which I have cited are the primary ones I consulted and not necessarily the only descriptive or theoretical studies of the ludling in question. Module numbers separated by a slash indicate that there is not enough evidence to decide between those modules. Module numbers separated by a comma indicate different dialects of the same luding, while numbers separated by a plus indicate that the ludling has operations in more than one module. Ludlings for which I only have a single piece of evidence regarding a conversion domain are not listed, unless there are other ludlings in the same language.

## AMHARIC

Cay(C)(C)CoC Teaplate (Bender and Teshome Deaisse 1983; McCarthy 1985)
MODULE 1


Before epenthesis

PMO violations (vovels and affixes lost)

## BAKWIRI

False Syllable Reversal (Hombert 1973, 1986)
MIDULE 3


## BEDOUIN HIJAZI ARABIC

Persutation (HCCarthy 1982)
hodule 1



## BUIN

Dog Speech (Laycock 1969)
MODULE $1 / 2 / 3$
C deletion, other modifications


Poetic Speech (Laycock 1969)
MODULE $1 / 2 / 3$
Truncation, suffixation, other modifications


After all morphology


Trasposition (Laycock 1969)
MODULE 3


SP violations (vord-initial g)

## BURMESE

```
-a*t-/-e7t- Infixation (Hass 1969)
Serial infixation
```



Choice of infix
-ap?t-Infixation (Haas 1969)
MODULE 1/2/3

r's as separate vords

## VC Exchange (Has 1969)

MDOULE 2


## CANTONESE

La-sj Language (Yip 1982)

MODULE 3


## CUNA

## Sorsik Sansakke (Sherzer 1970)

hodues $1 / 2,3$
Transposition




## V Replacenent (Sherzer 1976)

MODULE $1 / 2 / 3$



## ENGLISH

Alfalfa Lapgazge (Laycock 1972)
HODULE $2 / 3$

## Serial infixation



After all morphology


> Agb Language (Mohanan 1982) Infixation of -ayb-

MODULE $1 / 2 / 3$


Barracada langage (Berkovits 1970)
HODULE 1/2/3
Initial C replaceaent; other modifications


After all morphology

PMO violations (initial Cs replaced by b)

Brother's Langaage (Applegate 1961)
hODULE $1 / 2 / 3$
C replacenent, other sodifications


Before stop allophony

PMO violations (Cs replaced by 7)

Pig Latin (Halle 1962; Kaisse \& Shaw 1985; McCarthy \& Prince 1986)
MODULE $1 / 2 / 3$
Exchange vith Cey


Segrent-nithin-Syllable Reversal (Covan, Braine, \& Leavitt 1985) MODULE 3



Total Segrent Reversal 1 (Covan, Braine, \& Leavitt 1985)
hodule 3 Adults


After TSS, Palatalization, Stress




## ESTONIAN

```
-pj- Iofixation (Lehiste 1985)
```

hODULE 3


## FINNISH

Aiverinkieli (Antilla 1975, Canpbell 1981, Seppånen 1982)
HODULE 1/2/3
Truncation, -Vuer suffixation



Rontti kieli (Campbell 1980, 1981, 1986)
hodule $1 / 2 / 3$ CV exchange vith koatti



Before Final Geoination, Vovel Harsony

Wallika (Canpbell 1981)
hodule $1 / 2 / 3$
Truncation and -lli suffixation


Siansaksa (Camphell 1980, 1981, 1986)
MODULE $2 / 3$
CV exchange in successive words


Between words


## FRENCH

Verlan 1 (Sherzer 1976)
hODULE 3
Total syllable reversal, FHs deleted


Verlat 2 (Sherzer 1976)
MODULE 3
© exchange between and within words


## Verlan 3 (Lefkowitz 1987)

MODULE 3
Total syllable and segment reversal, transposition, interchange, $\theta$-epenthesis, truncation


PMO violations (truncation)


## FULA

C Exchange (Noye 1971, 1975)

-Ifir- Infixation (Noye 1971, 1975)
MODULE $1 / 2 / 3$


<------------------| ?Vowel assiailation in irregular verb?


## Trabsposition (Noye 1971, 1975)

## MODULE 3



Irabsposition + -gV-Infixation (Noye 1971, 1975)
MODULE 3


Traspoosition + -39-Infixation (Noye 1971, 1975)
hDDULE 3

$\left\lvert\, \begin{aligned} & \text { Clitic group }\end{aligned}\right.$

$\left\lvert\, \begin{aligned} & \text { PCI effects (FHs ignored) }\end{aligned}\right.$

MODULE I/2/3



FUZHOU
La-si labguage (Vip 1982)
MODULE $1 / 2 / 3$


HANUNOD
CV Exchange (Conklin 1959)
MODULE $1(+3)$


CVasaragb Teaplate (Conklin 1959)
MODULE 1 ( +3 )

-g Suffixation (Conklin 1959)
MODULE $1 / 2(+3)$


SP enforcements (¥conplex codas)
SP enforcements (Ecosplex codas)

gayCUC Tepplate (Conklin 1959)
MODULE 1 ( +3 )


PMO violations (truncation, affixes lost)



# $\left\lvert\, \begin{aligned} & \text { Phrase tersinators }\end{aligned}\right.$ <br> 5P violations (optional phonation modifications) 

HEBREW

C Exchange (Yakir 1973)
MODULE 2/3


Betveen yords
-gdV- lafixation (Yakir 1973)
HODULE $1 / 2 / 3$


V Replacesept (Yakir 1973)
MODULE $1 / 2 / 3$


## INUKT I TUT

Ratajjait (Nattiez 1983a, Beaudry 1978a, Bagenihl 1988)
module 3
Mapping of vocables onto teaplates, insertion of [-vce] and [-exp]


SP violations (voiceless V5, tones, pulenic ingressive)


## JAPANESE

Babiba Laggage (Haraguchi 1982)
HODULE $1 / 2$
Infixation of -bV-


Before pitch-accent assigneent

Hosanosa Langaage (0tsikrev 1963)
MODULE 3
Infixation of -bosa-




## JAVANESE

```
C Exchange (Sadtano 1971)
MODULE 3
```


SP violations (abl, au sequences)

## Ellipsis (Sadtano 1971)

hodule 2
Truncation and regrouping

-s-/-sV- Infixation (Sadtano 1971)
MODULE $1 / 2$



## KEKCHI

Jerigonza (Camphell 1974)
MODULES 1/2, 3
Infixation of -pN-


After all morphology


## KUNSHAN

No-pa Langage (Yip 1982, Zhining 1988)
RODULE 3


## LUGANDA

Laditya (Clements 1986)
MDDULE 3
False syllable reversal



## MALAYALAM

```
Pa Lamgage (Mohanan 1982)
MODULE \(1 / 2 / 3\)
Infixation of -pa-
```



Before Intervocalic Voicing, Glide Insertion

```
Before Onset Shortening
```


## MANDARIN

Nay-ka Langaage (Yip 1982, Zhining 1988)
HODULE $1 / 2$


Mey-ta Labgage (Yip 1982, 2hining 1988)
hODULE 3


## MOROCCAN ARABIC

Pernatation 1 (McCarthy 1986)
MODULE 1

(------------------|

Persutation 2 (HcCarthy 1986)
HODULE 2/3


Long distance geainates=2 units

## SANGA

## Kinshirgelo (Coupez 1969)

MODULE 3
False interchange

-paiste:- Infixation (Coupez 1969)
MODULE 3

-shi- Infixation (Coupez 1969)
MOOULE 3


PMO violations (tone loss)


```
    f's as separate words
```

-Zavo:tre:- Iafixation (Coupez 1969)
hodule 3


## SARAMACCAN

## Akoopina 1 (Price \& Price 1976)

MODULE 1/2/3
Syllable reduplication, infixation of -IUIV-


PMO violations (tone loss)


## Akoopind 4 (Price \& Price 1976)

MOOULE 3
Hord reduplication, infixation of -edo-


Aloopina 5 (Price \& Price 1976)
MODULE 3
Infixation of -fa-, syllable reduplication


## Atoopiaa 6 (Price \& Price 1976)

hodule 3
Syllable reversal, infixation, alternate lexicon, other modifications


Phrase tersinators

## SWEDISH

ROvarsprảket (Seppalnen 1982)
MODLLE 3
Infixation of -oC-


$$
\begin{gathered}
|--?--|-\cdots---\gg \\
\text { 6l violations }
\end{gathered}
$$

## TAGALOG

Syllable Reversal + -at-1-Vn- Infixation (Conklin 1956)
nodule 1/2/3



After all sorphology

```
Before vovel lengthening, nasal assiailation
Before vovel lengthening, nasal assiailation
```

Total Segneat Reversal (Conklin 1956) NDDULE 1


Total Syllable Reversal (Conklin 1956, Garcia 1934)
hODULE 2

?--------- Before inflectional norphology?

hodule $1 / 2$

-VgVd- Iafixation (Conklin 1956)
hodule $1 / 2 / 3$

f's as separate vords

## TAIWANESE

Ha-sa Language (Yip 1982)
MODULE $1 / 2 / 3$



PMO violations (tone loss)

## THAI

Khanpuad (Surintramont 1973)
MODULE 2
VC exchange


Between words


Sp enforcements (syllable/tone co-occurrence restrictions)

## TIGRINYA

-gl- Infixation (Bageaihl 1987)
MODULE 1


## (-------------------1



## YORUBA

-gV-Infixation (Isola 1982) HODULE 3


nOTES
${ }^{2}$ As in the preceding chapter, all examples are cited in the orthographies/transcriptions of the original sources.
aNL Tagalog does have an e/i alternation, but it is not relevant to the form under consideration here. According to Schachter and Otanes (1972: 10,17), $i$ is in free variation with e in phrase-final syllables, and the two vowels also alternate in stems when certain suffixes are added; neither of these environments is met in this word.

In this example, mag-, the transient prefix, is set off from the base by an inserted glottal stop (q) (Conklin 1956:137).
${ }^{4}$ Two other, questionable, examples of ludlings accessing morphological information may be mentioned. In a Navajo ludling briefly described in Otsikrev (1963:6), the syllable da appears to be infixed only after certain morphemes of the NL form:
(i) alth-k'es-disih shanihah > althda-k'esda-disih shanihahda 'give me some candy'

Clearly more data are required to determine if this is indeed a case of morphological conditioning. Secondly, in some English segmental reversals, ludling-specific syllable divisions are sometimes utilized. Cowan, Braine, and Leavitt (1985:691-3) note that in many cases such syllable boundaries coincide with morphological boundaries, suggesting that perhaps the ludling has access to some morphological information when applying its syllabification algorithm. However, this conflicts with the majority of other evidence for this ludling, which (as we will see in subsequent sections) supports a postlexical conversion site.

EIn this and other segment reversals of English, speakers appear to set up a ludling-specific syllabification system; this is largely identical to the NL placement of syllable boundaries, but it often differs (as in these
examples). Cowan, Braine, and Leavitt (1985) identify the following factors which play a role in the luding syllabification system (in descending order of importance): a) Na syllabification; b) stress; c) vowel quality; d) orthography; and e) morpheme boundaries (see note 4). This provides an additional argument for ludling conversion following stress assignment, since the location of NL stress may influence the placement of ludling syllable boundaries, and those boundaries would alter the stress location were conversion to precede stress assignment. These ludling forms also evidence a (perhaps related) process of glottal stop insertion which is also ludling-specific.
cyip (1987) analyzes this, not as the result of CiV Lengthening, but as one instantiation of a more general (lexical) rule of closed syllable shortening (assuming the i is epenthetic). If this analysis is adopted, these forms indicate that ludling conversion simply applies after this more general rule of shortening.

7If, as McCarthy and Prince (1986) suggest, the Pig Latin 'affix' is considered to be a separate word, we would not expect $T S S$ to apply in this context in any case, since it is restricted to word-internal applications.

Qlefkowitz (1987:174-5) points out that Verlan 3 also appears to apply across word boundaries in some instances, in that individual (monosyllabic) words are reversed as if they comprised the syllables of a single polysyllabic word. However, all of these cases involve fixed expressions or extremely common phrases, and therefore are probably entered as an entire unit in the lexicon (NL and/or ludling).
-This ludling is based in part on the Japanese writing system. In certain well-defined cases, an intermediate ludling form of a word is constructed prior to infixation by using the names of some of the characters
of the Japanese syllabary (see Haraguchi (1982) for more details). In both this and the preceding chapter, I have made a point of not using ludling data which draw heavily on orthographic systems, and ordinarily $I$ would not cite a case such as this. I have departed fron this canon in the present instance, though, simply because there are so few ludling data of any kind Which bear on the question of ludling interaction with NL intonation/pitchaccent assignment.

10Schlegel (1891), Berkovits (1970), and Sherzer (1982)-- the original sources of these data-- do not, however, write the ludling syllables as separate words, 35 MkCarthy and Prince (1986) do.

11 In these cases, an alternative hypothesis would be that certain syntactic constituents are being directly accessed by the ludling. However, recent work has shown that a direct-syntax approach is unnecessary for most cases which were originally hypothesized to require it (cf. Selkirk 1986, Cowper and Rice 1987), and therefore $I$ consider this to be a distinctly less preferred analysis of these data as well.

I Nasal assimilation also applies lexically in Tagalog, because it. is limited to certain morphemes in its word-internal application; cf. Schachter and Otanes (1972:21).

19The schwa in Hetzron's transcription represents the same vowel as the $\langle\imath\rangle$ in McCarthy's and Bender and Teshome Demisse's transcriptions, namely the high central unrounded vowel (the so-called'sixth-order' vowel).
*3Structure Preservation is clearly not operative in the domain where intonation assignment takes place (between Levels 4 and 5) since this involves the insertion of features not used contrastively at the underlying level (namely tones).

AWhile I will be adopting the DSP in the following discussion, it
should also be kept in mind that another view of the effect of SP on ludings cannot in principle be ruled out. In particular, it is possible to regard SP as an independent specification of particular components. It could be that ludling conversion does not inherit the influence of SP from the NL domain in which it is localized, but rather varies parametrically as either structure-preserving or non-structure-preserving independently of the NL. Such variation could be universal, i.e. one particular ludling module could be designated as structure-preserving for all languages, regardless of whether it coincides with a structure-preserving domain in the NL. This parametric variation could also be language-particular: the same luding module could be structure-preserving in one language, structure-violating in another. Such a parametric account of the effect of NL principles on ludings is required in any case for the Crossing Constraint: there is no point in the ML grammar where the CC is not in effect, yet as I showed in Chapter 3, a number of ludlings do incur violations of the CC (which are later rectified). This is explained by the parametric nature of the $C C$ within the ludling component: for some ludlings, the CC (or rather, the 'no crossing' setting) is simply not in effect. Although such an approach does not appear to be required for SP (or any of the other principles to be considered in this section), I will not rule it out a priori as a possible point of variation between ludlings.
${ }^{16}$ Cowan, Br aine, and Leavitt (1985) conclude that the appearance of the 9 in forms such as this probably represents the influence of orthography rather than conversion prior to the lexical rule of $g$ deletion. Recall from section 2.2.1.3 that segment reversals in English precede no other lexical phonological rules.

27Both ludling and NL allow Cyi sequences, though.
${ }^{10}$ This does not require the rule to have global power, i.e. to 'look ahead' to determine whether an ill-formed structure will result. It can simply be assumed that all rule applications are optional, with their outputs subject to the filtering effects of constraints (as in the syntactic component). If regrouping does not apply, the output of exchange will be marked ungrammatical because it violates SP. If regrouping does apply, the output of exchange will not violate SP and will be allowed to surface.
©oYip (198B) suggests that this may actually be an OCP effect on the labial tier.

20This appears to be another example of reversal of the head/nonhead priority in node conservation similar to that noted in Chapter 2 for surrogate languages. According to Shaw (1987), the righthand branch of a contour segment functions as the head and therefore is conserved (in NL systems). In this case, the lefthand branch is conserved, suggesting a reversal of the NL priority.
${ }^{22}$ The Verlan 3 forms may optionally not undergo truncation, in which case no homophony results: səpã 'think', səpi 'piss', səpa 'pass', səpt 'lesbian'.

221 am discounting here the questionable cases in Taglog and Bedouin Hijazi Arabic mentioned in section 2.2.1.3. There is one other case which, in addition to apparently requiring access to a level of representation prior to a lexical rule, also seems to represent a discontinuous derivation. This is Fula C Exchange: as Churma (1987:36-7) notes, the input to the ludling must not yet have undergone initial consonant mutation/gradation, nor can the ludling output itself undergo this process. The following forms are originally from Noye (1971, 1975).

| (i) NL | Ludling | If conversion <br> followed mutation | If ludling output <br> underwent mutation |
| :--- | :--- | :--- | :--- |
| a. ndillen | lidden | *lindden | lidden |
| b. kiiroyen | riihoyen | *riikoyen | *ndiihoyen |
| c. ndillu | liddu | *linddu | liddu |
| d. kuuca | cuuha | *cuuka | cuuha |

Although these data may be representative of a wider pattern in the ludling, I hesitate to draw any conclusions on the basis of a data base of this size (which is small even by the standards of the generally impoverished samples of ludling descriptions).

20 The Javanese Ellipsis ludling appears to present an ordering paradox for this model if it is viewed as a polymodular ludling. Recall that this ludling consists of two distinct operations: truncation of NL words, followed by regrouping of the resulting syllables. Truncation should be assigned to Module 3 because it is non-structure-preserving (it creates contour segments in coda position). Regrouping must be assigned to Module 2, however, since it is structure-preserving (its output undergoes cluster simpification in conformity with NL canonical syllable shapes). Thus, regrouping would be assigned to an earlier module than truncation even though truncation must in fact precede regrouping. This apparent paradox disappears when we realize that SP only affects the ludling representation when it is resubmitted to the NL phonology. Both regrouping and truncation are assigned to Module 2. SP does not affect either of these luding operations themselves, only their outputs when returned to the NL system. Thus, truncation is free to create structure-violating sequences; this is then immediatey followed by regrouping within the same module, whereupon the representation is returned to the ML phonology and SP results in cluster simplification.

24Hombert (1986) mentions a syllable reversal luding in Taiwanese which he invented to test its interaction with NL tone. This novel ludling is potentially problematic for our model because it evidences three variations with respect to the NL rules of tone sandhi: in some cases, ludling conversion precedes tone sandhi, in other cases, conversion follows tone sandhi, while in still other cases tone sandhi applies both before and after ludling conversion. Assuming that speakers who are presented with a novel ludling are free to assign it to any of the three modules within the ludling component, all of these orderings except the last follow if we place tone sandhi in the P1 component. However, the third ordering possibilitytone sandhi applying both to the input and output of the ludling-- violates the principle of unidirectionality elaborated in section 2.3.1.3 and cannot be readily accommodated by this model.

2sStrictly speaking, these are not distinct 'dialects', since as Sherzer (1970) points out, speakers who convert prior to NA, for example, may convert after VW (though presumably not in the same word). This simply indicates that both conversion sites are available to each speaker whenever a ludling form is generated. In contrast, in true luding 'dialects', only one module is used by the speaker for the generation of all luding forms. 2 In a preliminary perusal of Holmer (1947), a reference grammar of Cuna, I have unfortunately been unable to locate any crucial evidence which would either support or refute these NL rule locations.

27 The effects of a rule of vowel lengthening have been suppressed in these transcriptions; see the next section for a discussion of this rule.
zel was unable to consult Al-Mozainy (1981), in which these rules and the ludling were originally described. Presumably this source would be able to confirm or refute this prediction. However, John McCarthy informs me that
the evidence does not appear to be conclusive one way or the other. The rule involved, vowel raising, is non-structure-preserving (since it creates the segment [ $\dot{q}]$, not part of the underlying inventory of $B H A$ ), but this could indicate either a postsyntactic or a late lexical rule application (assuming a non-structure-preserving domain in the latter portion of the lexicon). On the other hand, vowel raising does not appear to apply consistently across word boundaries. However, this does not rule out postlexical application, since application across word boundaries is only a sufficient, rather than a necessary, condition for postlexical application.

## REFERENCES

Note: page numbers cited in the text for all articles reprinted in Sebeok and Umiker-Sebeok (1976) (hereafter S\&d) (except for Nketia (1971)) refer to the pagination of the reprinted article and not the original version.

Abney, Steven (1985) 'Functional Elements and Licensing', ms, MIT.
Alexandre, Pierre (1969) 'Langages tambourinés: une écriture sonore?', Semiotica 1:273-277. Reprinted in S\&U, pp.816-824.

Al-Mozainy, H. (19B1) Vowel Alternations in a Bedouin Hijazi Arabic Dialect. Unpublished Ph.D. dissertation, University of Texas, Austin.

Ames, David W., Edgar A. Gregersen, and Thomas Neugebauer (1971) Taaken Samàarii: A Drum Language of Hausa Vouth', Africa 41:12-36.

Anderson, Stephen R. (1978) 'Tone Features', in V. Fromkin (ed.), Tone. A Linguistic Survey. New York: Academic Press.
--- (1981) 'Why Phonology Isn't 'Natural'", Linguistic Inquiry 12:493-539.
--- (1982) 'The Analysis of French Schwa: Or, How to Get Something for Nothing', Language 58:534-573.

Antilla, Raimo (1975) 'Affective Vocabulary in Finnish: An(other) Invitation', Ural-Altaische Jahrbthcher 47:10-19.

Aoki, Haruo (1963) 'Reduplication in Nez Perce', International Journal of Anerican Linguistics 29:42-44.

Applegate, Joseph (1961) 'Phonological Rules of a Subdialect of English', Mord 17:186-93.

Archangeli, Diana (1984a) Underspecification in Yawelmani Phonology and Morphology. Unpublished Ph.D. dissertation, MIT.
--- (1984b) 'The Root CV-Template as a Property of the Affix: Evidence from Yawelmani', Natural Language and Linguistic Theory 1:347-385.
--- and Douglas Pulleyblank (1986) The Content and Structure of Phonological Representations. ms, University of Arizona and University of Southern California.

Arewa, Ojo and Niyi Adekola (1980) 'Redundancy Principles of Statistical Communications as Applied to Yoruba Talking-drum', Anthropos 75: 185-202.

Armstrong, Robert G. (1955) "Talking Instruments in West Africa', Explorations 4:140-153. Reprinted in 5\&U, pp.865-877.

Arnott, D.W. (1970) The Nosinal and Verbal Systess of Fula. Dxford: Clarendon Press.

Aronoff, Mark (1976) Mord Formation in Generative Grampar. Cambridge, Massachusetts: MIT Press.

Aufinger, Albert (1948) 'Secret Languages of the Small Islands Near Madang', South Pacific 3:90-95,113-20.

Bagemihl, Bruce (1984) 'Actual Aspect in Clallam: A C-V Template Analysis', ms, Indiana University and the University of British Columbia.
--- (1987) 'Tigrinya Speech Disguise and Constraints on Spreading Rules', in M. Crowhurst (ed.), Proceedings of the Mest Coast Conference on Formal Linguistics E:1-15. Stanford: Stanford Linguistics Association.
--- (1988) 'The Morphology and Phonology of Katajjait (Inuit Throat Games)', The Canadian Journal of Linguistics 33:1-58.

Bal four, Henry (1948) 'Ritual and Secular Uses of Vibrating Membranes as VoiceDisguisers', Journal of the Royal Anthropological Institute 78:45-69.

Beach, Douglas M. (1924) The Science of Tonetics and Its Application to Bantu Languages,' Bantu Studies 2:73-106.

Beaudry, Nicole (1978a) 'Toward Transcription and Analysis of Inuit Throat Games: Macro-structure', Ethnowusicology 22:26i-273.
--- (1978b) 'Le katajjaq, un jeu Inuit traditionnel', Etudes Inuit Studies 2:35-53.

Beckett, Eleanor (1974) A Linguistic Analysis of Gurpa. Unpublished M. A. thesis, University of British Columbia.

Beier, Ulli (1954) 'The Talking Drums of the Yoruba', African Masic 1:29-31. reprinted in S\&U, pp.690-692.

Bender, Marvin L., Sydney W. Head, and Roger Cowley (1976) The Ethiopian Writing System', in M.L. Bender, J.D. Bowen, R.L. Cooper, and C. A. Ferguson (eds.), Language in Ethiopia, pp. 120-129. London: Oxford University Press.

Bender, M. Lionel and Teshome Demisse (1985)' An Argot of Addis Ababa Unattached Girls', Language in Society 12:339-347.

Berkovits, Rochelle (1970) 'Secret Languages of School Children', New York Folk Quarterly 26:127-52.

Bloomfield, Leonard (1933) Language. New York: Holt, Rinehart, and Winston.
Bolinger, Dwight (1978) 'Intonation Across Languages', in J.H. Greenberg (ed.), Universals of Human Language, Vol.2: Phonology, pp.471-524. Stanfords Stanford University Press.

Borowsky, Toni (19B6) Topics in the Lexical Phonology of English. Unpublished Ph.D. dissertation, University of Massachusetts, Amherst.

Broselow, Ellen and John J. McCarthy (1983) 'A Theory of Internal Reduplication', The Linguistic Review 3: 25-98.

Burling, Robbins (1970) Man's Many Voices. New York: Holt, Rinehart, and

Winston.
Burssens, Amaat (1936) 'Le luba, langue à intonation, et le tambour-signal', in
E. Blancquaert and W. Pee (eds.), Proceedings of the 3rd International Congress of Phonetic Sciences (Ghent), pp.503-507. Ghent: Laboratory of Phonetics of the University. Reprinted in S\&U, pp.474-477.

Busnel, René-Guy (ed.) (1970a) Etudes sur la langue sifflée de Kuskby en
Turquie, Vols. 14-15 of Revue de phonétique appliquée. Mons, Belgium: Institut Polytechnique, Centre Universitaire de l'Etat. Reprinted in S\&U, pp. 1023-1173.
--- (1970b) 'Recherches expérimentales sur la langue sifflée de KuskBy', in Busnel (1970a), pp.41-75. Reprinted in S\&U, pp.1057-1089.
--- and André Classe (1976) Whistled Languages (Conmunication and Cybernetics 13). Berlin: Springer-Verlag.
---, A. Moles, and M. Gilbert (1962) 'Un cas de langue sifflee utilisée dans les Pyrénées fraņaises', Logos 5:76-91. Reprinted in S\&U, pp.881-899.
---, A. Moles, and B. Vallancien (1962) 'Sur l'aspect phonétique d'une langue sifflée des Pyréņes françaises', in A. Sovi jurvi and P. Aalto (eds.), Proceedings of the 4 th International Congress of Phonetic Sciences. (Helsinkj), pp.533-546. The Hague: Mouton. Reprinted in S\&U, pp. 900-913.

Campbell, Lyle (1974) 'Theoretical Implications of Kekchi Phonology', International Journal of Anerican Linguistics 40:269-78.
--- (1980) 'The Psychological and Sociological Reality of Finnish
Vowel Harmony', in R.M. Vago (ed.), Issues in Vowel Harmony, pp.245-270. Amsterdam: John Benjamins.
--- (1981) 'Generative Phonology vs. Finnish Phonology: Retrospect and
Prospect', in D.L. Goyvaerts (ed.), Phonology in the 1980's, pp.147-182. Ghent: Story-Scientia.
--- (1986) 'Testing Phonology in the Field', in J.J. Ohala and J.J. Jaeger (eds.), Experimental Phonology, pp.163-173. Orlando: Academic Press.

Canfield, D. Lincoln (1981) Spanish Pronunciation in the Avericas. Chicago: University of Chicago Press.

Carrington, John F. (1944) 'The Drum Language of the Lokele Tribe', African Studies 3:75-78. Reprinted in S\&U, pp.532-552.
--- (1949) Talking Druss of Africa. London: Harry Kingsgate Press. Reprinted in S\&U, pp.592-668.
--- (1953) 'Communication by Means of Gongs and Dther Instruments in Central Africa', Explorations 1:24-33. Reprinted in S\&U, pp.679-689.
--- (1957) 'Four-Toned Announcements on Mbole Talking Gongs', African Music 1:23-26. Reprinted in S\&U, pp.751-756.

Cat ford, John C. (1970) 'The Articulatory Possibilities of Man', in B. Mal mberg (ed.), Manual of Phonetics, pp.309-333. Amsterdam: North Holland Publishing Company.
--- (1977) Fundamental Problems in Phonetics. Bloomington: Indiana University Press.

Caughley, Ross C. (1976) 'Chepang Whistle Talk', in S\&U, pp.997-1022.
Cavanagh, Beverley (1976) 'Some Throat-Games of Netsilik Eskimo Women', Canadian Folk Husic Journal 4:43-47.
--- (1982) Music of the Netsilik Eskimo: A Study of Stability and Change. (National Museuv of Man Mercury Series 82) Ottawa: Musee National de l'Homme.

Centner, Th.H. (1962) L'enfant africain et ses jeux. Elisabethville, Katanga: CEPSI.

Chan, Mar jorie K.M. (1983) 'Stress and Vowel Quality Changes in the Fuzhou Chinese Dialect', ms, University of Washington. Presented at the annual meeting of the Canadian Linguistic Association, May 30-June 2, 1983, University of British Columbia.

Chao, Yuan Ren (1934) 'The Non-Uniqueness of Phonemic Solutions of Phonetic Systems', BuIletin of the Institute of History and Philology (Academia Sinica) 4:363-397.

Charron, Claude (1978) 'Toward Transcription and Analysis of Inuit ThroatGames: Micro-structure', Ethnowusicology 22:245-249.

Chen, Matthew Y. (1987) 'The Syntax of Xiamen Tone Sandhi', Phonology Yearbook 4:109-149.

Cheng, Lisa Lai Shen (1987) 'On the Prosodic Hierarchy and Tone Sandhi in Mandarin', in P. Avery and H. Yakseker (eds.), Toronto Horking Papers in Linguistics 7:24-52.

Cheon, M.A. (1905) 'L'argot annamite', Bulletin de l'Ecole Francaise d'ExtrêmeOrient 5:47-75.

Chomsky, Noam (1981) Lectures on Government and Binding. Dordrecht: Foris.
--- and Morris Halle (1968) The Sound Pattern of English. New York: Harper \& Row.

Chrisman, Dscar (1893) 'Secret Languages of Children', Science 22:303-305.
Christaller, J.G. (1933) Dictionary of the Asante and Fante Language called Tshi (Twi). 1st edition, 1881, 2nd edition, revised and enlarged, 1933. Basel: Basel Evangelical Missionary Society.
(1964) A Grampar of the Asante and Fante Language called Tshi (Chwee, Twi). 1st edition, 1875, 2nd edition, 1964. Ridgewood, New Jersey: Gregg Press.

Churma, Donald G. (1979) Arguments Frow External Evidence in Phonology. Ph. D. dissertation, Dhio State University. Published in 1985 by Garland Press, New York.
--- (1987) 'Fula Consonant Gradation as a Segmental Phonological Process: The Unexpurgated Version', ms, Stanford University.

Clarke, Roger T. (1934) 'The Drum Language of the Tumba People', Aperican Journal of Sociology 40:32-48. Reprinted in S\&U, pp.418-433.

Classe, Andre (1957a) "The Phonetics of the Silbo Gomero", Archivun Linguisticun 9:44-61. Reprinted in S\&U, pp.966-982.
--- (1957b) 'The Whistled Language of La Gomera', Scientific American 196:111120.
--- (1963) 'Les langues sifflees, squelettes informatifs du langage', in A. Moles and B. Vallancien (eds.), Communications et Langages, pp. 129-139. Reprinted in S\&U, pp.983-992.

Clements, George N. (1981a) 'The Hier archical Representation of Tone", in G.N. Clements (ed.), Harvard Studies in Phonology 2:50-108.
--- (1981b) 'Akan Vowel Harmony: a Non-linear Analysis', in G.N. Clements (ed.), Harvard Studies in Phonology 2:108-177.
--- (1985) 'The Geometry of Phonological Features", Phonology Yearbook 2: 225252.
--- (1986) 'Compensatory Lengthening and Consonant Gemination in LuGanda', in L. Wetzels and E. Sezer (eds.), Studies in Compensatory Lengthening, pp.37-77. Dordrecht: Foris.
--- and Samuel J. Keyser (19B3) CU Phonology. Cambridge, Massachusetts: MIT Press.

Coberly, Mary Schramm (1975) 'Arbitrary and Natural Features of Non-Tone Language Whistle Speech as Evidence of Diffusion', in F. Ingemann (ed.), Hid-America Linguistics Conference Papers, pp.59-70. Lawrence, Kansas: Department of Linguistics, University of Kansas.

Cole, Jennifer (19B7) PIanar Phonology and Morphology. Unpublished Ph.D.dissertation, MIT.

Conklin, Harold C. (1956) 'Tagalog Speech Disguise', Language 32:136-39.
--- (1959) 'Linguistic Play in its Cultural Context', Language 35:631-36.
Cook, Thomas L. (1969) The Pronunciation of Efik for Speakers of English. Bloomington: Intensive Language Training Center, Indiana University.

Cornyn, William (1944) Outline of Burmese Grampar (Language Dissertation no. 38). Supplement to Language 20(4). Baltimore: Waverly Press.

Coupez, A. (1969) 'Une leçon de linguistique', Africa-Tervuren 15:33-37.

Courtenay, Karen (1971) 'Yoruba: A 'Terraced-Level' Language with Three Tonemes', Studies in African Linguistics 2:239-255.
-- (1976) 'Ideophones Defined as a Phonological Class: The Case of Yoruba', Studies in African Linguistics, Supplement 6:13-26.

Cowan, George M. (1948) 'Mazateco Whistled Speech', Language 24:280-286. Reprinted in S\&U, pp.1385-1393.
--- (1952) 'El idioma silbado entre los Mazatecos de Daxaca y los Tepehuas de Hidalgo, Mexico', Tlaotani 1:31-33. Reprinted in S\&U, pp. 1394-1399.
--- (1972) 'Segmental features of Tepehua Whistle Speech', in A. Rigault and R. Charbonneau (eds.), Proceedings of the 7 th International Congress of Phonetic Sciences (Montreal), pp.695-698. The Hague: Mouton.
--- (1976) 'Whistled Tepehua', in S\&U, pp.1400-1409.
Cowan, Nelson, Martin D.S. Braine, and Lewis A. Leavitt (1985) 'The Phonological and Metaphonological Representation of Speech: Evidence from Fluent Backward Talkers', Journal of Memory and Language 24:679-698.
--- and Lewis A. Leavitt (1981) 'Juggling Acts with Linguistic Units', in C. 5. Masek, R.A. Hendrick, and M.F. Miller (eds.), Papers from the Parasession on Language and Behavior, pp.50-56. Chicago: Chicago Linguistic Society.
--- and --- (1982) 'Talking Backward: Exceptional Speech Play in Late Childhood', Journal of Child Language 9:481-495.
---, ---, Dominic Massaro, and Raymond Kent (1982) 'A Fluent Backward Talker', Journal of Speech and Hearing Research 25:48-53.

Cowper, Elizabeth A. and Keren D. Rice (1987) 'Are Phonosyntactic Rules Unnecessary?', Phonology Yearbook 4:185-194.

Dalby, David (1967) 'A Survey of the Indigenous Scripts of Liberia and Sierra Leone: Vai, Mende, Loma, Kpelle, and Bassa', African Language Studies 8:151.
-- (1968) 'The Indigenous Scripts of West Africa and Surinam: Their Inspiration and Design', African Language Studies 9:156-197.
--- (1969) 'Further Indigenous Scripts of West Africa: Manding, Wolof, and Fula Alphabets and Yoruba 'Holy' Writing', African Language Studies 10:161-181.

Davis, Henry (1987) The Acquisition of the English Auxiliary Systen and Its Relation to Linguistic Theory. Unpublished Ph.D. dissertation, University of British Columbia.

Davis, Stuart (1985) Topics in Syllable Geowetry. Unpublished Ph.D. dissertation, University of Arizona.

Dieth, Eugen (1950) Vademecus der Phonetik. Bern: Francke.

Dixon, R.M.W. (1980) The Languages of Australia. Cambridge: Cambridge University Press.

Dolphyne, Florence Abena (1965) The Phonetics and Phonolgy of the Verbal Piece in the Asante Dialect of Twi. Unpublished Ph. D. dissertation, University of London.
--- (1986) Tone and Grammar in Akan: The Tone of the Possessive Constructions in the Asante Dialect', in K. Bogers, H. van der Hulst, and M. Mous (eds.), The Representation of Suprasegeentals, pp.35-49. Dordrecht: Foris.

Dugast, Idelette (1955) 'Le langage tambouriné ou sifflé chez les banen', extract from I. Dugast, Monographie de la tribu des Ndiki (Banen des Caseroun) (=Travaux et mémaires de I'institut d'ethnologie 50), pp.567-602, Appendix I. Reprinted in S\&U, pp.70B-741.

Eboue, F. (1935) 'La clef musicale des langages tambourinés et sifflés', Bulletin du Conité d'Etudes Historiques et Scientifiques de I'Afrique Occidentale Française 18:353-360. Reprinted in S\&U, pp.434-440.

Emeneau, Murray (1969) 'Onomatopoeia in the Indian Linguistic Area', Language 45: 274-299.

Essien, U.E. (1977) 'To End Ambiguity in a Tone Language', in P.F.A. Kotey and H. Der-Houssikian (eds.), Language and Linguistic Problews in Africa, pp. 155-167. Columbia, South Carolina: Hornbeam Press.

Evans, Ivor N.H. (1923) Studies in Religion, Folklore, and Custow in British North Borneo and the Malay Peninsula. Cambridge: Cambridge University Press.

Evans-Pritchard, E.E. (1954) 'A Zande Slang Language', Man 54:185-186.
Everett, Daniel L. (1985) 'Syllable Weight, Sloppy Phonemes, and Channels in Pirahã Discourse', in M. Niepokij, M. VanClay, V. Nikiforidou, and D. Feder (eds.), Proceedings of the Eleventh Annual Meeting of the Berkeley Linguistics Society, pp.408-416. Berkeley: Berkeley Linguistics Society.
-- (1988) 'Dn Metrical Constituent Structure in Pirahã Phonology', Natural Language and Linguistic Theory 6:207-246.
--- and Keren Everett (1984) 'On the Relevance of Syllable Onsets to Stress Placement', Linguistic Inquiry 15:705-711.

Fabb, Nigel (1984) Syntactic Affixation. Unpublished Ph.D. dissertation, MIT.
--- (1986) 'English Suffixation is Constrained Only by Selectional Restrictions', paper presented at LSA Annual Meeting, New York. To appear in Natural Language and Linguistic Theory.

Farb, Peter (1973) Hord Play. New York: Al fred A. Knopf.
Faye, C.U. (1923-25) "The Influence of "Hlonipa" on the Zulu Clicks", Bulletin of the Scool of Oriental and African Studies 3:757-782.

Fee, Jane and David Ingram (1982) 'Reduplication as a Strategy of Phonological Development', Journal of Child Language 9:41-54.

Ferguson, Charles (1977) 'Baby Talk as a Simplified Register', in C. Snow and C. Ferguson (eds.), Talking to Children. Language Input and Acquisition, pp.219-236. Cambridge: Cambridge University Press.
--- (1983). 'Reduplication in Child Phonology', Journal of Child Language 10: 239-243.

Finlayson, R. (1981) 'Hlonipha-- The Women's Language of Avoidance Among the Xhosa', in W.R. Leben (ed.), Precis frow the Twelfth Conference on African Linguistics, pp.25-28. (Supplement 8 to Studies in African Linguistics.) Los Angeles: UCLA Department of Linguistics and African Studies Center.

Frachtenberg, L.J. (1918) 'Abnormal Types of Speech in Quileute', International Journal of American Linguistics 5:295-299.

Fromkin, Victoria (1985) 'Introduction [Interview with Peter Ladefoged]', in V. Fromkin (ed.), Phonetic Linguistics. Essays in Honor of Peter Ladefoged, pp.1-24. Orlando: Academic Press.

Garcia, Mauro (1934) 'Secret Dialects in Tagalog', Philippine Magazine 31:2830.

Gathercole, Geoffrey (1983) 'Tonogenesis and the Kickapoo Tonal System', IJAL 49:72-76.

Goldie, Hugh (1964) Dictionary of the Efik Language. 1st edition, 1874, 2nd edition, 1964. Ridgewood, New Jersey: Gregg Press.

Goldsmith, John (1976) Autosegpental Phonology, Ph.D. dissertation, MIT. Published by Garland Press, 1979.
--- (1981) 'English as a Tone Language', in D.L. Goyvaerts (ed.), Phonology in the 1980's (Story-Scientia Linguistics Series 4), pp.287-308. Ghent: StoryScientia.

Greenberg, Joseph (1954) Essays in Linguistics. Chicago: University of Chicago Press.
--- (1969) 'Some Methods of Dynamic Comparison in Linguistics', in J. Puhvel (ed.), Substance and Structure of Language, pp.147-203. Berkeley: University of California Press.

Griaule, Marcel (1935) Jeux et divertissenents abyssins. Paris: Libraire Ernest Leroux.

Guillemin, L. (1948) 'Le tambour d'appel des Ewondo', Etudes Canerounaises 21-22:69-89. Reprinted in S\&U, pp.574-588.

Guilleminet, P. (1960/62) 'Langages speciaux utilisés dans la tribu Bahnar de Kontum (Sud Viêt-Nam-Indochine)', Bulletin de l'Ecole Frangaise d'ExtrêmeOrient 1:117-32.

Gumperz, John J. (1969) 'Communication in Multilingual Societies', in S.A. Tyler (ed.), Cognitive Anthropology, pp.435-449. New York: Holt, Rinehart, and Winston.

Guthrie, Malcoln (1953) The Bantu Languages of Western Equatorial Africa. London: Oxford University Press.

Haas, Mary (1964) 'Men's and Women's Speech in Koasati', in D. Hymes (ed.), Language in Culture and Society, pp.228-233. New York: Harper and Row.
--- (1967) 'A Taxonomy of Disguised Speech', paper presented at the annual meeting of the LSA.
--- (1969) 'Burmese Disguised Speech', Bulletin of the Institute of History and Philology (Academia Sinica) 39:277-285.

Hale, Kenneth (1971) 'A Note on a Walbiri Tradition of Antonymy', in D.D. Steinberg and L.A. Jakobovits (eds.), Semantics: An Interdisciplinary Reader in Philosophy, Linguistics, and Psychology, pp.472-482. London: Cambridge University Press.
--- (1973) 'Deep-Surface Canonical Disparities in Relation to Analysis and Change: An Australian Example', Current Trends in Linguistics 11:401-458.

Halle, Morris (1962) 'Phonology in Generative Grammar', Mord 18:54-72.
--- and K.P. Mohanan (1985) 'Segmental Phonology of Modern English', Linguistic Inquiry 16:57-116.
--- and Jean-Roger Vergnaud (1982) ' On the Framework of Autosegmental Phonology', in H. van der Hulst and N. Smith (eds.), The Structure of Phonological Representations, Part I, pp.65-82. Dordrecht: Foris.
--- and --- (1980) 'Three Dimensional Phonology', Journal of Linguistic Research 1:83-105.
--- and --- (1987) 'Stress and the Cycle', Linguistic Inquiry 18:45-84.
Hammond, Michael (1982) 'Foot Domain Rules and Metrical Locality', in D.P. Flickinger, N. Macken, and N. Wiegand (eds.), Proceedings of the Hest Coast Conference in Formal Linguistics 1:207-218. Stanford: Stanford Linguistics Association.
--- (1984) Constraining Metrical Theory: A Hodular Theory of Rhythm and Destressing. Ph.D. dissertation, UCLA. Revised version distributed by the Indiana University Linguistics Club.
--- (1986) 'The Obligatory Branching Parameter in Metrical Theory', Natural Language and Linguistic Theory 4:185-228.

Haraguchi, Shosuke (1982) 'An Autosegmental Theory: Its Expansion and Extension', Journal of Linguistic Research 5:59-80.

Harris, J.W. (1980) 'Nonconcatenative Morphology and Spanish Plurals',

Journal of Linguistic Research 115-31.
Harrison, Sheldon (1976) Mokilese Reference Gramar. Honolulu: University Press of Hawaii.

Hasler, Juan A. (1960) 'El lenguage silbado', La Palabra y el Hombre (=Revista de la Universidad Veracruzana) 15:25-36. Reprinted in S\&U, pp.1412-1425.

Hayes, Bruce (1981) A Metrical Theory of Stress Rules. Ph.D. dissertation, MIT. Revised version distributed by Indiana University Linguistics Club.
--- (1984) 'The Prosodic Hierarchy in Meter', to appear in P. Kiparsky and G. Youmans (eds.), Rhyths and Meter. Orlando: Academic Press.
--- (1986a) 'Assimilation as Spreading in Toba Batak', Linguistic Inquiry 17:467-99.
--- (1986b) 'Inalterability in CV Phonology', Language 62:321-353.
Henderson, Eugenie (1965) Tiddim Chin. An Analysis of Two Texts. London: Oxford University Press.

Herzog, George (1945) 'Drum-Signaling in a West African Tribe', Word 1:217-238. Reprinted in 5\&U, pp.553-573.

Hetzron, Robert (1964) 'La voyelle du sixième ordre en amharique', Journal of African Languages 3:179-190.

Hirshberg, Leonard Keene (1913) "'Dog Latin' and Sparrow Languages Used by Baltimore Children', Pedagogical Seminar 20:257-58.

Hoard, James (1978) 'Syllabication in Northwest Indian Languages, with Remarks on the Nature of Syllabic Stops and Affricates', in A. Bell and J.B. Hooper (eds.), Syllables and Segeents, pp.59-72. Amsterdam: North Holland.

Hockett, Charles F. (1955) A Manual of Phonology. (Indiana University Publications in Anthropology and Linguistics, IJAL Mevoir 11). Bloomington: Indiana University Press.
--- (1958) A Course in Modern Linguistics. New York: The Macmillan Company.
Holmer, Nils M. (1947) Critical and Comparative Grassar of the Cuna Language. Gothenburg: Elanders Boktryckeri Aktiebolag.

Hombert, Jean-Marie (1973) 'Speaking Backwards in Bakwiri', Studies in African Linguistics 4:227-36.
-- (1986) 'Word Games: Some Implications for Analysis of Tone and Other Phonological Constructs', in J.J. Ohala and J.J. Jaeger (eds.), Experisental Phonology, pp.175-186. Drlando: Academic Press.

Hood, Mantle (1982) The Ethnomsicologist. 2nd ed. Kent, Ohio: Kent State University Press.

Hualde, Jose (1987) 'On Basque Affricates', in M. Crowhurst (ed.), Proceedings
of the Hest Coast Conference on Formal Linguistics 6:77-89. Stanford: Stanford Linguistics Association.

Huang, C.T.J. (1980) 'The Metrical Structure of Terraced-Level Tones', Proceedings of NELS 10:257-270.

Hyman, Larry M. (1976) 'Phonologization', in A. Juillard (ed.), Linguistic Studies Offered to Joseph Greenberg, Vol.2: Phonology, pp.407-418. Saratoga, California: Anma Libri.
--- (1983) 'Are There Syllables in Gokana?', in J. Kaye, H. Koopman, D. Sportiche, and A. Dugas (eds.), Current Issues in African Linguistics (vol.2), pp.171-179. Dordrecht: Foris.
-- (1985) A Theory of Phonological Height. Dordrecht: Foris.
--- (1986) 'The Representation of Multiple Tone Heights', in K. Bogers, H. van der Hulst, and M. Mous (eds.), The Phonological Representation of Suprasegmentals, pp.109-152. Dordrecht: Foris.
--- and Russell G. Schuh (1974) 'Universals of Tone Rules: Evidence from West Africa', Linguistic Inquiry 5:81-115.

Ingram, David (1974) 'Phonological Rules in Young Children', Journal of Child Language 1:49-64.

Ingria, Robert (1980) 'Compensatory lengthening as a Metrical Phenomenon', Linguistic Inquiry 11:465-95.

Iṣola, Akinwumi (1992) 'Ena: Code-Talking in Yoruba', Journal of Mest African Languages 12:43-51.

Kahn, Daniel (1976) Syllable-based Generalizations in English Phonology. Ph.D. dissertation, MIT. Distributed by the Indiana University Linguistics Club, Bloomington.

Kaisse, Ellen (1985) Connected Speech: The Interaction of Syntax and Phonology. New York: Academic Press.
--- and Patricia A. Shaw (1985) 'On the Theory of Lexical Phonology', Phonology Yearbook 2:1-30.
--- and Arnold M. Zwicky (1987) 'Introduction: Syntactic Influences on Phonological Rules' Phonology Yearbook 4:3-11.

Kaye, Jonathan and Jean Lowenstamm (1985) 'On the Syllable Structure of Certain West African Languages', in D.L. Goyvaerts (ed.), African Linguistics. Essays in Honor of M.h.K. Semikenke, pp.285-30B. Amsterdam: John Benjamins.

Kenstowicz, Michael J. (1982) 'Gemination and Spirantization in Tigrinya', Studies in the Linguistic Sciences 12:103-122.
--- and Charles Kisseberth (1979) Generative Phonology: Description and Theory. New York: Academic Press.

Key, Harold (1965) 'Some Semantic Functions of Reduplication in Various Languages', Anthropological Linguistics 7:88-101.

Kimberlin, Cynthia Tse (1980) 'The Music of Ethiopia', in E. May (ed.), Musics of Many Cultures, pp.232-252. Berkeley: University of California Press.

Kinkade, M. Dale (1976) 'Columbian Salish Imitative Words', ms, University of British Columbia. Presented at the annual meeting of the American Anthropological Association, Washington, D.C.

Kiparsky, Paul (1982) 'From Cyclic Phonology to Lexical Phonology', in H. van der Hulst and N. Smith (eds.), The Structure of Phonological Representations, Part I, pp.131-175. Dordrecht: Foris.
--- (1985) 'Some Consequences of Lexical Phonology', Phonology Yearbook 2:85138.

Kirshenblatt-Gimblett, Barbara (1976)'Bibliographic Survey of the Literature on Speech Play and Related Subjects', in B. Kirshenblatt-Gimblett (ed.), Speech Play, pp.179-223. Philadelphia: University of Pennsylvania Press.

Klima, Edward S. and Ursula Bellugi, with R. Battison, P. Boyes-Braem, S. Fischer, N. Frishberg, H. Lane, E.M. Lentz, D. Newkirk, E. Newport, C.C. Pederson, and P. Siple (1979) The Signs of Language. Cambridge, Massachusetts: Harvard University Press.

Labouret, H. (1923) 'Langage tambourine et sifflé, Bulletin du Cosité d'Etudes Historiques et Scientifiques de l'Afrique Occidentale Francaise 6:120-158. Reprinted in S\&U, pp.33-57.

Ladefoged, Peter (1971) Preliminaries to Linguistic Phonetics, University of Chicago Press, Chicago.
--- (1980) 'What Are Linguistic Sounds Made Df?', Language 56, 485-502.
--- (1982) A Course in Phonetics. 2nd ed. New York: Harcourt, Brace, Jovanovich.

Langdon, Margaret (1978) 'Animal Talk in Cocopa', International Journal of American Linguistics 44:10-16.

Laughren, Mary (1984) 'Warlpiri Baby Talk', Australian Journal of Linguistics 4:73-88.

Laycock, Don (1969) 'Sublanguages in Buin: Play, Poetry, and Preservation', Pacific Linguistics A.22:1-23.
--_ (1972) 'Towards a Typology of Ludlings, or Play Languages', Linguistic Communications (Morking Papers of the Linguistic Society of Australia) E:61-113.
--- (1975) 'Special Languages in Parts of the New Guinea Area's in S.A. Wurm (ed.), Nen Guinea Area Languages and Language Study, Vol.3: Language, Calture, Society, and the Modern Morld, pp.133-149. Pacific Linguistics Series C, 40.

Leenhardt, Maurice (1946) Langues et dialectes de l'Austro-Mélanésie. Travaux et ménoires de l'institut d'ethnologie, vol. 46. Paris: Université de Paris.

Lefkowitz, Natalie J. (1987) Talking Backwards and Looking Formards: The French Language Gase Verlan. Unpublished Ph.D. dissertation, University of Washington.
-- and Steven H. Weinberger (1987) 'The First Branch Principle and Parameter Setting in Language Games: The Case of Verlan', paper presented at the 62nd annual meeting of the LSA, San Francisco, California.

Lehiste, Ilse (1970) Suprasegmentals. Cambridge, Massachusetts: MIT Press.
-- (1985) 'An Estonian Word Game and the Phonematic Status of Long Vowels', Linguistic Inquiry 1E:490-92.

Lenneberg, E.H. (1970) 'An Acoustic Analysis of the Turkish Whistling Language of KuskBy', in Busnel (1970a), pp. 25-39. Reprinted in S\&U, pp.1043-1056.

Leroy, C. (1970a) 'Etudes de phonétique comparative de la langue turque sifflee et parlee', in Busnel (1970a), pp.119-161. Reprinted in S\&U, pp.1128-1164.
--- (1970b) 'An Ecological Study', in Busnel (1970a), pp.13-24. Reprinted in S\&U, pp.1031-1042.

Leslau, Wolf (1939) 'Observations sur quelques dialectes du tigrigna', Journal Asiatique 231:61-115.
-.- (1941) Documents tigrigna (éthiopien septentrional): Grapmaire et textes. Paris: Klincksieck.
--- (1964) Ethiopian Argots. The Hague: Mouton.
Levin, Juliette (1983) 'Reduplication and Prosodic Structure', paper presented at GLOW, York, England
--- (1985) A Metrical Theory of Syllabicity. Unpublished Ph.D. dissertation, MIT.
-- (1987) 'Between Epenthetic and Excrescent Vowels (or What Happens After Redundancy Rules)', in M. Crowhurst (ed.), Proceedings of the Hest Coast Conference on Formal Linguistics 6:187-201. Stanford: Stanford Linguistics Association.

Liberman, Mark and Janet Pierrehumbert (1984) 'Intonational Invariance Under Changes in Pitch Range and Length', in M. Aronoff and R.T. Dehrle (eds.), Language Sound Structure, pp.157-233. Cambridge, Massachusett5: MIT Press.
--- and Alan Prince (1977) 'On Stress and Linguistic Rhythm', Linguistic Inquiry 8:249-336.

Lieber, Rochelle (1980) On The Organization of the Lexicon. Unpublished Ph.D.
dissertation, MIT.
_-_ (1983) 'New Developments in Autosegmental Morphology: Consonant Mutation', in M. Barlow, D. Flickinger, and M. Wescoat (eds.), Proceedings of the hest Coast Conference on Formal Linguistics 2:165-175. Stanford: Stanford Linguistics Association.
--- (1987) 'Morphology and the Morphemic Tier Hypothesis', ms., University of New Hampshire and MIT.

Lindblom, Bjdrn, James Lubker, and Thomas Gay (1979) 'Formant Frequencies of Some Fixed-Mandible Vowels and a Model of Speech Motor Programming by Predictive Simulation', Journal of Phonetics 7:147-161

Lowenstanm, Jean and Jonathan Kaye (1986) 'Compensatory Lengthening in Tiberian Hebrew', in L. Wetzels and E. Sezer (eds.), Studies in Compensatory Lengthening, pp.97-146. Dordrecht: Foris.
--- and Jean-Francois Prunet (1985) 'On Certain Nominal Patterns in Tigrinya', in Precis frop the 15th Conference on African Linguistics (Studies in African Linguistics, supplement 9).
-- and Jean-Francois Prunet (1996) 'Le tigrinya et le principe du contour obligatoire', Revue Quebecoise de Linguistique 16:181-207.

Lubker, James F. (1979) 'The Reorganization Times of Bite-Block Vowels', Phonetica 36:273-293.

Lush, Allan J. (1935) 'Kiganda Drums', Uganda Journal 3:7-20. Reprinted in S\&U, pp. 458-473.

Maddieson, Ian (1978) 'Universals of Tone', in J. Greenberg (ed.), Universals of Human Language, Vol.2: Phonology, pp.335-366. Stanford: Stanford University Press.

Marantz, Alec (1982) 'ReReduplication', Linguistic Inguiry 13:483-545.
McCarthy, John J. (1979) Formal Problens in Semitic Phonology and Morphology. Unpublished Ph.D. dissertation, MIT.
--- (1981) 'A Prosodic Theory of Nonconcatenative Morphology', Linguistic Inquiry 12:373-418.
--_ (1982) 'Prosodic Templates, Morphemic Templates, and Morphemic Tiers', in H. van der Hulst and N. Smith (eds.), The Structure of Phonological Representations I, pp.191-223. Dordrecht: Foris.
--- (1983) 'Consonantal Morphology in the Chaha Verb', in M. Barlow, D. Flickinger, and M. Wescoat (eds.), Proceedings of the West Coast Conference on Formal Linguistics 2:176-188. Stanford: Stanford Linguistics Association.
--- (1985) 'Speech Disguise and Phonological Representation in Amharic', in H. van der Hulst and N. Smith (eds.), Advances in Non-linear Phonology: Results of the Ansterdan Workshop on Non-1inear Phonology, 8 th-12th August 1983, pp.305-312. Dordrecht: Foris.
-- (1986) 'OCP Effects: Gemination and Antigemination', Linguistic Inquiry 17:207-263.
(to appear) 'Feature Geometry and Dependency', to appear in O. Fujimura (ed.), Articulatory Organization-- Frow Phonology to Speech Signals. Basel: 5. Karger.
(in press) 'Linear Order in Phonological Representation', to appear in Lingustic Inquiry 20(1).
--- and A. Prince (1986) Prosodic Morphology. ms, University of Massachusetts, Amherst and Brandeis University.

McCawley, James (1978) 'What is a Tone Language?', in V. Fromkin (ed.), Tone. A Linguistic Survey, pp.113-131. New York: Academic Press.

McIntosh, Mary (1984) Fulfulde Syntax and Verbal Morphology. Boston: Kegan Pal International.

Mohanan, K.P. (1982) Lexical Phonology. Unpublished Ph.D. dissertation, MIT. Distributed by Indiana University Linguistics Club, Bloomington.
--- (1986) The Theory of Lexical Phonology. Dordrecht: Reidel.
--- and Tara Mohanan (1984) 'Lexical Phonology of the Consonant System of Malayalam', Linguistic Inquiry 15:575-602.

Moles, A. (1970) 'Etude socio-linguistique de la langue sifflée de Kuskby', in Busnel (1970a), pp.77-118. Reprinted in S\&U, pp. 1090-1127.

Montpetit, Carmen and Celine Veillet (1977) 'Recherches en ethnomusicologie: les katajjait chez les Inuit du Nouveau-Qubbec', Etudes Inuit Studies 1:154-164.

Moravesik, Edith A. (1977) On Rules of Infixing. Bloomington: Indiana University Linguistics Club.
--- (1978) 'Reduplicative Constructions', in J. Greenberg (ed.), Universals of Human Language, Vol.3: Hord Structure, pp.297-334. Stanford: Stanford University Press.

Munson, Joy and David Ingram (1985) 'Morphology Before Syntax: A Case Study from Language Acquisition', Journal of Child Language 12:681-684.

Nash, David (1980) Topics in Harlpiri Grampar. Ph.D. dissertation, MIT. Published in 1986 by Garland Press, New York.

Nattiez, Jean-Jacques (1982) 'Comparison within a Culture: The Katajjaq of the Inuit', in R. Falck and T. Rice (eds.), Cross-Cultural Perspectives on Wusic, pp.134-140. Toronto: University of Toronto Press.
--- (1983a) 'Some Aspects of Inuit Vocal Games', Ethnomusicology 27:457-475.
--- (1983b) 'The Fekkukara of the Ainu (Japan) and the Kataj.jaq of the Inuit (Canada): A Comparison', The Horld of Music 25:33-44.

Nekes, P. Hermann (1912) 'Trommel sprache und Fernruf bei den Jaunde und Dual a in Sudkamerun', Mitteilungen des Seminars far orientalische Sprache 15:6983. Reprinted in 5\&U, pp. 289-306.

Newman, Paul (1968) 'Ideophones from a Syntactic Point of View', Journal of West African Languages 5:107-118.

Nketia, J.H. Kwabena (1962) 'The Hocket-Technique in African Music' Journal of the International Folk Music Council 14:44-52.
--- (1963a) Drumping in Akan Communities of Ghana. Edinburgh: Thomas Nelson and Sons: Extract reprinted in S\&U, pp.772-805.
--- (1963b) African Masic in Ghana. Evanston, Illinois: Northwestern University Press.
--- (1971) 'Surrogate Languages of Africa', in T.A. Sebeok (ed.) Current Trends in Linguistics, Vol.7: Linguistics in Sub-Saharan Africa, pp.699732. The Hague: Mouton. Reprinted in 5\&U, pp.825-864.

Noye, Dominique (1970) Cours pratique de Languae peul. Maroua, Cameroon: Mission Catholique.
--- (1971) Un cas d'apprentissage linguistiques L'acquisition de la Langue par les jeunes Peuls du Diamare (Nord-Cameroun). Paris: Geuthner.
--- (1975) 'Langages secrets chez les Peul', African Languages 1:81-95.

Nyaggah, Lynette (1976) 'Associative Tone and Syllable Structure in Asante Twi', in L.M. Hyman, L.C. Jacobson, and R.G. Schuh (eds.) Papers in African Linguistics in Honor of He.E. Helmers, Studies in African Linguistics Supplement 6, pp: 191-200.

Ddden, David (1986) 'On the Role of the Obligatory Contour Principle in Phonological Theory', Language 62:353-383.
_-_ (1987) 'Kimatuumbi Phrasal Phonology', Phonology Yearbook 4:13-36.
Ohala, John J. (1986) 'Consumer's Guide to Evidence in Phonology', Phonology Yearbook 3:3-26.

Olmstead, David L. (1951) 'The Phonemes of Yoruba', Mord 7:245-249.
Otsikrev, Artsid (1963) Play Languages and Language Play. Hillsboro, Oregon: Esperanto.

Padden, Carol A. and David M. Perlmutter (1987) 'American Sign Language and the Architecture of Phonological Theory', Natural Language and Linguistic

Theory 5:335-375.
Palmer, F.R. (1957) 'Gemination in Tigrinya', in Philological Society (ed.), Studies in Linguistic Analysis, pp.139-4B. Oxford: Dxford University Press.

Pam, M.D. (1973) Tigrinya Phonology. Unpublished Ph.D. dissertation, CUNY.
Paradis, Carole (1988a) 'Towards a Theory of Constraint Violations', ms, MIT. (to appear in NcGill Morking Papers in Linguistics)
--- (1988b) 'Paramètres négatifs et contraintes particulières', paper presented at the Canadian Linguistic Association annual meeting, May 29, 1988, University of Windsor.

Passy, P. (1914) The Sounds of the French Language, Their Formation, Copbination and Representation, 2nd. ed., translated by D.L. Savoy and D. Jones. Oxford.
--- (1922) Petite phonétique comparée des principales lanques européennes, Brd ed. Leipzig.

Perlmutter, David M. (1986) 'No Nearer to the Soul', Topic... Comment in Natural Language and Linguistic Theory 4:515-523.

Piggott, Glyne L. (1987) 'On the Autonomy of the Feature Nasal', in A. Bosch, B. Need, and E. Schiller (eds.), Papers frow the Parasession on Autosegmental and Hetrical Phonology, pp.223-238. Chicago: Chicago Linguistic Society.
--- and Rajendra Singh (1985) 'The Phonology of Epenthetic Segments', Canadian Journal of Linguistics 30:415-451.

Pierrehumbertg Janet (1980) The Phonology and Phonetics of English Intonation. Ph.D. dissertation, MIT. Distributed by Indiana University Linguisties Club, 1987.

Pike, Kenneth L. (1943) Phonetics. Ann Arbor: University of Michigan Press.
--- (1948) Tone Languages. Ann Arbor: University of Michigan Press.
--- (1970) 'The Role of Nuclei of Feet in the Analysis of Tone in Tibeto-Burman Languages of Nepal', in P.R. Leon, G. Faure, and A. Rigault (eds.), Prosodic Feature Analysis/ Analyse des Faits Prosodiques (=Studia Phonetica III). Montreal: Didier. Reprinted in S\&U, pp.993-996.
--- and Eunice V. Pike (1947) 'Immediate Constituents of Mazateco Syllables', IJAL 13:78-91.

Price, Richard and Sally Price (1976) 'Secret Play Languages in Saramaka: Linguistic Disguise in a Caribbean Creole', in B. Kirshenblatt-Gimblett (ed.), Speech Play, pp.37-50. Philadelphia: University of Pennsylvania Press.

Prunet, Jean-François (1986) Spreading and Locality Dowains in Phonology.

Unpublished Ph.D. dissertation, McGill University.
Pulleyblank, Douglas (1983) 'Accent in Kimatuumbi', in J. Kaye, H. Koopman, D. Sportiche, and A. Dugas (eds.), Current Approaches to African Linguistics Vol. 2, pp. 195-215. Dordrecht: Foris.
--- (1985) 'Phrasal Morphology in Yoruba', Proceedings of the Mest Coast Conference on Formal Linguistics 4.
--- (1986) Tone in Lexical Phonology. Dordrecht: Reidel.
-- (1988) 'Vocalic Underspecification in Yoruba', Linguistic Inquiry 19:233270.

Rattray, R.S. (1922) 'The Drum Language of West Africa', Journal of the African Society 22:226-236, 302-316. Reprinted in 5\&U, pp.366-389.

Raum, Otto (1937) 'Language Perversions in East Africa', Africa 10:221-226.
Ray, Verne F. (1945) 'The Contrary Behavior Pattern in American Indian Ceremonialism', Southwestern Journal of Anthropology 1:75-113.

Read, Gardner (1969) Music Notation. 2nd ed. Boston: Allyn and Bacon.
Redden, James E. (1979) A Descriptive Grammar of Ewondo. Occasional Papers in Linguistics 4, Department of Linguistics, Southern Illinois University.

Reinhart, Tanya (1976) The Syntactic Dowain of Anaphora. Unpublished Ph.D. dissertation, MIT.

Resnick, Melvyn C. (1975) Phonological Variants and Dialect Identification in Latin Averican Spanish. The Hague: Mouton.

Rialland, Annie (1981a)' Le sifflement des tons et les structures syllabiques en Gurma (parler de Botou)', in W.U. Dressler, D.E. Pfeiffer, and J.R. Rennison (eds.), Phonologica 1980, pp.357-363. Innsbruck: Institut fur Sprachwissenschaft der Universitat Innsbruck.
-- (1981b) 'Le système tonal du gurma, langue gur de Haute-Volta', Journal of African Languages and Linguistics 3:39-64.
--- (1983) 'Le système tonal du moba compar巨 à celui du gurma', in J. Kaye, H. Koopman, D. Sportiche, and A. Dugas (eds.), Current Approaches to African Linguistics, Vol.2, pp. 217-234. Dordrecht: Foris.

Rice, Keren D. (1987) 'The Function of Structure Preservation: Derived Environments', Proceedings of NELS 16.

Ritzenthaler, R.E. and F.A. Peterson (1954) 'Courtship Whistling of the Mexican Kickapoo Indians', Aperican Anthropologist 56:1088-1089. Reprinted in S\&U, pp.1410-1411.

Sadtano, E. (1971) 'Language Games in Javanese', in J. Sherzer, L. Foley, Sister C. Johnson, N.A. Johnson, A. Palakornkul, and E. Sadtano, A Collection of Linguistic Games. Penn-Texas Working Papers in

Sociolinguistics 2. Austin: University of Texas.
Sagey, Elizabeth (1986) The Representation of Features and Relations in NonLinear Phonology. Unpublished Ph.D. dissertation, MIT.
--- (198Ba) 'On the Ill-formedness of Crossed Association Lines', Linguistic Inquiry 19:109-118.
--- (198Bb) 'Non-constituent Spreading in Barra Gaelic', ms, University of California-Irvine.

Saladin d'Anglure, Bernard (1978) 'Entre cri et chant: les katajjait, un genre musical feminin', Etudes Inuit Studies 2:85-94.

Samarin, William (1970) 'Inventory and Choice in Expressive Language', Hord 2E:153-169.

Sandler, Wendy (1987) Sequentiality and Siaultaneity in American Sign Language Phonology. Unpublished Ph.D. dissertation, University of Texas, Austin.

Sapir, Edward (1915) Abnormal Types of Speech in Nootka. Canada, Department of Mines, Geological Survey, Memoir 62; Anthropological Series No. 5. Ottawa: Government Printing Bureau.
--- (1921) Language. New York: Harcourt, Brace.
--- (1931) 'Notes on the Gweabo Language in Liberia', Language 7:30-41.
--- (1933) 'La realite psychologique des phonemes', in P. Janet and G. Dumas (eds.), Psychologie du Langage, pp.247-265. Paris: Alcan.

Saussure, Ferdinand de (1916) Cours de linguistique generale. Paris: Payot. Translated (1966) as Course in General Linguistics. New York: McGraw-Hill.

Schachter, Paul (1961) 'Phonetic Similarity in Tonemic Analysis', Language 37:231-23日.
--- (1969) 'Natural Assimilation Rules in Akan', IJAL 35:342-355.
--- and Victoria Fromkin (1968) A Phonology of Akan: Akuapen, Asante and Fante. UCLA Working Papers in Phonetics 9.
--- and Fe T. Otanes (1972) Tagalog Reference Grammar. Berkeley: University of California Press.

Schadeberg, Thilo C. (1977) 'Anticipation of Tone: Evidence from Bantu', in P.F.A. Kotey and H. Der-Houssikian (eds,), Language and Linguistic Problews in Africa, pp.195-204. Columbia, South Carolina: Hornbeam Press.

Schane, Sanford A. (1968) French Phonology and Morphology. Cambridge, Massachusetts: MIT Press.

Schein, Barry (1981) 'Spirantization in Tigrinya', HIT Morking Papers in Linguistics 3:32-42.
--- and Donca Steriade (1986) 'On Geminates', Linguistic Inquiry 17:691-744.
Schlegel, G. (1891) 'Secret Languages in Europe and China', T'oung Pao 2:161.
Schlesier, Karl H. (1987) The Holves of Heaven: Cheyenne Shamanism, Ceremonies, and Prehistoric Origins. Norman, Oklahoma: University of Oklahoma Press.

Schlindwein, Deborah (1985) 'Tier Alignment in Reduplication', Proceedings of NELS 16:419-433.

Schwartz, Richard G., Lawrence B. Leonard, M. Jeanne Wilcox, and M. Karen Folger (1980) 'Again and Again: Reduplication in Child Phonology', Journal of Child Language 7:75-87.

Sebeok, Thomas A. and Donna Jean Umiker-Sebeok (eds.) (1976) Speech Surrogates: Drum and Whistle Systems (2 Volumes). The Hague: Mouton.

Selkirk, Elisabeth 0. (1982) The Syntax of Words. Cambridge, Massachusetts: MIT Press.
--- (1984) Phonology and Syntax: The Relation Between Sound and Structure. Cambridge, Massachusetts: MIT Press.
--- (1985) 'Intonation, Stress, and Meaning', in M. Niepokij, M. VanClay, V. Nikiforidou, and D. Feder (eds.), Proceedings of the Eleventh Annual Heeting of the Berkeley Linguistics Society, pp.408-416. Berkeley: Berkeley Linguistics Society.
--- (1986) 'On Derived Domains in Sentence Phonology', Phonology Yearbook 3:371-405.

Seppanen, Jouko (1982) Computing Fanilies of Natural Secret Languages: An Exercise in Functional Linguistics. Helsinki: Helsinki University of Technology Computing Centre.

Shankara Bhat, D.N. (1968) 'The Secret Code of South Kanara Devil Dancers', Anthropological Linguistics 10:15-18.

Shaw, Patricia A. (1985) 'The Role of Prosodic Structure in Reduplication', ms, University of British Columbia. Presented at the annual meeting of the Canadian Linguistic Association, Universite de Montreal, June 1985.
--- (1987) 'Non-Conservation of Melodic Structure in Reduplication', in A. Bosch, B. Need, and E. Schiller (eds.), Papers from the Parasession on Autosegwental and Netrical Phonology, pp.291-306. Chicago: Chicago Linguistic Society.

Sherzer, Joel (1970) 'Talking Backwards in Cuna: The Sociological Reality of Phonological Descriptions', Southwestern Journal of Anthropology 26:343353.
(1976) 'Play Languages: Implications for (Socio)Linguistics', in B. Kirshenblatt-Gimblett (ed.), Speech Play, pp.19-36. Philadelphia: University of Pennsylvania Press.
--- (1982) 'Play Languages: With a Note on Ritual Languages', in L.K. Obler and L. Menn (eds.), Exceptional Language and Linguistics; pp.175-199. New York: Academic Press.

Simmons, Donald C. (1955) 'Efik Iron Gongs and Gong Signals', Man 55: 107-108. Reprinted in S\&U, pp.742-745.
--- (1980) Extralinguistic Usages of Tonality in Etik Folklore. University, Alabama: University of Alabama Press.

Smalley, William (1967) Hanual of Articulatory Phonetics. Tarryton: Practical Anthropology.

Smith, Norval (19B5) 'Spreading, Reduplication, and the Default Option in Miwok Nonconcatenative Morphology', in H. van der Hulst and N. Smith (eds.), Advances in Non-I inear Phonology: Results of the Ansterdan Horkshop on Nonlinear Phonology, Bth-12th August 1983, pp.363-80. Dordrecht: Foris.

Snyders, J. (1969) 'Le langage par tambours à San Cristoval, British Solomon Islands', Journal de la Societé des Oceanistes 24:133-138. Reprinted in S\&U, pp. 1293-1299.

Sproat, Richard (1985) On Deriving the Lexicon. Unpublished Ph.D. dissertation, MIT.

Steere, E. (1955) A Handbook of the Swahili Language. 4th ed. revised by A. B. Hellier. London: Sheldon Press.

Steriade, Donca (1987) 'Locality Conditions and Feature Geometry', in J. McDonough and B. Plunkett (eds.), Proceedings of NELS 17: 595-617. Amherst: GLSA, University of Massachusetts.
--- (1988) 'Reduplication and Syllable Transfer in Sanskrit and Elsewhere', Phonology 5:73-155.

Stern, Theodore (1957) 'Drum and Whistle 'Languages': An Analysis of Speech Surrogates', Aperican Anthropologist 59:487-506. Reprinted in S\&U, pp.124148.
-- (1963) 'A Provisional Sketch of Sizang (Siyin) Chin', Asia Hajor 10:222278.

Stewart, John M. (1971) 'Niger-Congo, Kwa', in T.A. Sebeok (ed.) Current Trends in Linguistics, Vol.7: Linguistics in Sub-Saharan Africa, pp.178-212, The Hague: Mouton.

Stowell, Tim (1979) 'Stress Systems of the World, Unite!', in K. Safir (ed.), Papers in Syllable Structure, Netrical Structure, and Harmony Processes. MIT Horking Papers in Linguistics 1:51-76.

Suharno, Ignatius (1982) A Descriptive Study of Jayanese. Pacific Linguistics Series D, no.45. Canberra: Australian National University.

Surintramont, Aporn (1973) 'Some Aspects of Underlying Syllable Structure in Thai: Evidence from Khampuan-- A Thai Word Game', Studies in the Linguistic

Sciences 3:121-142.

Taylor, Allan R. (1975) 'Nonverbal Communication Systems of Native North America", Semiotica 13:329-374.

Tranel, Bernard (1981) Concreteness in Generative Phonology. Berkeley: University of California Press.

Treiman, Rebecca (1983) 'The Structure of Spoken Syllables: Evidence from Novel Word Games', Cognition 15:49-74.

Trevor, J.C. and C.M.N. White (1955) 'Backwards Languages in Africa', Man 55:96.

Tucker, A.N. (1964) 'Systems of Tone-Marking African Languages', Bulletin of the School of Oriental and African Studies 27:594-611.
--- (1971) 'Orthographic Systems and Conventions in Sub-Saharan Africa', in T.A. Sebeok (ed.) Current Trends in Linguistics, Vol.7: Linguistics in SubSaharan Africa, pp.618-653. The Hague: Mouton.

Ullendorff, Edward (1955) The Sevitic Languages of Ethiopia. London: Taylor's (Foreign) Press.

Umiker, Donna Jean (1974) 'Speech Surrogates: Drum and Whistle Systems', in T.A. Sebeok (ed.), Current Trends in Linguistics, Vol. I2: Linguistics and Adjacent Arts and Sciences, pp.497-536. The Hague: Mouton.

Vago, Robert M. (1985) 'The Treatment of Long Vowels in Word Games', Phonology Yearbook 2:329-342.

Voegeling Charles F. and Florence M. Voegelin (1977) Classification and Index of the Horld's Languages. New York: Elsevier.

Voorhis, Paul H. (1971) 'Notes on Kickapoo Whistle Speech', IJAL 37:238-293. Reprinted in S\&U, pp.1434-1443.
--- (1974) Introduction to the Kickapoo Languege. (Language Science Konographs 13). Bloomington: Indiana University Press.

Warren, Dennis M. (1976) Bibliography and Vocabulary of the Akan (Thi-Fante) Language of Ghana (African Series Vol. 6). Bloomingtona Indiana University Pres5.

Welmers, William E. (1946) A Descriptive Grampar of Fanti (Language Dissertation no. 39), supplement to Language 22(3). Baltimore: Waverly Press.
--- (1971) 'Checklist of African Language and Dialect Names', appendix in T. A. Sebeok (ed.) Current Trends in Linguistics, Vol.7: Linguistics in SubSaharan Africa, pp.759-900. The Hague: Mouton.
--- (1973) African Language Structures. Berkeley: University of California Press.

Westermann, Diedrich and Margaret A. Bryan (1952) The Languages of West Africa. Oxford: Dxford University Press.

Wilken, Gene C. (1980) 'Whistle Speech in Tlaxcala (Mexico)', Anthropos 74:881888.

Wilson, W.A. (1961) 'Outline of the Balanta Language', African Language Studies 2:139-168.
--- (1963) 'Talking Drums in Guinea', Estudios Essaios e Documentos 102:201219. Reprinted in 5\&U, pp.806-815.

Winston, F.D.D. (1960) 'The 'Mid' Tone in Efik', African Language Studies 1:185-192.

Wurm, S.A. (1972) 'Languages, Call', in P. Ryan (ed.), Encyclopaedia of Papua and New Guinea, p.617. Melbourne: Melbourne University Press/The University of Papua New Guinea.

Yakir, Ruth (1973) 'Secret Languages of Israeli Children', in Language-Behavior Papers 2:29-39. Jerusalem: Language-Behavior Section, The School of Education of the Hebrew University and the Ministry of Education and Culture.

Yap, Fe Aldave (1970) The Sounds of Pilipino: A Descriptive Analysis. Manila: Institute of National Langauge, Department of Education.

Yip, Moira (1980) The Tonal Phonology of Chinese. Unpublished Ph.D. dissertation, MIT.
-- (1982) 'Reduplication and C-V Skeleta in Chinese Secret Languages', Linguistic Inquiry 13:637-661.
--- (1987) 'English Vowel Epenthesis' Natural Language and Linguistic Theory 5:463-84.
--- (1988) 'The Dbligatory Contour Principle and Phonological Rules: A Loss of Identity', Linguistic Inquiry 19:65-100.

Younes, R. (1983) 'The Representation of Geminate Consonants', ms., University of Texas, Austin.

Zhiming, Bao (198B) 'Fanqie Languages and Reduplication', ms, MIT.
Zwicky, Arnold M. (1975) 'The Strategy of Generative Phonology', in W.U. Dressler and F.V. Mares (eds.), Phonologica 1972, pp.151-165. Munchen: Wilhelm Fink Verlag.

- (1987) 'French Prepositions: No Peeking', Phonology Yearbook 4:211-27.


[^0]:    Some surrogates may also have what could be considered to be an alternate $L$ domain, in that they utilize a much smaller vocabulary than their source language; see Nketia (1971) for an example in Akan surrogate speech. In this case, however, the $L$ of the surrogate is simply a subset of the $L$ of its parent language; it therefore differs only quantitatively (rather than substantively) from the latter and probably should not be considered an independent domain.

    COne possible candidate for a purely phonological modification (8b) might be the phenomenon of deliberately speaking in, or imitating, a foreign accent, mentioned in Laycock (1972).

    IIt might appear that the Hl onipha systems therefore exemplify (11c) rather than (11a), i.e. an alternate phonological system seems to be involved. Recall from (2) and the discussion at the beginning of this section, however, that alternate $\overline{\text { s }}$ domains are defined in a very specific way: either a different sound inventory, or different phonological

[^1]:    $C G$
    a $y k$
    

[^2]:    saln a ludling of Samoan there is some evidence of behaviour similar to

[^3]:    1.2. Manipulation of Syllable and Timing Structures

    Both ludlings and surrogates frequently exhibit processes which manipulate timing structures or rearrange syllabic constituency. A significant feature of the Katajjait ludling described in the preceding

[^4]:    ?Tagalog, Total Syllable Reversal: before inflectional morphology?

