VOWEL HARMONIES OF THE CONGO BASIN:
AN OPTIMALITY THEORY ANALYSIS OF VARIATION IN THE
BANTU ZONE C

by

MYLES FRANCIS LEITCH

B.A., Dalhousie University 1977
M.A., University of Texas 1982

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE STUDIES
Department Of Linguistics

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA
November 1996

© Myles Francis Leitch 1996
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Linguistics

The University of British Columbia
Vancouver, Canada

Date Feb. 15, 1997
Abstract

A central claim of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a) is that phonological variation can be modeled through the variable ranking of universal constraints. In this thesis, I test this claim by examining variation in the tongue root vowel harmony system in a number of closely related yet distinct Bantu languages of Congo and Zaire. The twenty-odd languages are drawn from each of Guthrie 1967's eight Bantu C. subgroups and are shown to vary along a number of dimensions. One is morphological, related to whether or not the harmonic element in the lexical root extends to prefixes and suffixes. This variation is shown to follow from the variable ranking of constraints that seek to align the harmonic feature, [retracted tongue root] ([rtr]) with the edges of the morphological domains STEM and WORD. A second parameter of variation concerns the relationship between high vowels and [rtr]. A third dimension involves the interaction of [rtr] with the low vowel [a] under harmony. Here, three patterns involving (i) low vowel assimilation, (ii) low vowel opacity, or (iii) low vowel transparency under harmony are shown to follow from the variable ranking of a few constraints. A significant theme that emerges in the study is recognizing and characterizing the distinct morphological and phonological domain edges involved in vowel harmony. An important contribution of this study is in bringing to light a language family where phonological tongue height, in this case expressed by the feature [low], is shown to be incompatible with tongue root retraction, as expressed in the feature [rtr]. Although the gestures of tongue body lowering and tongue root retraction are sympathetic in the articulatory dimension and in their acoustic effect, they are seen to be phonologically hostile, in fact, because of the redundancy relation between them. This redundancy-based phonological incompatibility is implemented via licensing-failure: [low] fails to "license" [rtr] because lowness implies retraction (Ito, Mester and Padgett 1994).
# Table of Contents

Abstract .................................................................................................................. ii  
Table of Contents .................................................................................................... iii  
List of Abbreviations ............................................................................................... vi  
Acknowledgements ................................................................................................... vii  

1. INTRODUCTION .................................................................................................. 1  
   1.1 PHONOLOGICAL VARIATION AND CONSTRAINT INTERACTION .......................... 1  
   1.2 THE GUTHRIE 1967 BANTU CLASSIFICATION SYSTEM .................................... 6  
   1.3 OPTIMALITY THEORY MECHANISMS .................................................................. 9  
       1.3.1 Constraints and Constraint Tableaux ................................................................. 10  
       1.3.2 Faithfulness Constraints .................................................................................... 13  
   1.4 VOWEL FEATURES: ORGANIZATION AND SPECIFICATION ............................. 13  
       1.4.1 Is [rtr] a Valid Vocalic Feature? ........................................................................ 14  
       1.4.2 [rtr] vs. [atr] ........................................................................................................ 19  
       1.4.3 General Feature Organization Assumptions ....................................................... 20  
   1.5 CHAPTER BY CHAPTER CONTENTS OUTLINE .................................................. 23  
       1.5.1 Chapter 2 ............................................................................................................ 23  
       1.5.2 Chapter 3 ............................................................................................................ 23  
       1.5.3 Chapter 4 ............................................................................................................ 24  
       1.5.4 Chapter 5 ............................................................................................................ 24  
       1.5.5 Chapter 6 ............................................................................................................ 25  

2. ALIGNMENT DOMAINS FOR VOWEL HARMONY IN BANTU C ........................... 27  
   2.1 OVERVIEW OF BANTU C MORPHOLOGY .............................................................. 27  
       2.1.1 Roots and [rtr] .................................................................................................... 27  
       2.1.2 Overview of Nominal Morphology .................................................................... 29  
       2.1.3 Stem and Word in Bantu C Verb Morphology .................................................... 31  
   2.2 VOWEL HARMONY TUNED TO MORPHOLOGY: INITIAL CHARACTERIZATION .... 35  
       2.2.1 Basic Harmony-by-Alignment Mechanisms ....................................................... 37  
       2.2.2 Stem Harmony Only: A Sketch of Bolia, C-30 .................................................. 41  
           2.2.2.1 No Word-Edge Alignment .......................................................................... 46  
       2.2.3 Stem And Prefix Harmony: A Sketch Of Ntomba C-30 ..................................... 48  
           2.2.3.1 Left Word-Edge Alignment ........................................................................ 51  
       2.2.4 Stem And Final Vowels: A Sketch Of Babole: C-10 .......................................... 53  
           2.2.4.1 Right Word-Edge Alignment ...................................................................... 54  
       2.2.5 Complete Harmony: Elembe-Nkutu / Losikongo .............................................. 57  
           2.2.5.1 Right and Left Word Edge Alignment ............................................................ 60  
       2.2.6 Nkundo: One-Syllable-to-the-Left Harmony ..................................................... 63
5. LOW VOWEL / RETRACTED VOWEL DISTRIBUTION IN NOMINALS .......................... 174

5.1.1 Babole I: Symmetrical Non-occurrence of [e/o] and [a] ........................................ 174
5.1.2 Babole II: *[a...e/o] via [rtr]-Underparsing .......................................................... 178
5.1.3 Nkundo Nominals: [e...a] is OK / [a...e] is Bad .................................................... 183
5.1.4 C-50 Languages: Nominals Where [a...e/o] Are Good ........................................ 191
  5.1.4.1 C-50 Languages: General Properties ............................................................... 192
  5.1.4.2 Low Vowel Nominal Patterns ............................................................................ 193
  5.1.4.3 Analysis of C-50 Low Vowel Nominal Patterns ................................................. 196
  5.1.4.4 Summary ........................................................................................................... 200

6. COALESCENCE AND NON-HARMONIC RETRACTION ............................................ 202

6.1 CASE STUDIES OF COALESCENT RETRACTION .................................................. 203
  6.1.1 Bolia ...................................................................................................................... 203
  6.1.2 Nkengo ................................................................................................................ 205
  6.1.3 Lwankamba ......................................................................................................... 207
  6.1.4 Tetela .................................................................................................................... 210
    6.1.4.1 A Sketch of Tetela C-70 ................................................................................ 212
  6.1.5 The Coalescent Retraction Problem ................................................................. 218
    6.1.5.1 Coalescence is on a Different ‘Level’ .............................................................. 221
    6.1.5.2 Coalescence and Harmony: Is [rtr] Indexing Needed Too? ......................... 226
    6.1.5.3 Lexical and Post-Lexical Harmonies: Revision ............................................ 230
    6.1.5.4 Closing Remarks on Coalescent Retraction and Harmony ......................... 241

6.2 SUMMARY AND CONCLUSION ............................................................................... 242
  6.2.1 Musing I. Empirical Breadth .............................................................................. 243
  6.2.2 Musing II: Distinguishing M-Domains and P-Domains ..................................... 243
  6.2.3 Musing III: Ambiguous Analyses and Marginal Classes .................................. 244
  6.2.4 Musing IV: [rtr] as a Vocalic Feature ............................................................... 245
  6.2.5 Musing V: Level-ordering and Phonological “Components” .............................. 246
  6.2.6 Conclusion ........................................................................................................ 246

References .................................................................................................................. 248

Appendix A: 5 Maps - Geographical Distribution of Variation Features .................. 259

Appendix B: Vowel Harmony Properties of Key Languages .................................. 265
List of Abbreviations

**Morphosyntactic Labels**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGR</td>
<td>Agreement</td>
</tr>
<tr>
<td>APL</td>
<td>Applicative</td>
</tr>
<tr>
<td>CAUS</td>
<td>Causative</td>
</tr>
<tr>
<td>CMPL</td>
<td>Completive</td>
</tr>
<tr>
<td>COMP</td>
<td>Comparative</td>
</tr>
<tr>
<td>EXT</td>
<td>Extension</td>
</tr>
<tr>
<td>FM</td>
<td>Formative Marker</td>
</tr>
<tr>
<td>FUT</td>
<td>Future</td>
</tr>
<tr>
<td>FV</td>
<td>Final Vowel</td>
</tr>
<tr>
<td>NEG</td>
<td>Negation</td>
</tr>
<tr>
<td>OM</td>
<td>Object Marker</td>
</tr>
<tr>
<td>PASS</td>
<td>Passive</td>
</tr>
<tr>
<td>PST</td>
<td>Past</td>
</tr>
<tr>
<td>RECIP</td>
<td>Reciprocal</td>
</tr>
<tr>
<td>REV</td>
<td>Reversive</td>
</tr>
<tr>
<td>RFLX</td>
<td>Reflexive</td>
</tr>
<tr>
<td>SM</td>
<td>Subject Marker</td>
</tr>
<tr>
<td>STAT</td>
<td>Stative</td>
</tr>
</tbody>
</table>

**Number / Person Distinctions**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SU1sg</td>
<td>First person singular subject</td>
</tr>
<tr>
<td>SU2s</td>
<td>Second person singular subject</td>
</tr>
<tr>
<td>SU1pl</td>
<td>First person plural subject</td>
</tr>
<tr>
<td>OB3pl</td>
<td>Third person plural object</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
</tr>
</tbody>
</table>

**Phonological Features**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Phoneme</th>
</tr>
</thead>
<tbody>
<tr>
<td>[front]</td>
<td>[fr]</td>
</tr>
<tr>
<td>[round]</td>
<td>[rd]</td>
</tr>
<tr>
<td>[back]</td>
<td>[bk]</td>
</tr>
<tr>
<td>[low]</td>
<td>[lo]</td>
</tr>
<tr>
<td>[high]</td>
<td>[hi]</td>
</tr>
<tr>
<td>[retracted tongue root]</td>
<td>[rtr]</td>
</tr>
<tr>
<td>[advanced tongue root]</td>
<td>[rtr]</td>
</tr>
<tr>
<td>[sonorant]</td>
<td>[son]</td>
</tr>
<tr>
<td>[voiced]</td>
<td>[vd]</td>
</tr>
</tbody>
</table>
Acknowledgments

This thesis is dedicated to the Babole people of Congo. Without their gracious hospitality and patience over several years, the spark of curiosity that began this research might never have become a flame. They were able to put aside (or at least suspend) the natural suspicion that they would justifiably have of strangers and treated us with great gentleness and humanity during our years with them. They taught us their language, welcomed our children, and helped us in many ways to learn to live in and love their place on the Likouala-aux-Herbes riverbank.

Every student needs a teacher. I first read Professor Doug Pulleyblank’s book ‘Tone in Lexical Phonology’, while struggling with the basics of the Babole language in Congo. From that great distance, I recognized in Doug Pulleyblank a great teacher and keen disciplined mind (counterpoint to my own wandering thoughts and wild ideas!). I owe to Doug Pulleyblank a great deal for inspiring me to look deeper than I sometimes wanted to, for providing a consistent model of (very) hard work, and for believing in me. Professor Pat Shaw as well has had a lasting influence on me through her love of knowledge and ideas (not to mention her keen editorial eye). I especially appreciate the role that Pat Shaw had in making the UBC linguistics department a safe and creative place to think and be. To my other gifted teachers at UBC, Henry Davis, Rose-Marie Dechaine, Hamida Demirdache, Laura Downing, Mark Hewitt, Dave Ingram, Dale Kinkade, Mike Rochemont, thank you for your ideas, encouragement and discussions. Thanks to Carmen DaSilva for her incurable good humor and many skills. I will miss all of you; the shared experience of these years together has been very rich and rewarding for me. My fellow students, Eleanor Blain, Nike Ola, Lisa Matthewson, Ping Jiang-King, Kimary Shahin, Aki Uechi, Elizabeth Currie, Susan Blake, Taylor Roberts, and Strang Burton have enriched my life with their ideas and friendship. I trust that it has been mutual.

I gratefully acknowledge that the research contained in this dissertation was partially funded by grants awarded to Douglas Pulleyblank by the Social Sciences and Humanities Research Council of Canada.

My wife Janet has showed unwavering love and good will, creating along with our children Daniel and Adrienne a wonderful home where we live and move and have our being together. The music, the struggles, the good food, the outings, sharing a gypsy lifestyle together in Brazzaville, Dzeke, Vancouver, Toronto, Grand Forks and everywhere in between... this work would not have been possible without them.

I would be remiss in not thanking our colleagues at the Summer Institute of Linguistics who have supported this PhD program in many ways. Finally I thank God who gave me life and a mind in the first place and who gave those gifts back to me renewed when I encountered Jesus Christ, “in whom are hidden all the treasures of wisdom and knowledge” (Colossians 2:3, New International Version).
1. Introduction

1.1 Phonological Variation and Constraint Interaction

One of the questions that has occupied the practitioners of modern linguistics concerns linguistic variation. In what ways are human languages the same? How are they different? Linguistic variation should follow from or at least be correlated with something in the structure of the theory of language. That is, languages should not vary in unpredictable and random ways, but rather in regular and predictable ways, and within certain bounds. If we have a theory about the structure of language, then this theory should tell us something about how languages are likely to change, what the limits of certain kinds of changes might be, and perhaps even what each step should look like.

There are several ways that one might approach this problem. One might start with very different languages, say English, Chinese, and Arabic. Since we have a theory of language and in particular of phonology, we might inquire how these languages each manifest properties of the universal grammar (linguistic ability) that underlies them. If common properties are discovered among languages as different as these, it is dramatic evidence that they share a common substrate of universal grammar, since no historical link is known to exist between them. Another strategy might be to look at a large number of highly similar languages which clearly are historically related. The small incremental changes that one sees over a given geographical domain (perhaps adding up to large differences over large distances) should tell us something about linguistic structure and
the human mind that holds it. Alternatively, if we have a theory that makes predictions about linguistic variation, we might be able to use such data to test our theory.

In this research project, I have looked at a large number of very closely related Bantu languages from the lowland rainforest drainage basin of the Congo river in Africa. The languages exist in a zone covering parts of the countries of Congo and Zaire spanning almost a thousand miles east-west and north-south. The central idea in this thesis is that the rich phonological variation seen in a narrow domain (the vowel harmony system) follows from a few simple phonological principles or constraints that are accorded a different degree of importance from language to language. This means that rather than evoking different principles to explain differing patterns in the languages considered, the fund of principles is assumed to be fixed and universal while only the relative importance or ranking of the grammatical principles varies. A simple example involving three principles would go like this. Language X has phonological principles α, β, and γ in the ranking {α >> β >> γ} (where ">>" means "is more important than"). Language Y, on the other hand has a different phonological grammar where {β >> α >> γ}. In language Y, principle β "outranks" principle α, while in language X, the opposite ranking exists between the two constraints. The idea of a constraint or principle is that they are requirements holding of the surface form rather than of an underlying or intermediate form.

All constraints hold equally of the surface form and may therefore be in conflict with each other, making contradictory demands. A simple example of this might involve two principles. One is the familiar universal preference that syllables have onsets
(henceforth ONS, see Prince and Smolensky (P&S) 1993). Another is the requirement that non-lexical material (segments, features, associations) not be present in outputs (essentially a ban on insertion, called here LEX following Pulleyblank 1994). Clearly the principles LEX and ONS are in conflict in a language where onsetless syllables arise since we must either leave syllables without onsets and so violate ONS, or insert an onset and so violate LEX. This kind of constraint conflict is a central notion of the theory of constraint interaction adopted in this thesis. This theory of ranked constraint grammars is fully articulated in Prince and Smolensky 1993 and a large and growing body of literature. This theory is called Optimality Theory by its originators and practitioners and will be referred to in this document as simply OT (following current usage). Clearly any constraint in such a system is at least potentially violable. Some languages violate ONS to satisfy LEX. Other languages violate LEX, inserting a segment to satisfy ONS. What differs from language to language is not the fund of phonological principles at work (ONS, LEX, etc..) but just the relative importance or “ranking” of the constraints. The constraints then are claimed to be universal principles of the human language facility. They are “soft” violable universals rather than “hard” inviolable universals.

By way of general introduction, OT is not a theory of phonology, per se, but a theory of cognition and mental organization in general, and a theory of linguistic organization in particular. The phonological content of OT is in the constraints themselves and in the capacity of constraint ranking to capture all phonological

---

1 Excellent introductions to the key ideas and formalism of OT can also be found in McCarthy and Prince (M&P) 1993a, M&P 1993b, M&P 1994a.

2 There is an OT theory of syntax as well which works with a set of universal syntactic principles. Some members of the set of universal syntactic principles might be: (i) Θ (thematic)-theory postulates (ii) binding theory postulates, etc.
regularities. In due course, I will introduce the constraint families that figure in my analysis. A central thrust of OT is that linguistic ability can be modeled solely in terms of constraint interaction. This means that crucially in OT a phonology does not consist of a derivational rule-system interacting with a constraint system, but of constraints only.

While the importance of surface-true constraints for phonology has long been recognized (Kisseberth 1969, 1970, McCarthy 1979, Ito 1986, Archangeli and Pulleyblank 1994 to name a few), OT claims that phonology is driven by constraint interaction alone. Given even these cursory introductory remarks, it should be clear that linguistic variation is one important testing ground for a theory like OT, especially very fine-grained variation where languages are known to be historically related. By looking at the kind of variation that actually occurs, one can test whether it is the kind of variation predicted by the theory.

One goal of my dissertation then is to show that the analysis of the variation in a large areal system (all of the central Bantu zone) provides support for the idea of constraint ranking in OT. The questions that I shall be attempting to answer include the following:

---

3 Although these principles are dramatically different from the kinds governing phonology, OT claims that they compete in the same fashion within their respective domains. See, for example, Grimshaw 1993.

3 Lacharitè and Paradis 1993 provides a concise and insightful history of constraints in generative phonology.

4 Other questions of course arise with respect to established notions like "level" or "strata" or "components" in phonology. M&P 1993a did posit lexical and post-lexical levels in their account of Axininca Campa. The strongest form of the theory would clearly be one where even the lexical / post-lexical differences could be shown to follow from constraint interaction within a single block. I will maintain, along with M&P 1993a that there is at least a lexical and post-lexical domain distinction following recent research such as Lombardi 1996. In the analysis that I present, in fact, a component distinction between lexical and post-lexical proves to be necessary for analysis-internal reasons. I will maintain therefore that there are distinct (constraint-ranked) grammars for the lexical and post-lexical levels, although this only becomes clear when I examine coalescent retraction in Chapter 6.

5 If the languages are closely related, the claim that identical principles are involved seems more initially plausible at least.
• can the attested variation be shown to follow from the variable ranking of a small number of well motivated constraints?

• what are the interesting properties of the constraint system that is assumed to underlie an integral areal linguistic system?

I will show that an OT ranked constraint account yields significant insights into the variation in the Bantu C area. This can not be taken to "prove" OT perhaps; rather it is an attempt to demonstrate that an OT analysis of linguistic variation is convincing because it handles a surprising range of facts straightforwardly. Since any particular analysis incorporates assumptions about phonological substantives; a set of features, a version of feature organization/geometry, etc., any OT analysis can only be as viable as the substantive assumptions that are built into the constraint formulations and into the interpretation of GEN, the representation generator in OT. Real diversity persists of course among phonologists as to the nature of these substantives. To the extent that this OT analysis of Bantu 7-vowel harmony succeeds, it does serve to support the leading idea of OT; most of the attested variation is explained in my account, although a few problems remain. Secondly and more importantly, the kind of variation that actually occurs falls out from the way the theory functions and requires a minimum of stipulation. This goes a step beyond simply accounting for what is there. These points will be elaborated and made clear as the thesis unfolds.

---

6 Whether a rule-based account could account for the same wide range of facts with equivalent ease I leave for others to work out.

7 One only needs to consider articulation-only theories of feature structure (Halle 1995, Halle and Vaux 1994, Kenstowicz 1994) as opposed to acoustics-only theories of features organization (Casali 1996, for one example), as opposed to functional mixed "articulation and acoustics" theories as in Odden 1993. It seems unlikely that OT will render such substantive discussions superfluous. Nonetheless see Padgett 1995, 1996 for an interesting attempt to construct an OT-specific theory of features.

8 See Dresher 1996 for an entertaining and insightful critique of OT within the context of modern phonology.
1.2 The Guthrie 1967 Bantu Classification System

While constraint-driven phonology provides the theoretical backdrop for this thesis, some introductory comments also need to be made about the way Bantu languages are classified and referred to in the linguistic literature. Since Guthrie 1967-1971, Bantu languages are conventionally referred to using the classificatory system he set up. The geographically vast Bantu area (covering nearly all of sub-Saharan Africa) is divided into major zones on the basis of a survey of morphological and phonological characteristics. The zones are denoted by uppercase letters A, B, C, etc. The Guthrie Bantu Zones are shown in (1-1)

(1-1) Guthrie Bantu Zones (Guthrie 1967-1971)

The letter-denoted zones are themselves divided into subgroups labeled for example A-10, A-20, A-30, etc. Again these subgroupings are partly based on salient morphological and phonological features and partly on simple geographical location. Individual
languages are indicated by a Zone letter followed by a two digit number. So, for example Zone C has subgroups C-10, C-20, etc., and particular languages are designated C-11, C-12 (members of C-10), C-22, C-23 (members of C-20) and so on. It is accepted by most scholars that this system of identification is useful for roughly classifying a Bantu language. However it is equally acknowledged that the classification does not accurately reflect historically or genetically derived groupings. For the purposes of this study, it is important to know that the Zone C languages do share a significant number of morphological and phonological properties that distinguish them from neighboring languages. However my concern is neither to disprove or support Guthrie’s classification of particular languages. Rather my goal is to give a formal constraint-based account for the surprising phonological variation in a group of languages that are clearly closely related. In other work (Leitch 1996a) I address the question of vowel harmony evolution, suggesting how the vowel harmony analysis itself provides evidence for reliable internal grouping of Bantu C languages. To familiarize the reader with relevant basic facts of geography and classification, the map in (1-2) shows the location within Africa of the language area covered by this study. All of the languages in question are in the political states of Congo and Zaire. More to the point, the languages are all in the lowland rainforest drainage basin of the Congo River and its tributaries.

---

9 This point for example was a major theme in talks given at May 1996 Historical Comparative Bantu conference in Lyon, France.

10 Guthrie’s grouping of Bantu C languages turns out to be largely convincing. These languages as a group differ from surrounding neighbors in significant ways, especially with respect to the 7-vowel system and verbal morphology that is in focus in this study. As new languages are described, the practice is to fit them into the general schema of Guthrie classification, mainly for purposes of reference.

11 These languages are sometimes loosely referred to as “Rainforest Bantu”. This term comprises a non-technical contrastive pair with “Savannah Bantu”, which refers to all of the Eastern Bantu languages of Kenya, Tanzania etc.
The map in (1-3) shows the major subdivisions of Bantu C as proposed in Guthrie 1967-1971 and elaborated in subsequent research.

I used two kinds of criteria for including languages in the study. On the one hand I included any languages that showed significant or interesting variation in the vowel
harmony system, no matter which sub-group they came from. On the other hand I chose languages from each sub-grouping to make sure that the whole area was represented. The sample is thorough then in these two respects: (i) all of the significant variation that I found is included, and (ii) the whole area and each of its sub-areas is covered. Some smaller geographical areas are over-represented in terms of the number of languages examined, since there was significant variation in a small area. As well, some large areas are only represented by a single language, if there was little variation of interest to the study. A final point is that although my main focus is on Bantu C, I sometimes refer to the neighboring Bantu Zones B, and D (see the map in (1-3)) where a few languages are found that share aspects of the vowel harmony system of the Bantu C group. Appendix B. contains a sketch of the vowel harmony properties and analysis of each key language. Since the information about particular languages may be spread out over several chapters, the reader will find it useful to refer to Appendix B for a summary of all the relevant properties of particular languages.

1.3 Optimality Theory Mechanisms

Since it is my hope that this work be accessible to a wide audience, I would like to devote a little time now to introducing some of the formal machinery of OT. Although the central ideas of constraint-ranked grammars are straightforward and largely intuitive, the formal mechanism of constraint “tableaux” used for presenting analyses can be

---

12 Although I mention the C-40 language Ngombe, I do not provide an analysis of it since there are ambiguities in the data sources. See Appendix B. for a summary of the vowel harmony properties of Ngombe.

13 In particular, I mention Bantu B. Tiene (Ellington 1977), and Bantu D. Mituku (Stappers 1973), both languages of Zaire that are adjacent to the Bantu C area.
forbidding. I will introduce below the key technical ideas and formalisms that are essential to following the analyses developed in this thesis.

1.3.1 Constraints and Constraint Tableaux

OT conceives of phonological grammar as a hierarchically ordered set of competing constraints, each of which, in itself, can be violated. Constraints, unlike rules, do not apply serially or derivationally but in parallel and all at once. Constraints all apply at the level of output and no constraints are considered to hold of underlying forms. Candidate forms which fare best in the overall constraint interaction emerge as “optimal”. There are only two relations between constraints that figure in this thesis. The symbol “$$\gg$$” means “is more highly ranked than”. The symbol “$$||$$” means “is not crucially ranked with respect to”. To make constraint hierarchies easy to recognize, I will conventionally enclose them in curly brackets. A typical constraint hierarchy fragment might be as in (1-4). In this constraint hierarchy, constraint A outranks B, C, and D; but B and C have no crucial ranking. Some constraints do not interact with each other and there is never evidence available as to their ranking; hence the “non-ranked” symbol is needed.

(1-4) Constraint Hierarchies

$$\{...A \gg B \parallel C \gg D...\}$$

The “Constraint Tableau” is the conventional method of presenting a constraint interaction scenario. In a tableau, the output candidates\footnote{The candidate set is produced by a function GEN, which pairs each underlying form with a "large space" of output candidate forms "by freely exercising the basic structural resources of the representational theory" (Prince and Smolensky 1993:4-5). In practice, only the most plausible pertinent candidates are included in a tableau for evaluation.} to be evaluated are listed, one
to a row. The constraints, some of which are crucially ranked with respect to each other, are presented from left to right across the top of the Tableau. To introduce how constraint tableaux actually work, I will use the example of the constraint competition between ONS and LEX introduced earlier. Assume that a language has the constraint ranking \{LEX \gg ONS\}. In this language it will be a more serious to violate the constraint LEX by inserting something, than to violate ONS by leaving a syllable without an onset. Imagine an input representation (underlying form) as in (1-5). For expositional purposes, I will ignore possible sub-syllabic constituents such as nucleus and mora. The proposed input consists of a single vowel and a syllable node.

(1-5) An Onsetless Syllable Input

\[
\sigma \\
[o]
\]

Consider now several outputs that GEN might construct with such an input. (1-6)(i) maintains the input unchanged and (1-6)(ii) inserts an onset consonant \[h\].

(1-6) Output Candidates

(i) Status Quo       (ii) Onset Inserted

\[
\sigma \\
[o] \\
[h] [o]
\]

The question is: which output better satisfies the constraints? A constraint Tableau is a way of systematically evaluating how different surface forms (output candidates) satisfy a particular constraint ranking. Usually the constraint hierarchy is placed horizontally across the top of the tableau with the highest ranked constraints on the left. The
candidates to be evaluated are listed vertically on the left. A rudimentary tableau might appear as in (1-7).

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
 & LEX & $\gg\gg$ & ONS & $\gg\gg$ & \ldots \\
\hline
(i) \sigma & & & * & \rightleftharpoons & \text{This candidate violates ONS} \\
\sigma & [o] & & & & \\
(ii) \sigma & & & *! & \rightleftharpoons & \text{This candidate violates LEX (fatally)} \\
\hline
\end{tabular}
\end{table}

An asterisk in a tableau cell indicates that the candidate violates that constraint. The best candidate is the one which violates the fewest and least important constraints. In this simplified tableau, both candidates violate a single constraint, but candidate (i) is optimal given this constraint ranking because it violates a less important constraint. A “pointing hand” graphic is used to indicate the victorious or optimal candidate, in this case the syllable without an inserted onset. The most significant constraint violation of non-optimal forms is indicated with the “!” symbol; this indicates the violation that is “fatal” for a particular candidate. Clearly if we reversed the order of the constraints, making the presence of an onset more important than the ban on insertion, candidate (ii) (with an onset) would be optimal. So it is constraint ranking alone which determines the best output in OT. There are a few other graphical conventions used in constraint tableaux. One is that the constraint ranking is indicated by left (most important) to right (least
important) order. However, as mentioned earlier, not all constraints are crucially ranked with respect to each other. It is therefore necessary to know which constraints are crucially ranked with respect to each other in tableaux\textsuperscript{15}. Note that under this view of grammaticality, many optimal or 'grammatical' forms will actually violate one or more constraints, the optimal form being simply the least offensive. A typical constraint tableau in this thesis will be much more complex than (1-7), often evaluating four or five output candidate forms against a hierarchy of eight or more constraints. The simplified tableau is intended to introduce the constraint evaluation formalism apart from the complexities of particular analyses.

1.3.2 Faithfulness Constraints

In this work, I assume the “older” view of faithfulness within OT. That is, I use constraints of the PARSE / LEX families to evaluate the faithfulness of an output candidate to the input representation. I assume that the “correspondence” theory of faithfulness within OT laid out in \textit{McCarthy and Prince 1995} could also be implemented in my analysis, but I do not attempt this nor do I argue for one approach over against the other.

1.4 Vowel Features: Organization and Specification

There is a great deal of ferment in modern phonology concerning phonological features, in general, but especially about vowel features. This includes questions about: (i) the inventory of universal features themselves, (ii) how features are organized with respect to

\textsuperscript{15} A double line will be used in constraint tableaux to indicate crucial ranking between adjacent constraints. Other crucial ranking relationships will be discussed in accompanying text as required.
each other (feature “geometry”), (iii) whether features are binary or single valued, (iv) the role of variable feature specification in derivations (underspecification), and so on. I will devote the following section to laying out my assumptions, and where necessary, justifying them. I will be assuming a “standard” set of vocalic features that modern phonology has inherited from the SPE framework, but with some modifications, to be discussed shortly. I adopt the position (following much recent work) that all features are single-valued (privative), rather than binary. These features include [high], [low], [round] and [rtr]. I will in addition adopt the feature [front] from Goad 1993. The feature [front] is essentially a privative analogue of [-back]. I also adopt a supervening category COLOR from Kirchner 1993 and Padgett 1995 which groups together vocalic “place” features such as [front] and [round]. I will discuss the organizing category COLOR in the context where it arises in Chapter 4.

1.4.1 Is [rtr] a valid vocalic feature?

The vocalic feature [rtr] or RETRACTED TONGUE ROOT has a special role to play in the analysis of vowel harmony presented in this thesis in that it is assumed to be the harmonic feature active in the vowel harmony process. As it turns out, this assumption is not uncontroversial. I will claim that a monovalent autosegment [rtr], where present, is underlying affiliated with morphological roots and that it “spreads” from there to various

16 Sound Pattern of English, Chomsky and Halle 1968.

17 Goad’s feature [front] is dorsal dependent which serves a double role of palatalizing dorsal consonants and marking place in front vowels. The palatalizing function will not be discussed here, but I will assume that the PLACE feature of front vowels is simply [front]. Goad 1993 argues that the vocalic height features should not be dorsal dependents, but should rather be placed under a vocalic node; I will not adopt this aspect of Goad 1993; the arguments for [front] go through independently of the arguments concerning the configuration of height features.
affixes in the phonology. This claim runs counter to the proposal made in Goad 1993 (p. 25) and amplified in Rose 1996 and elsewhere that there are “no convincing cases of [-atr] vowel harmony” (which translates as [rtr] in my account). This strong claim is based on Goad 1993’s re-analysis of Yoruba and Wolof (two cases which A&P 1989 argue to be [-atr]). Pulleyblank 1994 has responded, arguing that Goad’s “low-harmony” approach runs into difficulty when faced with the variation observed in various Yoruba dialects. In addition, the Wolof reanalysis proposed in Goad 1993 has been disputed in Pulleyblank 1994 on other grounds. It is far from clear therefore that the “no convincing cases” position on [rtr] harmony can be maintained. In a real sense the database for the discussion of [rtr] vowel harmonies has been too small. The more than twenty Bantu C languages presented in this thesis are all arguably [rtr] harmony cases and thus widen the scope of the theoretical discussion beyond the frequently discussed West African languages like Yoruba and Akan. I argue that the facts of Bantu C vowel harmony variation favor an analysis that refers to both [low] and [rtr], as traditionally conceived, contra Goad 1993 and Rose 1996 who claim that only [low] is required for analysis of apparent [-atr] harmony cases.

The vocalic feature [rtr] is under siege from other directions as well. Clements 1990, 1991 and Clements and Hume 1995 take the even stronger position that neither [rtr] or [atr] are required for the description of vowel systems. They propose that all

---

18 Goad 1993 and Rose 1996 both allow privative [atr] as a vocalic feature but argue that privative [rtr] is a feature that is only relevant for certain post-velar consonants (in terms of underlying system contrasts, [rtr] is relevant only for consonants, not for vowels). The post-velar consonant research is comprehensively reviewed in Rose 1996. My view is that consonantal [rtr] and vocalic [rtr] are both possible, but that they are not necessarily the same phonological feature. That is, I do not assume that vowels and consonants must utilize exactly the same set of features. Even if the same [rtr] feature were hypothesized for consonants and vowels, there is no a priori reason to suppose that vocalic and consonantal instantiations of [rtr] will have the same phonological properties or behavior. Consonantal [rtr] is about point of articulation (stricture) while vocalic [rtr] is about manipulating the pharyngeal cavity to affect first formant.
cases formerly analyzed as [rtr] or [atr] can be reanalyzed in his system of feature geometry with a single vowel aperture feature [open] (which is permitted to have multiple instantiations). Parkenson 1993, 1995's work on vowel harmony adopts Clements feature geometry proposal but replaces [open] with [closed], apparently because of descriptive adequacy problems with [open]. Vaux 1995 on the other hand, argues contra Clements 1990 that vocalic [atr], at least, is needed independently of the representation of height distinctions to account for interactions between consonant voicing and vocalic "tenseness" in many languages. In other work, Casali 1996 (an OT account) seeks to eliminate both [rtr] and [atr] and replace them with vocalic aperture features that are purely acoustic. In later chapters, I give some attention to Goad 1993 (Chapter 4.) and Casali 1996 (Chapter 6.) in the context of particular aspects of my analysis of Bantu C vowel harmony, pointing out specific instances where I think their theories might encounter difficulty.

It is not my goal however to criticize any of these carefully thought-out proposals; it may be that any of them is substantially correct. My intent in this thesis is twofold: (i) to show that a convincing analysis of this broad empirical domain is possible within the framework adopted and (ii) to draw out the generalizations about these languages that are important to phonological theory in general. Amidst the controversy concerning tongue root features in vowel systems, my position is that some languages at least are best

---

frequency values. The fact that [rtr] consonants sometimes lower neighboring vowels does not necessarily imply that [rtr] vowels should affect neighboring consonants. The effects may be asymmetrical, or further study of languages with clear vocalic [rtr] may reveal subtle effects on neighboring consonants.

19 In particular, no published theoretical work exists analyzing the unusual properties of the low vowels and the variation in the vowel harmony system of Bantu C languages as a whole.
analyzed as having a privative [rtr] vowel feature that is part of the underlying contrast system. I offer this study of Bantu C vowel harmony patterns as evidence that [rtr] should not be rejected as a vocalic feature. The reasons for originally conceiving of tongue root features for African vowel harmony systems are, I believe, still valid. Lindau’s pioneering work on vowel features (*Lindau 1975, 1978*), if translated into privative feature language, would maintain that both [atr] and [rtr] are features which relate to the manipulation of the pharyngeal cavity as a way of affecting first formant frequency (F1) values. *Lindau 1978* proposes a feature [Expanded] to capture the fact that advancing the tongue root has the effect of enlarging the pharyngeal cavity and hence of lowering F1. Retraction of the tongue root decreases the pharyngeal cavity and raises F1 values.

*Ladefoged and Maddieson 1995* (in a review of much of the tongue root vowel feature research) cite X-ray tracings of languages (Igbo and Akan) claimed to have TR vocalic features and conclude that tongue body height and tongue root advancement/retraction are independent articulatory parameters in these languages (but not in languages like English and German) where tongue root movement can be correlated with tongue height straightforwardly. It seems to me that if this is true then there is no *a priori* reason to suppose that only tongue advancement may be relevant to vocalic feature systems, but that retraction is also possible. *Steriade 1995*, in a long endnote (#35) pressing her case that both [atr] and [rtr] must be seen as privative, cites numerous examples where either tongue root advancement or retraction plays an active role in vowel harmony systems. It seems that there is nothing in the acoustic or articulatory dimensions that would preclude

---

20 Although she adopts the Goad 1993 view that privative [rtr] is relevant for post-velar consonants only, I think the data she provides might also be interpreted in favor of privative vocalic [rtr].
privative [rtr] vocalic systems. Once we leave the idea that [rtr] is really just [-atr], the
"marked" poor cousin of [atr], there is every reason to expect that [rtr] may be
implemented underlyingly in vocalic feature systems. This is especially true since the
languages in question, Akan (Volta-Comoe) Igbo, Yoruba (Niger Congo), and Bantu
(Niger Congo) are all descended from a common ancestor hypothesized to have a tongue
root cross-height system.

"... it seems most likely that proto-Bantu had a classic system of Cross-
Height vowel harmony with nine or possibly ten vowels and that it
inherited this system largely unchanged from proto-Volta Congo.

Stewart and van Leynseele 1979: 51
(cited in Hyman 1996)

I know of no phonetic study, along the lines of those done for Akan, by Stewart 1967a,
and for Igbo by Ladefoged 1964 exploring the acoustic and articulatory properties of the
7-vowel Bantu systems discussed in this thesis. Such evidence may finally be crucial in
confirming the status of tongue root retraction in these languages and underlines a key
direction for future research. Until such research is available however, the most
productive strategy for current work is to expect that just as privative [atr] vowel systems
have been attested, so also privative [rtr] systems will be found. I claim that, based on the
phonological evidence in the present analysis, that the Bantu C languages constitute
Calabrese 1995, continue to leave open the possibility that both tongue root articulator
features, \([rtr]\) and \([atr]\), are relevant for vowel systems. The present work also adopts this assumption and seeks to provide support for it.

1.4.2 \([rtr]\) vs. \([atr]\)

I have just argued in general terms that both [retracted tongue root] and [advanced tongue root] should be considered valid privative vocalic features, active in at least some linguistic systems. But what criteria are used to decide in particular cases whether \([rtr]\) or \([atr]\) or both are involved? An interesting correlation between vowel system type and \([rtr]\) / \([atr]\) harmony has been noted in both Goad 1993 and Casali 1996, namely that while 7-vowel systems are often given \([rtr]\) (=[-atr]) analyses, 5 and 9/10-vowel systems are almost always given \([atr]\) analyses\(^{21}\). Inspired by this correlation, Casali claims that neither \([atr]\) or \([rtr]\) are involved but that the apparent patterning of nine-vowel and five-vowel systems with \([atr]\) harmony and seven-vowel systems with \([rtr]\) harmony falls out naturally from his theory of acoustically-based vowel features\(^{22}\). Casali 1996 does not provide an analysis of the harmony phenomena treated in this dissertation, so it remains to be seen how his approach would be convincingly extended to account for 7-vowel harmony systems of the Bantu C type. One of the arguments in Goad 1993 is that \([rtr]\) is not needed as a vocalic feature since all of the supposed \([rtr]\) harmony cases are amenable to a [low] re-analysis. In §§ 4.2.3.5 I argue that the Bantu C type of 7-vowel

---

\(^{21}\) The empirical claim being made here, however, is not uncontroversial. Pulleyblank 1994, for example, discusses the Ifaki dialect of Yoruba, where high vowels to the left of a retracted vowel are also retracted. This would mean that Ifaki has a nine vowel system (at least phonetically) with a clear retraction analysis. My analysis definitely allows the possibility that 9 vowel systems should exist with an \([rtr]\) analysis, so this is an interesting empirical question that can be monitored as the database of relevant cases is expanded.

\(^{22}\) See §§ 6.1.5.2, where I provide a limited sketch of the feature proposal in Casali 1996.
harmony cannot straightforwardly be reanalyzed in terms of Goad’s [low] harmony. Rather, I claim that [rtr] and [low] are both required. My thesis is that a convincing and coherent analysis of the Bantu C paradigm is best achieved in a theory where both [rtr] and the vocalic features, [high], [low], [round] etc. are invoked. Also, in §§ 2.2.8, I demonstrate, based on domain asymmetries in vowel harmony, that Bantu C systems must be seen as involving [rtr] rather than [atr]; this is unequivocal and supports the generalization noted by Goad and Casali 23. The larger question of how harmony types, [rtr] and [atr], correlate with vocalic inventories must eventually be addressed, but it is not in focus in this study.

1.4.3 General Feature Organization Assumptions

Optimality Theory does not presuppose a particular representational theory. In fact researchers draw on a variety of representational frameworks in constructing constraint ranked analyses. In OT the structure generator GEN is the repository of representational theory. Given any input, GEN constructs an array of output representations based on the structural possibilities of the representational theory. As pointed out in Padgett 1995 however, there is a sense in which the explanatory power of OT is in the constraint ranking. With the highly articulated tree graphs of modern autosegmental approaches, the explanatory power lies in the representation (particularly in the organizing nodes). Thus there is a subtle problem with assuming a powerful representational theory like Clements

23 Extending the approach taken here to account for the correlation noted by Casali 1996 and Goad 1993 will be an important direction for future research.
and Hume 1995 within OT\textsuperscript{24}. I think Padgett 1995 has a good point to make in the current context of multiple competing phonological theories. He suggests that since we want to allow insights to emerge from the constraint ranking schema, we should explore limiting the richness of the representational component.\textsuperscript{25} Such a venture will no doubt raise more questions than it answers and so I do not propose to make this theme a major emphasis in this thesis. My analysis turns out to be rather neutral with respect to representational issues and should work with any feature geometry that permits [rtr] as a vocalic feature.

For concreteness sake, consider the geometry fragment in (1-8).

(1-8) Feature Geometry Fragment

\begin{center}
\begin{tikzpicture}
\node (root) at (0,0) {ROOT};
\node (guttural) at (-2,-1) {Guttural};
\node (place) at (2,-1) {Place};
\node (atr) at (-1.5,-2) {[atr]};
\node (rtr) at (1.5,-2) {[rtr]};
\node (front) at (-1.5,-3) {[front]};
\node (round) at (1.5,-3) {[round]};
\draw (root) -- (guttural);
\draw (root) -- (place);
\draw (guttural) -- (atr);
\draw (guttural) -- (rtr);
\draw (place) -- (front);
\draw (place) -- (round);
\end{tikzpicture}
\end{center}

In terms of graphical feature arrangement, the crucial distinction for my analysis would be that vocalic tongue root features, [rtr] and [atr], be segregated from vocalic features [round], [front]; the reasons for this will be apparent when the full range of cases is considered. One example of a published geometry that permits the necessary segregation is that from Halle 1995. However rather than focus on details of competing feature

\textsuperscript{24} The problem could be idiomatically characterized as being of the "having-your-cake-and-eating-it-too" class, where one has all the power of constraint-ranked grammars plus all the power of highly articulated feature trees.

\textsuperscript{25} Padgett 1995 proposes that the representational component be reduced to the so called bottle-brush model where all features link directly to the root node. The work done by organizational nodes in feature geometry proposals is taken over by feature "sets" in his model.
geometry proposals, I will tentatively adopt Padgett 1995’s Feature Class Theory (FCT).

Rather than a “tree” graph where non-terminal nodes group features hierarchically,

Padgett proposes that features are members of sets and that those sets are called

“classes”. Some feature classes are presented in (1-9).26

(1-9) Feature Classes as Sets of Features

<table>
<thead>
<tr>
<th>Feature Class</th>
<th>Set of Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE</td>
<td>{[lab], [cor], [dors], [ant], [hi], [lo], [fr],[rd], [dist]..}</td>
</tr>
<tr>
<td>GUTTURAL</td>
<td>{[rtr] [atr], [stiff], [slack], [const.], [spread]}</td>
</tr>
<tr>
<td>TONGUE ROOT</td>
<td>{[rtr] [atr], ...}</td>
</tr>
<tr>
<td>COLOR</td>
<td>{[rd], [fr]}</td>
</tr>
</tbody>
</table>

While feature classes might be seen as corresponding largely to organizational nodes in feature-geometric trees, some classes might cross-cut what would be clear distinctions in a feature tree. One example is the set COLOR that I will be invoking in my analysis.

COLOR groups vocalic place features such as [round] and [front], yet does not correspond exactly to the PLACE set since features like [anterior] and [distributed] are irrelevant for vowels. Both abstract tree nodes in feature geometry, and Padgettian “sets” reflect substantive grouping of features that either capture natural classes in phonological processes, or reflect some supposed phonetic universal. A crucial aspect of the original feature geometry proposals was that only nodes be allowed to spread. In Padgett 1995, the observation is made that constraints targeting feature classes must be considered to target the individual features in the class, if the key insights of feature geometry are to carried over to his system. Therefore a constraint that mentions a set COLOR will require that each feature-member of the set be acted upon. I will be elaborating these minimal

26 Assuming features from an articulator-oriented model such as Halle 1995 which preserves much of the insights from Sagey 1987 and Chomsky and Halle 1968.
assumptions about features and feature organization as necessary in the body of the
thesis.27

1.5 Chapter by Chapter Contents Outline

1.5.1 Chapter 2

I discuss the morphological and prosodic environments that the vowel harmony system
is embedded in. This includes an analysis of how harmony is analyzed as targeting the
edges of morphological and prosodic domains. The particular focus of this chapter is
providing a formal constraint ranking analysis of the various harmony domain patterns
attested throughout the Bantu C area. The independent parameters of variation to be
accounted for include: (i) whether prefixes harmonize or not, and (ii) whether word-level
suffixes harmonize or not. In addition to this a third pattern is attested where a single
syllable to the left of the stem harmonizes, regardless of the particular morpheme
involved. I account for this by showing that a prosodic domain edge is targeted in these
cases.

1.5.2 Chapter 3

In Chapter 3.1 examine the behavior of high vowels in the [rtr] harmony domains
motivated in Chapter 2. I develop analyses of the common behavior of high vowel
opacity to [rtr] harmony, but also offer an account of a clear case where high vowels are
transparent in prefixes (left word edge harmony) but opaque in suffixes (stem harmony).

27 In particular I refer the reader ahead to §§ 4.2.3.1 (Chapter 4) where I make a specific proposal about the vocalic
features underlying the 7-vowel systems under consideration.
Prosodic domains are argued to play a crucial role in the analysis of high vowel transparency to [rtr] (following Pulleyblank 1994).

1.5.3 Chapter 4

In Chapter 4, I provide an account of the complex behavior of low vowels in the verbal morphology across Bantu C. This includes explaining the three attested patterns: (i) low vowel assimilation under harmony, (ii) low vowel opacity to harmony, (iii) low vowel transparency to harmony. I motivate a licensing principle such that the feature [low] fails to license [rtr]. This principle, enshrined as a constraint, is invoked to explain the area-wide apparent incompatibility between low vowels and the harmonic feature. In all of Bantu C (with a single fascinating exception) low vowels never induce retraction harmony, and moreover are opaque to it when in a harmonic domain. I also develop an explanation of the “parasitic” vowel copy process that accompanies [rtr] vowel harmony in low vowels in certain languages. Constraint ranking is shown to play a crucial role in deriving the complex variation in low vowel behaviors in the areal system.

1.5.4 Chapter 5

Chapter 5 builds on the foundation of [low] / [rtr] incompatibility developed in Chapter 4., showing that complex vowel co-occurrence patterns in nominal stems also fall out from the proposed analysis, but only when we consider collateral historical evidence. I invoke a historical explanation for one kind of asymmetry involving a statistically marginal class of stem vowel patterns, showing that stem final retraction in nouns is always the vestigial remains of an earlier system where there was a productive retracted
suffix. This provokes a reassessment of the analysis of [i...e/ə] patterns provided in Chapter 3. The analysis also clarifies the central role that left-stem dominance plays in the phonological system as a whole.

1.5.5 Chapter 6

In this final chapter, I examine phonetically retracted sequences that arise through coalescence of mid and low vowels of the sort [a] + [e] → [e]. This kind of coalescence is shown to have arisen historically via consonant loss and subsequent prosodic reorganization to avoid vowel hiatus in some languages (but not others). I examine four cases in Bantu C that show extensive coalescence of this kind, underlining that derived coalescent retraction is never harmonic. This initially surprising behavior is shown to follow from the fact that retraction-producing coalescence is a late process that depends on the post-lexical presence of “redundant” [rtr]. Although [lo]/[rtr] licensing enforces a strict ban on all [low] - [rtr] linkings in the lexical component, in the post-lexical and phrasal phonology, redundant / phonetic [rtr] is available. Several other unexplained facts are shown to follow from the level-ordering hypothesis. One of the predictions of this approach is that a class of post-lexical [rtr] harmonies should be possible where harmony is sensitive to low vowels, that is where low vowels induce retraction. I conclude by discussing the case of Mbosi Olée (Fontaney 1989) where prefixal harmony is sensitive to stem-initial low vowels even though stem mid vowels are not. The same low vowels which steadfastly refuse to induce harmony in stems do in fact induce harmony in prefixes. I explore this case in some detail drawing out the implications that it has for my
overall thesis. I conclude that the two stratum approach is independently need to account for cases like Mbosi Olée.
2. Alignment Domains for Vowel Harmony in Bantu C

In this chapter, I will discuss the general properties of the vowel harmony system analyzed in this study. The framework for the analysis will be supplied by the theory known as "Generalized Alignment" (M&P 1994). Generalized Alignment is a theory about how featural and prosodic entities are oriented toward the edges of morphological or prosodic categories. In applying this theory to Bantu C vowel harmony, I will show that a wide range of subtle attested harmonic effects follow from an alignment typology drawing on the edges of morphological domains STEM and WORD and the domain prosodic WORD.

2.1 Overview of Bantu C Morphology

Various aspects of Bantu Morphology have been studied extensively during the last century and its basic properties are no longer mysterious (Whitehead 1899, Woodward 1902, Doke 1927 & 1938, Meinhoff and Van Warmelo 1932, Harries 1950, Whiteley 1966, Guthrie 1967, Givon 1972, Myers 1987, to name only a few). In this section, we will consider the basic structure of words in the languages of the Bantu C zone, particularly those aspects that are crucial to the analysis of vowel harmony.

2.1.1 Roots and [rtr]

A basic assumption that will underlie my analysis is that Bantu C lexical root morphemes, whether nominal or verbal, have a lexical (underlying) tongue root specification. This assumption has been commonly made in the literature on African
tongue root vowel harmonies at least since Clements 1981 (see also Archangeli and Pulleyblank 1989, 1994, Trigo 1991, Ladefoged and Maddieson 1995 for surveys of tongue root features in African languages). I will maintain in this paper that privative [rtr] is the relevant harmonic feature in the vowel harmony system of all 7-vowel Bantu C languages. Underived lexical morphemes are assumed to either have or not have an affiliated [rtr] specification as pictured in (2-1)\(^1\). While the analysis must assume a distinction between those morphemes which have the harmonic feature and those which do not, the underlying linked/unlinked status of the feature is irrelevant.\(^2\)

\[
\begin{array}{c|c|c|c}
\text{UF output} & \text{UF output} \\
\hline
[e...o] & [e...o] \\
\hline
E...O & \underbrace{E...O}_{\text{rtr}} & \underbrace{E...O}_{\text{rtr}} & E...O \\
\hline
\end{array}
\]

If the harmonic feature is hypothesized in the underlying form then the constraint system will evaluate the form in a certain fashion. Likewise if [rtr] is hypothesized to be absent for a particular form, the constraint system alone will decide what the optimal output will be. The absence of [atr] specification in the surface advanced form [e...o] in (2-1) is for simplicity of exposition only. It would be possible for a learner to hypothesize an "advanced" morpheme with [atr] underlyingly. The output depends only on the higher ranking of constraints related to the "dominant" feature, whether [rtr] or [atr]. For

\(^1\) I will represent the non-[rtr] root morphemes as being unspecified for any TR value but this is not crucial in my account, as will become clear. Likewise, I adopt the standard convention throughout of representing underlying mid vowels using upper case letters. So ‘E’ and ‘O’ are simply mid vowels that have some TR value, either advanced or retracted.

\(^2\) That is, consistent with OT assumptions, one cannot guarantee the success of a derivation by specifying that features in underlying forms are linked or unlinked. It should make no difference since only outputs are evaluated by constraints.
expository simplicity I will maintain the [rtr] / θ distinction for morphemes, with the understanding that the [rtr] harmony constraints dominate the [atr] ones in Bantu C tongue root vowel harmony.³

2.1.2 Overview of Nominal Morphology

In this section we will introduce the essential properties of Bantu C nominal forms. There is a surprising homogeneity over this Bantu sub-family, given that it covers such a large geographical area. The most common kind of Bantu C noun consists of a monosyllabic noun-class prefix followed by a disyllabic theme or stem⁴. I illustrate in (2-2) with data from Babole (Bantu C-10) and in (2-3) with data from Nkundo (Bantu C-60). Wherever possible, I indicate the Bantu noun-class affiliation of forms.

(2-2) Babole Nominals C-10 Leitch 1991

<table>
<thead>
<tr>
<th>Form</th>
<th>Gloss</th>
<th>Morphology</th>
<th>Noun Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) molómi</td>
<td>'husband'</td>
<td>mo-[lómi]</td>
<td>1</td>
</tr>
<tr>
<td>(ii) baalómi</td>
<td>'husbands'</td>
<td>baa-[lómi]</td>
<td>2</td>
</tr>
<tr>
<td>(iii) munsókó</td>
<td>'fetish room'</td>
<td>[munsókó]</td>
<td>3</td>
</tr>
<tr>
<td>(iv) minsókó</td>
<td>'fetish rooms'</td>
<td>mi-[nsókó]</td>
<td>4</td>
</tr>
<tr>
<td>(v) dikòngó</td>
<td>'spear'</td>
<td>di-[kòngó]</td>
<td>5</td>
</tr>
<tr>
<td>(vi) makòngó</td>
<td>'spear'</td>
<td>ma-[kòngó]</td>
<td>6</td>
</tr>
<tr>
<td>(vii) eëlò</td>
<td>'thigh'</td>
<td>e-[ëlò]</td>
<td>7</td>
</tr>
<tr>
<td>(viii) biëlò</td>
<td>'thighs'</td>
<td>bi-[ëlò]</td>
<td>8</td>
</tr>
</tbody>
</table>

³ See Pulleyblank and Turkel 1995 for relevant discussion of [rtr] / [atr] asymmetries within an OT framework
⁴ Unlike many eastern Bantu languages, most Bantu C languages lack pre-prefixes (augments). There are a few exceptions (see Gregoire and Janssens 1996 for a discussion of Bantu C languages that have augments).
| (ix) | ngɔkù | 'siture' | ngɔkù | 9 |
| (x) | ngɔkù | 'situres' | ngɔkù | 10 |
| (xi) | lɔnɔ | 'cleanliness' | lɔnɔ | 11 |
| (xii) | bo-soa | 'cleanliness' | bo-soa | 14 |
| (xii) | e-m̩elo | 'place of killing' | e-[m-ẽl-ɔ] | 7 |
| (xiii) | ch̩elo | 'resting place' | e-[h̩l-ẽl-ɔ] | 7 |
| (xiv) | esweelo | 'place of origin' | e-[sw̩-ẽl-ɔ] | 7 |

(2-3) Nkundo Nominals (C-60) Hulstaert 1963

<table>
<thead>
<tr>
<th>Form</th>
<th>Gloss</th>
<th>Morph.</th>
<th>Noun Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>eéké</td>
<td>'oiseau'</td>
<td>e-[éké]</td>
</tr>
<tr>
<td>b.</td>
<td>eefé</td>
<td>'douleur'</td>
<td>e-[eefé]</td>
</tr>
<tr>
<td>c.</td>
<td>lootö</td>
<td>'bouture'</td>
<td>lo-[œt ᵒ]</td>
</tr>
<tr>
<td>d.</td>
<td>loskɔ</td>
<td>'arm'</td>
<td>lo-[skɔ]</td>
</tr>
<tr>
<td>e.</td>
<td>elekelö</td>
<td>'passage'</td>
<td>e-[lek-ẽl-ɔ]</td>
</tr>
<tr>
<td>f.</td>
<td>efetswẽlɔ</td>
<td>'purification'</td>
<td>e-[fêtsw-ẽl-ɔ]</td>
</tr>
</tbody>
</table>

Nominals derived from verbal roots may incorporate verbal suffixes to give a wide variety of shapes. My assumption for underived nominals will be that they consist of a primitive morphological stem commonly consisting of two syllables. The morphological constituency is shown in (2-4). In underived nominals the stem directly and vacuously

---

5 A deverbal noun comprising the verb root -6m- 'kill' followed by the nominalizing suffix -ELO, 'place'.
6 A deverbal noun comprising the verb root -hõi- 'rest', followed by the nominalizing suffix -ELO, 'place'.
7 Both monosyllabic and polysyllabic stems are also possible. The longer stems often involve reduplication, compounding or are derived from verbs. Nominal and verbal roots may also be referred to as “themes”.

30
dominates the root / theme; there is no branching. In derived nominals the category STEM contains a verbal root and a suffix. These distinctions will be assumed throughout this study. The category Word usually dominates a PREFIX and a STEM for nominals; nominal prefixes are word-level affixes. Note in (2-4) that there are two possible interpretations for the constituency of derived nominals, (ii) and (iii). Suffixes may be STEM-level as in (ii) or WORD-level as in (iii). If there are multiple suffixes a combination of STEM- and WORD-level suffixes is possible.

(2-4) Morphological Constituency of Pure and Derived Nominals

<table>
<thead>
<tr>
<th>(i)</th>
<th>(ii)</th>
<th>(iii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underived Nominal</td>
<td>Derived Nominal</td>
<td>Derived Nominal</td>
</tr>
<tr>
<td>prefix</td>
<td>prefix</td>
<td>prefix</td>
</tr>
<tr>
<td>root / theme</td>
<td>root / theme</td>
<td>root / theme</td>
</tr>
<tr>
<td>stem</td>
<td>stem</td>
<td>stem</td>
</tr>
<tr>
<td>word</td>
<td>word</td>
<td>word</td>
</tr>
<tr>
<td></td>
<td>word</td>
<td>word</td>
</tr>
</tbody>
</table>

Although the distinction between derived and non-derived nominal stems is important for some aspects of the analysis to follow, it is not always possible to determine whether a particular nominal form is derived or not. In cases where a verbal root and productive suffix can be identified, this will be indicated by the use of bracketing, as above.

2.1.3 Stem and Word in Bantu C Verb Morphology

Verbal forms have a complex morphology. Parallel to (2-4), verbs have a lexical root which comes in a variety of prosodic shapes, the most common being -CVC-. In addition,

---

8 The situation is slightly more complex for verbs which have no prefix in the singular imperative. In Babole, Class 9 and 10 nominals all begin with a prenasalized segment which historically involved prefixation with a nasal morpheme of some kind. It is not always possible to unambiguously give a prefix - stem parse to Class 9 and 10 nominals.
-CV, -VC, and -V- are attested, as well as longer -CVCV- and -CVCCVC- forms. To the root may be added various stem-level suffixes called EXTENSIONS in the Bantu literature.

(2-5) Verbal Extensions

applicative -El- / -el- alternates

reversive -Ol- / -ol- alternates

causative -is- / -y- does not alternate under harmony

passive -Am- / -am- / -em- / -om- alternates in some languages

Following the extensions optionally in certain Tense / Mode / Aspect (henceforth TMA) configurations, there is an aspectual suffix -ak-, which carries a meaning of iterativity or perfectivity, depending on the context. This morpheme -ak- is sometimes referred to as the “pre-final” in Bantuist terminology since it almost always appears just before the final element in the verb. The terminal element is known conventionally as the “final vowel” (FV) which is either -i, -e, or -a. The root plus all suffixes (excluding the final vowel -e) forms the STEM. The final vowel -e is being excluded because of its variable phonological behavior, which is consistent with it being a word-level rather than stem-level suffix under my analysis.

(2-6) Structure Of The Verbal Stem In Bantu C

\[ \text{[[ROOT] + EXT}_1 + \text{EXT}_2 \ldots + \text{EXT}_n + \text{AK} + i/a]} = \text{STEM} \]

9 The actual phonological shape of the applicative and reversive morphemes varies across the different Bantu zones. In the Bantu C zone these are always mid vowel extensions.

10 The term Final Vowel is primarily descriptive, inherited from traditional works on Bantu morphology. The concept of Final Vowel is hybrid in nature. On the one hand the FV serves the prosodic function of providing a vowel to complete a syllable. Most verb roots and extensions end in a consonant and so require a vowel to be prosodically well formed. On the other hand, the FVs -i and -e have definite meaning that they contribute to the verb and are ordinary morphemes. The final vowel -a often appears to not have any particular semantic content, appearing in a range of disparate tense, mode and aspectual constructions and might be considered a default morphological vowel. SeeMutaka and Hyman 1990, and Downing 1994 for discussions of a morphological default final vowel -a on verbs in reduplicative processes.
Another distinction that is sometimes made in Bantu morphology is between STEM and BASE, where the BASE equals the STEM minus all final vowels (Meeussen 1967).

Preceding the stem are a series of grammatical formatives or inflectional morphemes. The languages differ of course as to which particular inflectional morphemes they allow and with respect to sequencing and phonological shape. Immediately preceding the verb in some languages are a series of Object Markers (OMs). These morphemes correspond to the direct object of the verb and are like incorporated object pronouns. Some Bantu C languages lack OMs, allowing only a subject reflexive (RFLX) marker in the pre-root position. The STEM together with OM has been analyzed as forming a constituent MACROSTEM in Mutaka 1990’s dissertation on Kinande (also argued for in Myers 1987 for Shona and adopted in A&P 1994, Black 1995 for Kinande). The Macrostem will be shown to have a possible role to play in the analysis of Bantu C vowel harmony.

(2-7) Macrostem Constituent

[OM [STEM]] = MACROSTEM

Preceding the object markers, if present, come from zero to several grammatical morphemes indicating TMA distinctions. I will refer to these simply as the ‘formatives’ (FMS) following the tradition of descriptive linguistics that has produced most of the data I am using11. At the extreme left edge there is an obligatory Subject Marker (SM) morpheme that agrees with the syntactic noun class of the subject noun. Particular prefix morphemes will be introduced in the context of examples from different languages we

---

11 Among the Formative Markers is usually a negation morpheme.
will be considering. The STEM / MACROSTEM plus the formatives and SM constitute the constituent WORD.

\[ \text{(2-8) Verbal Morphological Word} \]

\[
\text{[SM-FM-FM-[(OM)-STEM] -e]} = \text{WORD}
\]

Note in (2-8), that I have analyzed the final vowel -e as extra-stem material. Evidence will be presented shortly to support this assertion. Compare with (2-6) where other FVs are considered part of the STEM.

Another kind of criteria becomes important as my analysis develops; that is the notion \textit{lexical}. I want to point out that, in the context of (2-8), none of the verbal prefixes may be considered \textit{lexical}\textsuperscript{12}; in fact, agreement, tense, negation, and the other verbal prefixes are clearly syntactic / inflectional in nature\textsuperscript{13}. The simplified morphological schema presented above corresponds largely to the traditional templatic view of Bantu prefixal morphology\textsuperscript{14}. I give some glossed examples below to give the reader a sense of the morphology which will be in focus throughout the study. The left edge of the verb root is indicated with a left square bracket.

\textsuperscript{12} These morphemes never appear in derived nominal forms; they have no innate relationship to the verb root. I am using \textit{lexical} here to mean the root and all the affixes that it subcategorizes for. I will develop this specialized notion of lexicity further later in this chapter.

\textsuperscript{13} The final vowel morpheme as well seems inflectional in nature, but a rigorous syntactic characterization is beyond the scope of this study. What is in focus here is the way different classes of morphemes behave with respect to vowel harmony and what we may learn about Bantu C morphology from this. In particular, the question will arise whether featural alignment keyed to edges of morphological domains provides a rich enough characterization of the phonology / morphology interface.

\textsuperscript{14} This simplified view will be enriched as needed throughout the course of the dissertation.
(2-9) Morphology in Bantu C Verbal Forms

(i) Babole C-10
Leitch 1995
tô-ká-l-[bimb-i
SU1pl-NEG-RFLX-[hit-CMPL
'We didn’t hit ourselves’

(ii) Bobangi C-30
Whitehead 1899 p. 48
na-tiko-[kos-ol-a
SU1sg-COMP-[save-REV-FV
'I saved more thoroughly’

(iii) Ngombe C-40
Mangulu 1988 p.61
bá-ta-petá-[ba1-a
SU3pl-NEG-FUT-[speak-FV
'they will yet not speak’

(iv) Doko C-40
Hulstaert 1961 p. 133
dá-bá-[bóm-e
SU1pl-OB3pl-[hit-E
'we should hit them’

(v) Likile C-50
Carrington 1977 p. 81
ba-[bend-ák-i
SU3pl-[lift_up-AK-CMPL
'they lifted up...’

(vi) Nkundo C-60
Hulstaert 1963 p. 36
a-fɔ-[mɛl-ak-e
SU3sg-NEG-[smoke-HAB-E
'he doesn’t smoke’

(vii) Ombo C-70
Meeussen 1952 p. 26
t-á-kono-[kɔŋ-ol-a
SU1pl-FUT-[pick_up-REV-FV
'we will pick up...’

(viii) Ndengese C-80
Hulstaert and Goemaere 1984 p. 58
tɔ-ɔ-[kendo-a
SU1pl-PST-[leave-FV
'we left’

This introductory morphological and prosodic characterization will be elaborated as required in the course of the study.

2.2 Vowel Harmony Tuned to Morphology: Initial Characterization

The overall picture that we want to capture may be stated as follows: lexical verb roots and nominal stems either have or do not have a harmonic feature specification [rtr]. In all cases mid vowels in stem suffixes will harmonize with a harmonic feature in the root:

stem harmony is a basic property of the system. There are no cases where a retracted verb
root does not induce harmony in mid vowel stem suffixes: there are absolutely no non-derived stem sequences of the type [e/o...e/o]\(^{15}\) or [e/o...e/o]\(^{16}\). Non-stem material consisting of prefixes and the final vowel -e, may harmonize or not depending on the harmony domains established by the alignment grammar of the particular language. The basic machinery for the OT analysis that we will be considering involves constraints of the ALIGN family. The formalism for alignment comes from McCarthy and Price 1993b as it has been extended to featural harmonic systems in Kirchner 1993, Pulleyblank 1993, Akinlabi 1995, Cole and Kisseberth 1994, 1994, Smolensky 1993, etc. The ALIGN constraints that we will initially be concerned with are given in (2-10).

(2-10) ALIGN [rtr] Constraints for Bantu C Vowel Harmony

I. ALIGN {[rtr], R || STEM, R} = ALIGN SR
   Align the right edge of an [rtr] featural span with the right edge of the morphological category STEM.

II. ALIGN {[rtr], L || STEM, L} = ALIGN SL
    Align the left edge of an [rtr] featural span with the left edge of the morphological category STEM.

III. ALIGN {[rtr], R || WORD, R} = ALIGN WR
    Align the right edge of an [rtr] featural span with the right edge of the morphological category WORD

IV. ALIGN {[rtr], L || WORD, L} = ALIGN WL
    Align the left edge of an [rtr] featural span with the left edge of the morphological category WORD

\(^{15}\) Sequences of this sort do occur but the vowels in question are word-level suffixes and may or may not be included in word-level harmony. These cases are explored in this chapter in § 2.2.3

\(^{16}\) Sequences of this sort are attested in a single language Tetela, C-70 which is explored in detail in Chapters 5 and 6. Tetela has non-alternating retracted suffixes and these involve [rtr] which must be crucially distinguished from the harmonic root-affiliated variety.
2.2.1 Basic Harmony-by-Alignment Mechanisms

There are a few issues which should be clarified now to avoid questions once the analysis is underway. These issues concern the basic mechanism by which domain harmony effects are achieved via featural alignment. Consider the five representations in (2-11), and the constraint evaluation for each representation. Harmony is accomplished in this framework by targeting the two edges of a domain\textsuperscript{17}. In (i) only the left edge is aligned, causing two ALIGN\textsubscript{R} violations; this is not a domain-harmonic configuration. In (ii) only the right edge is aligned, resulting in two ALIGN\textsubscript{L} violations. In (iii) the feature is aligned to both edges but the gapped representation is excluded on universal grounds (following \textit{A&P 1994}, p. 22). The representation that best accomplishes alignment to both edges is (iv); it does this by linking to the intervening eligible anchor as well. Representation (2-11)(iv) is the normal expression of harmony in a domain and note that it satisfies both ALIGN constraints as well as PASRE. Both edges are targeted and the intervening prosodic anchors are harmonized as a result of edge-alignment. Of course there is a cost associated with having intervening anchors targetted, since paths must be added. However what about representation (v)? Note that when a feature is not parsed, ALIGN violations cannot be computed at all and so a floating feature does not violate ALIGN constraints (see \textit{Pulleyblank 1994} for a formal demonstration of this axiom). This will turn out to be an important point in the analysis to follow.

\footnote{\textsuperscript{17} If a feature is otherwise linked because of some independent requirement, alignment to a single edge may result in harmony. This arises in Bantu C because STEM-edge alignment always dominates WORD-edge alignment. In such a case a single ALIGN\textsubscript{W} constraint need only dominate LEX PATH to have a visible effect since STEM harmony "anchors" the harmonic feature. The "nested" nature of Bantu C vowel harmony is discussed at the end of this chapter.}
Harmony is realized in this view by creating an autosegmental association between the root-specified [rtr] and appropriate prosodic anchors. Therefore within the account, harmony is only possible when a constraint ALIGN [X] dominates LEX PATH, the faithfulness constraint that assigns a cost to inserting a Path between feature [X] and some anchor. A straightforward typology of morphologically-keyed harmony follows from the basic relation between ALIGN [X] constraints and LEX PATH. The factorial typology generated by the four ALIGN constraints in (2-10) plus LEX PATH generates 5! or (5x4x3x2x1)=120 possible rankings. In fact only a very small number of the possible rankings, (2-12) (iii)-(vi), are attested.

---

18 This is not the only possible way of analyzing harmony: see Cole and Kisseberth 1995 for an OT view of harmony that does not rely on mechanisms of autosegmental association and spreading.
(2-12) Basic Morphological Harmony Domain Schema

(i) *No harmony (not attested)
LEX PATH >> {ALIGN SL/SR || ALIGN WL/WR}

(ii) *Prefix Harmony only \(^{19}\) (not attested)
{ALIGN WL >> LEX PATH >> ALIGN SL || ALIGN SR || ALIGN WR}

(iii) STEM but not prefixes or final -e.
{ALIGN SL || ALIGN SR >> LEX PATH >> ALIGN WL || ALIGN WR} (Bolia C-30, Ngombe C-40)

(iv) STEM and final -e but not prefixes
{ALIGN SL || ALIGN SR || ALIGN WR >> LEX PATH >> ALIGN WL} (Babole C-10, Likuba C-20)

(v) STEM and prefixes but not final -e
{ALIGN SL || ALIGN SR || ALIGN WL >> LEX PATH >> ALIGN WR} (Ntomba C-30)

(vi) Complete Harmony: all suffixal and prefixal material
{ALIGN SL || ALIGN SR || ALIGN WL || ALIGN WR >> LEX PATH} (Nkengo, Lwankamba C-60)

A few comments are in order for (2-12). In order to have harmony at all, ALIGN must dominate LEX PATH. When LEX PATH is undominated in (i), there is no harmony. As we proceed down the list of constraint grammars toward (vi) we find progressively more liberal (extended) harmony. That the rankings (2-12)(iii)-(vi) alone are attested (and not many conceivable other rankings) invites explanation. In particular we will want to try to identify possible meta-ranking principles that make large numbers of unattested rankings impossible. Several observations might be made in this regard. First, for all of the languages considered in this study, the ALIGN constraints for the purely morphological category STEM always dominate LEX PATH. This corresponds to the observation that

STEM harmony is a canonical property of this group of languages; this can be formalized

\(^{19}\) This ranking would result in harmonizing of prefixes if another constraint required linking of \([rtr]\) in the root, otherwise it would force linking of the harmonic feature to the left edge of the word but without harmony. I believe both cases to be excluded for principled reasons, namely that ALIGN STEM >> ALIGN WORD is a universal: ALIGN constraints on more deeply embedded morphological constituents dominate ones on less deeply embedded constituents.
in the ranking \{ALIGN SR/SL \gg \textsc{lex path}\}^{20}. Secondly, it is conspicuous that prefixal harmony is never allowed without stem harmony. In other words, harmony always permeates the stem domain before it extends to an edge of the next “higher” domain. This second observation can be factored out and formalized in the ranking \{ALIGN R/L S \gg ALIGN R/L W\}. Taken together, these two apparently fixed rankings pare down the field of possible grammars to something approaching what we actually find.

Instead of free permutation of all constraints, what is in fact attested is free permutation of \textsc{lex path} with ALIGN WR and ALIGN WL giving 3!=6 possible rankings (rather than 5!=120). The question of whether these observed ranking restrictions can be shown to follow from some meta-ranking principles is an important one. I will take it up later in this chapter once particular analyses have focused the issues. In the sections to follow I will present data and analyses for languages corresponding to each of the attested rankings in (2-12), (iii)-(vi). In the final section of the chapter I will also discuss the unexpected and problematic harmony pattern found in Nkundo (Mongo C-60) and a number of other languages, where harmony extends exactly one syllable to the left of the left stem edge. This pattern will force me to revise the analysis in an interesting direction, allowing the possibility that prosodic domain edges play a role in some cases.

\textsuperscript{20} If \textsc{stem} harmony were not obligatory (as reflected in this ranking), there could still be featural alignment to a single edge, but this would no longer be harmony, but rather simply an alignment-driven \textsc{stem} asymmetry in feature distribution. This is of course possible cross-linguistically. It is furthermore possible that alignment to a single edge is the marked case, especially for underived morphological environments.
2.2.2 Stem Harmony Only: A Sketch of Bolia, C-30

In this section, I will sketch an analysis of Bolia (Mamet 1960). Bolia is a language that has no prefixal harmony and likewise fails to harmonize the final vowel -e. Bolia harmonizes neither nominal or verbal prefixes.

(2-13) Mid Vowel Harmony but no Prefixal Harmony in Bolia

Nouns
bo-nsele  cl. 4  'lezard gris commun'
bo-nsele  cl. 4  ' nudité'
bo-tombo  cl. 4  'chasse-palaquin du chef en forme de pirogue'
bo-tondo  cl. 4  'toit'

Verbs
kō-[kel-a imp. exhortative  'fais donc'
kō-[kend-e imp. exhortative  'marche donc'
lo-yo-[koh-e imp. motional  'venez prendre'
ba-pō-[bong-ê 21 ind. pres.negative  'ils ne conviennent pas'

There is simply no spreading of the root harmonic feature to prefixes in Bolia; the vowel of the prefixes are invariably of the "advanced" set. However, in cases of vowel hiatus, under strict vocalic adjacency, a prefix vowel will assimilate totally to a stem-initial vowel to its right. This can be seen with vowel-initial stems such as (2-14)(i) and (iii), where the prefixal mid vowel has become retracted when in hiatus with a retracted stem-initial vowel. Contrast (2-14)(i) and (iii) with (2-14)(ii), where the normal case of prefixal non-harmony holds.

21 The non-harmony of final -e in this example and the one just above is a variable aspect of Bantu C vowel harmony that will be accounted for later in this chapter. It is not a typographical mistake.
(2-14) Prefix Vowel Assimilation under Strict Vocalic Adjacency

(i) bo-ongo bi-ongo *bo-ongo 3/4 'cervelle'
(ii) bo-bondo be-bondo *bo-bondo 3/4 'berceuse'
(iii) bo-5m5 *bo-5m5 3/4 'peur'
(iv) ye-enwa be-enwa *be-enwa 7/8 'phenomene'

The assimilation under vocalic adjacency holds of verbs as well as can be seen in example (2-15).

(2-15) Assimilation under V-V Adjacency in Verbs
tö-[s1-o] * to-s1-o
1pl-[be_tired-FV
'nous sommes fatigués'

These are not counterexamples to the generalization that prefixes do not harmonize, it is rather a different process entirely\(^\text{22}\). This has nothing to do with alignment of [rtr] to a morphological edge but rather with vowel feature assimilation under strict V-V adjacency; it is a formally different process\(^\text{23}\). In the course of this study I will present many different cases of vocalic feature assimilation and coalescence that must be formally distinguished from the morphological [rtr] vowel harmony.

---

\(^{22}\) The full paradigm has other curious intricacies not in focus here. For the reader’s benefit, here is the complete paradigm. Data is culled from Lexique Bolia-Francais, Mamet 1960, p. 144-210.

\(^{23}\) The analysis of elision, gliding, coalescence in V-V hiatus contexts is a formally different problem than that of vowel harmony. See Casali 1996 for a detailed OT analysis of cross-linguistic variation in behavior of vowels in hiatus.
I will now present data in (2-16) to illustrate the failure of the final vowel -e to harmonize in this language (while the final vowel -a does assimilate\textsuperscript{24}). The final vowel -e appears in a variety of Tense-Mode-Aspect configurations, as will be seen below, and may be considered as a single morpheme with an aspectual meaning of non-completeness.

(2-16) Final -E Fails to Harmonize

(i) Durative Motional -e, (page 48)
\begin{align*}
\text{á-tó-[komb-é]} & \quad \text{'il suit'} \quad \text{advanced root -komb-} \\
\text{á-tó-[kend-é]} & \quad \text{'il marche'} \quad \text{retracted root -kend-}
\end{align*}

(ii) Recent Past -e, (page 51)
\begin{align*}
\text{bá-mbó-[tomb-é]} & \quad \text{'ils ont porté...'} \quad \text{advanced root -tomb-} \\
\text{á-mbó-[tep-śl-é]} & \quad \text{'il a desséré...'} \quad \text{retracted root -tepśl.}\textsuperscript{25}
\end{align*}

(iii) Subjunctive -e (pages 57, 58)
\begin{align*}
\text{á-[min-é]} & \quad \text{'qu'il boive du vin...'} \quad \text{advanced root -min-} \\
\text{á-[lo-śk-é]} & \quad \text{'qu'il construise...'} \quad \text{retracted root -lo-}
\end{align*}

(iv) Imperative Motional -e (page 57)
\begin{align*}
\text{lo-tó-[tomb-cl-e]} & \quad \text{'allez porter au...'} \quad \text{advanced root -tomb-} \\
\text{lo-tó-[koh-śe]} & \quad \text{'allez prendre...'} \quad \text{retracted root -koh-}
\end{align*}

(v) Indicative Present Negative -e (page 59)
\begin{align*}
\text{mi-pó-[kel-é]} & \quad \text{'je ne fais pas'} \quad \text{advanced root -kel-} \\
\text{bá-pó-[bong-śe]} & \quad \text{'ils ne conviennent pas'} \quad \text{retracted root -bong-}
\end{align*}

\textsuperscript{24} It might be possible to claim that the Final Vowels -e, and -i are both word level suffixes, while final -a is uniformly a stem level suffix. What we will see is that if suffixal [a] assimilates in a language, then every instance of suffixal [a] assimilates; there is no domain-related variation in the behavior of the low vowel. We will see in the next chapter that the high vowel [i] is always a non-undergoer of harmony and is generally opaque to [rtr] harmony because of the incompatibility between [rtr] and [hi]. As a result it would be impossible to establish for a particular language whether a final -i is a non-undergoer because of its phonological properties alone or because it is outside of the harmony domain as determined by the alignment grammar. I will leave this question open until further research can provide independent evidence for the status of final vowel [i] with respect to harmony domains. At any rate it is necessary to provide some account for the variable behavior of the final vowel -e. For the moment therefore, I will maintain that the final vowel -e alone is a word-level suffix and that the variable behavior is due to ranking of the constraints ALIGN WL and LEX PATH.

\textsuperscript{25} This verb contains the reversive extension -Ol- which is seen to harmonize with the root [rtr] value.
Non-final suffix [e] does harmonize.

(vi) Imparfait Negative -e (page 62)
a) ntf-mō-[ēb-āk]-ē 'je ne connaissais pas...'
b) ntf-mō-ko-[hōn-ēl-ēk]-ē 'je ne vous avais pas écrit ....'

Example (2-16) (vi)b) is particularly revealing in that we can see that the applicative morpheme -El- is harmonizing with the retraction in the root, as is the low vowel pre-final suffix -Ak-\(^{26}\). This example also establishes that harmony is not operating with respect to a syllabic foot, but rather will extend to any number of syllables; only the final vowel -e is excluded. Stem harmony is fully operative, inducing retraction on the applicative mid-vowel suffix, but prefixes and the final vowel -e are not included. In addition to the final vowel suffix -e, there is a nominal suffix -o, which shows up in a certain class of derived nominals and does not harmonize. These nouns are all derived from verbs through the addition of the applicative suffix -el-, followed by a nominal(izing) suffix -o. To make the generalization completely explicit, only the retracted mid vowels in roots provoke harmony at all and in those cases the final -o does not harmonize.\(^{27}\)

(2-17) Bolia Nominals with Non-Harmonizing Final -o

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Meaning</th>
<th>Stem</th>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>bo-min-el-o</td>
<td>'deglutition'</td>
<td>-min-</td>
<td>'boire, engloutir'</td>
<td></td>
</tr>
<tr>
<td>e-tumb-el-o</td>
<td>'mise à jeu'</td>
<td>-tumb-</td>
<td>'mettre le feu'</td>
<td></td>
</tr>
<tr>
<td>e-mek-el-o</td>
<td>'essay'</td>
<td>-mek-</td>
<td>'essayer'</td>
<td></td>
</tr>
<tr>
<td>e-hémb-el-o</td>
<td>'dérision'</td>
<td>-hémb-</td>
<td>'mépriser'</td>
<td></td>
</tr>
<tr>
<td>e-bóbmb-el-o</td>
<td>'armoire'</td>
<td>-bóbmb-</td>
<td>'cacher'</td>
<td></td>
</tr>
</tbody>
</table>

\(^{26}\) Bolia is a language where suffixal low vowels under [rtr] harmony assimilate completely to the preceding vowel. This pattern of suffixal low vowel assimilation is very common: /eC, a/ \(\rightarrow [eC]a\) and /aC, a/ \(\rightarrow [aC]a\). This pattern is analyzed with the other low vowel behaviors in Chapter 5.

\(^{27}\) The reverse verbs -kak-ol-, 'décrocher' and -homb-ol-, 'rembourser', which contain the reversive suffix -Ol-, show that it is not the case that the back round mid vowel in general fails to undergo harmony.
The applicative suffix is harmonizing in the relevant examples, showing that it is not a feature-related problem with the vowel [e] in general. For the purpose of contrast, morphologically parallel forms in Nkundo (Hulstaert 1961), show harmony in both the noun-class prefix and the final vowel morpheme -o:

Nkundo  e-[fetsw-el]-o  'purification'  
         [ʃtr]

Bolia  e-[hemb-el]-o  'derision'  
        [ʃtr]

It must be admitted that the failure of a particular edge morpheme or class of edge morphemes to harmonize could be handled by stipulatively marking them as extra-harmonic (in the sense of extra-metrical, extra-tonal, etc.). Alternatively, one could claim that the failure to harmonize was due to variable specification of the segments in question. This approach would need to claim, for example, that in Bolia, prefixal mid vowels were specified for [ATR] and that it is the structural presence of specification that is inhibiting harmony. For alternating stem suffixes, on the other hand, like the applicative -el- / -el it would need to be claimed that there was underlying lack of specification and hence harmony. Still other suffixes would be specified [ATR], as in the case of non-alternating subjunctive/negative final -e, etc. The analysis I will propose derives the variable harmonic behavior of edge elements (prefixes, final vowels -e and -o) from constraint ranking, the same mechanism that determines all other variation in an
OT framework. All that needs to be said is that certain affixes (inflectional prefixes, verb-final -e and nominalizing final -o) are word level affixes in every case. The domain boundaries established by variation in constraint ranking do the work and nothing crucial depends on variable specification\textsuperscript{28} of particular morphemes.

2.2.2.1 No Word-Edge Alignment

I will now sketch how my OT analysis of Bolia works. Recall the basic ranking of constraints proposed for Bolia from (2-12), reproduced in (2-18) below.

\textit{(2-18) Bolia Alignment Ranking}

\{ALIGN SL \parallel \text{ALIGN SR} \gg \text{LEX PATH} \gg \text{ALIGN WL} \parallel \text{ALIGN WR}\}

Because of the crucial ranking between LEX PATH and the WORD-edge alignment constraints, harmonizing non-stem material can never produce optimal forms. The tableau in (2-19) below shows how the form ehémbelo, 'dérision', would be selected as optimal by the constraint interaction. The same constraint interaction analysis would apply to the verbal forms in (2-16).

\textsuperscript{28} For general theoretical criticisms of underspecification see Mohanan 1991 and Steriade 1995.
We turn next to look at Ntomba (Mamet 1955), a close geographic and linguistic neighbor of Bolia where we find prefixal harmony but harmonic failure of the same final elements as with Bolia.
2.2.3 Stem And Prefix Harmony: A Sketch Of Ntomba C-30

Ntomba, C-30 (Mamet 1955) is an example of a language which has asymmetrical WORD-edge alignment of [rtr] to the left only (all prefixes harmonize but final -e/-o do not). The contrast to Bolia can be seen in the morphologically parallel forms in (2-20).

(2-20) Variable Word Edge Alignment in Bantu C

(i) Bolia e-[hemb-el]-o 'dérision' No WORD edges

(ii) Ntomba e-[lok-el]-o 'ensorcellement' Left WORD edge Only

Before demonstrating the constraint interaction scenario that determines the Ntomba pattern, we will first consider more data to establish that Ntomba is completely parallel to Bolia in terms of the failure of WORD right alignment. Mamet's own characterization of the vowel harmony pattern is worth noting:

"Cette règle concerne tous les affixes, apports aux radicaux quels qu’ils soient: préfixes, infixes, suffixes, soit nominaux, soit verbaux, c’est à dire tous morphèmes quelconques formant avec le radical du base un seul mot...Il y a également exception à cette règle pour les finales flexionelles en “e” de la conjugaison (verbale) et pour la finale en “o” des mots derivés de verbes."

Mamet 1955, p. 10

To this explicit characterization I add the following examples. The examples in (2-21) show that any number of mid vowel prefixes will harmonize when the root is retracted. Contrast (2-21)(iii), (v), (vi) (retracted roots) with (2-21)(i), (ii), (iv) (non-retracted roots); mid vowel prefixes uniformly harmonize with retracted roots.
(2-21) Mid-Vowel Verbal Prefixes Harmonize in Ntomba

Recent Past (page 40) (this tense has a final vowel -e)
(i) na-mbō-[kel]-ē 'j'ai fait'
(ii) e-mbō-[tang]-ē 'elle est tombée (la pluie)'
(iii) tō-mbō-mō-[kend-el]-ē 'nous sommes allés vers lui'

Near Future (page 42) (this tense has a final vowel -a)
(iv) o-kō-[ha] 'iras-tu?'
(v) o-kō-[kend-ē] 'iras-tu?' (another verb glossed 'go')
(vi) tō-kō-kw-[ēn-ē] 'nous te verrons'

The examples in (2-22) contrast present negatives having a retracted and non-retracted verb root. Note, in addition to the differences in prefixal harmony, the failure of final -e to harmonize when the root is retracted.

(2-22) Present Negatives

[nápwenē] na-pō-[ēn-ē] 'il ne voit pas' Mamet 1955 p. 14
1s-NEG-see-FV
1s-NEG-know-FV

The examples in (2-23) and (2-24) show that the failure of final -e to harmonize is not related to adjacency to the verb-root initial vowel; neither adjacent, (2-23), nor distant, (2-24), final -e harmonizes.

(2-23) Imperative Negative without -AK (more formal)

tō-[ēng-ē] 'ne dors pas' Mamet 1955 p. 38
NEG-[eat-FV]

(2-24) Imperative Negatives with -AK [rtr]

Neg-[eat-AK-FV]

Mamet 1955 p. 37
Just as with Bolia, non-final suffixal [e] in Ntomba does harmonize, as the applicatives in (2-25) show.

(2-25) Ntomba Applicative Alternations (Mamet 1955, p. 23-24)

<table>
<thead>
<tr>
<th>Advanced Roots</th>
<th>Gloss</th>
<th>Applicative</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>hang-a</td>
<td>dire</td>
<td>hang-el-a</td>
<td>dire à</td>
</tr>
<tr>
<td>lemb-a</td>
<td>empenner</td>
<td>lemb-el-a</td>
<td>empenner pour</td>
</tr>
<tr>
<td>ping-a</td>
<td>injurier</td>
<td>ping-el-a</td>
<td>injurier pour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retracted Roots</th>
<th>Gloss</th>
<th>Reversive</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ket-e</td>
<td>entailler</td>
<td>-ket-el-e</td>
<td>entailler pour</td>
</tr>
<tr>
<td>hong-o</td>
<td>pister</td>
<td>-hong-el-e</td>
<td>pister pour</td>
</tr>
<tr>
<td>hón-o</td>
<td>décorer</td>
<td>-hón-en-e</td>
<td></td>
</tr>
</tbody>
</table>

The reader is reminded that any suffixal low vowel in Bolia / Ntomba assimilates completely with the preceding vowel when it is in an [rtr] harmony domain. Thus in any Tense / Mode / Aspect (TMA) such as Imperative, where a final vowel -a follows a retracted vowel, the -a becomes a copy of the retracted vowel. This kind of alternation will receive a complete description and analysis in Chapter 4. In addition to the applicative alternations, we can look at the reversive/intensive suffix -ol- / -ol- for evidence that non-final mid vowel suffixes harmonize.

(2-26) Ntomba Reversive/ Intensive Alternations

<table>
<thead>
<tr>
<th>Advanced Roots</th>
<th>Gloss</th>
<th>Reversive</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>kámb-a</td>
<td>être en besoin</td>
<td>kámb-ol-a</td>
<td>éscaper du besoin</td>
</tr>
<tr>
<td>ék-a</td>
<td>apprendre</td>
<td>ék-ol-a</td>
<td>s'exercer</td>
</tr>
<tr>
<td>lip-a</td>
<td>fermer</td>
<td>lip-ol-a</td>
<td>ouvrir</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retracted Roots</th>
<th>Gloss</th>
<th>Reversive</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>homb-o</td>
<td>louter</td>
<td>homb-ol-o</td>
<td>indemniser</td>
</tr>
<tr>
<td>ékia</td>
<td>appuyer</td>
<td>ék-ol-o</td>
<td>désappuyer</td>
</tr>
</tbody>
</table>

29 This form illustrates a process of nasal consonant harmony between bare nasals, [m] and [n], and a following /l/.

50
In contrast to the harmonizing “o” of the reversive extension -Ol- in Ntomba, a final vowel -o that is added to certain deverbal nouns\(^{30}\) does not harmonize, (2-27), just as we saw for Bolia (see (2-17) and (2-20)).

(2-27) Ntomba Nnominals with Non-Harmonizing Final -o

<table>
<thead>
<tr>
<th>Stem</th>
<th>Meaning</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-kih-el-o</td>
<td>'siege'</td>
<td>-kih-</td>
</tr>
<tr>
<td>e-luk-el-o</td>
<td>'recolte'</td>
<td>-luk-</td>
</tr>
<tr>
<td>e-kel-el-o</td>
<td>'acte'</td>
<td>-kel-</td>
</tr>
<tr>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-kend-el-o</td>
<td>'marche'</td>
<td>-kend-</td>
</tr>
<tr>
<td>e-bôt-el-o</td>
<td>'gestation'</td>
<td>-bôt-</td>
</tr>
<tr>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-lök-el-o</td>
<td>'ensorcellement'</td>
<td>-lok-</td>
</tr>
<tr>
<td>e-kan-en-o</td>
<td>'pensee'</td>
<td>-kan-</td>
</tr>
</tbody>
</table>

On the other hand, vowel harmony affects all mid vowels in non-derived nominal stems such that they are either retracted or not, as in (2-28).

(2-28) Mid Vowel Harmony in Non-Derived Nominal Stems

<table>
<thead>
<tr>
<th>Stem</th>
<th>Meaning</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-bongo</td>
<td>'sorte de harpon'</td>
<td></td>
</tr>
<tr>
<td>e-lepô</td>
<td>'grelot'</td>
<td></td>
</tr>
<tr>
<td>e-lombe</td>
<td>'notable'</td>
<td></td>
</tr>
<tr>
<td>e-héndé</td>
<td>'écureuil'</td>
<td></td>
</tr>
<tr>
<td>e-bongo</td>
<td>'brouillard sur la savanne'</td>
<td></td>
</tr>
<tr>
<td>bw-ëlo</td>
<td>'blancheur'</td>
<td></td>
</tr>
<tr>
<td>e-lombe</td>
<td>'qui est sociable'</td>
<td></td>
</tr>
<tr>
<td>e-hête</td>
<td>'sorte de poisson tilapia'</td>
<td></td>
</tr>
</tbody>
</table>

2.2.3.1 Left Word-Edge Alignment

Recall that formally I derive prefixal alignment when ALIGN WL dominates LEX PATH.

The morphological alignment ranking proposed for Ntomba is given in (2-29).

(2-29) Alignment Ranking for Ntomba

\{ALIGN SL || ALIGN SR || ALIGN WL >> LEX PATH >> ALIGN WR\}

\(^{30}\) There are other types of deverbal nominatives with a final suffix -o which also fails to harmonize, for example lu-[ëy-ëk-o] 'action de parer un coup' from the verb -ëy- 'parer un coup'.
The constraint tableau in (2-30) illustrates how this ranking will isolate as optimal those forms which harmonize only stem plus prefix material. The telling contrast is between Candidates #4 and #5. Harmonizing the Word-level suffix (by satisfying ALIGN WR) has the effect of adding a fatal LEX PATH violation.

(2-30) Constraint Tableau for Ntomba Stem + Prefix Harmony

eləkelo, 'ensorcellement'

<table>
<thead>
<tr>
<th></th>
<th>PARSE RTR</th>
<th>ALIGN SL</th>
<th>ALIGN SR</th>
<th>ALIGN WL</th>
<th>LEX PATH</th>
<th>ALIGN WR</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-[10k-El]-O</td>
<td>![rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>!*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>E-[10k-El]-O</td>
<td>![rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>E-[10k-El]-O</td>
<td>![rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>E-[10k-El]-O</td>
<td>![rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>E-[10k-El]-O</td>
<td>![rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We turn next to look at Babole (Leitch 1994, 1995) where all final mid vowel suffixes, including final -e, harmonize, while prefixes do not.

2.2.4 Stem And Final Vowels: A Sketch Of Babole: C-10

Babole is a Bantu C language spoken in the District of Epena in the Republic of Congo some 500 miles North of the Bolia-Ntomba area (see Map 1 in Appendix A). The river where the Babole people live (the Likouala-Aux-Herbes) empties into the Sangha River just before it in turn empties into the Congo river south of Mossaka. All Babole data come from my own field work conducted in the Dzeke dialect of Babole from 1988-1992. Babole (i) shares the pattern of suffixal low-vowel assimilation to retracted roots that we have seen in Bolia and Ntomba; (ii) lacks prefixal harmony entirely; and (iii) consistently harmonizes all suffixal material. I will now provide data to illustrate these properties of Babole. First of all (2-31) clearly shows that mid-vowel prefixes do not harmonize, even when directly adjacent to vowel-initial stems. The mid-vowel harmony pattern seen in the stems in (2-31) is moreover completely consistent; there is no mixing of retracted and advanced mid vowels in any stem.

(2-31) Mid Vowel Prefixes Do Not Harmonize

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>eákɔ́</td>
<td>'arm'</td>
<td>e-ákɔ́</td>
<td>7</td>
</tr>
<tr>
<td>cɛlɔ́</td>
<td>'thigh'</td>
<td>e-ɛlɔ́</td>
<td>7</td>
</tr>
<tr>
<td>ekɔngɛ́</td>
<td>'language'</td>
<td>e-kɔngɛ́</td>
<td>7</td>
</tr>
<tr>
<td>bohɔlɛ́</td>
<td>'footprint'</td>
<td>bo-hɔlɛ́</td>
<td>14</td>
</tr>
</tbody>
</table>

53
In addition, forms morphologically parallel to those seen in Bolia (2-17) and Ntomba (2-27) show complete harmony of word-final suffixal “o” when retraction is present in the root.

(2-32) Babole Nominals Harmonize Final -o

e-okw-el-o 'indifference'
di-tal-el-o 'place where animals are divided up'

→ e-hɔl-el-o 'place of rest'

→ di-nkɔmb-ɔt-el-o 'piece of circular wire'
derivation uncertain

In addition, the Babole TMA configurations that have a final vowel -e always harmonize that final -e with the verb roots retraction value. Compare parallel subjunctives from Ntomba and Babole in (2-33) below; when the verb root initial vowel is retracted, the final -e harmonizes consistently in Babole, unlike Ntomba where it never does.

(2-33) Subjunctive Forms in Ntomba and Babole

Ntomba
á-[kel-e] 'qu'il fasse'
á-[en-e] 'qu'il voie' 31
bá-[lot-el-e] 'qu'ils s'habillent pour'

Babole
á-[kel-e] 'qu'il fasse'
á-[én-e] 'qu'il voie'
bá-[hɔl-el-e] 'qu'ils se reposent pour'

2.2.4.1 Right Word-Edge Alignment

The hypothesis I have been entertaining is that the verbal final vowel suffix -e and nominal suffix -o are consistent word-level suffixes across Bantu C. Under this hypothesis

31 Note that the lexical tone of the verb root -én- is high in both Babole and Ntomba. In Ntomba subjunctives however, the lexical high tone of verb roots is lost (Mamet 1955 p. 47). Babole subjunctives retain high tones on both the prefixes and verb roots.
the cross-linguistic variation in harmonic behavior is not due to a change in the
morphosyntactic status of the suffixes from language to language; that is, final -e is not
analyzed as a word level suffix in languages where it fails to harmonize and a stem-level
suffix in languages where it does harmonize. I am analyzing the difference as being due
solely to the ranking of the WORD edge alignment constraints with respect to other
constraints. This is not the only approach that might capture all of the relevant facts.
However it is an elegant analysis and describes the data as well as the competing
solutions that involve stipulating from language to language that the final mid vowels and
or prefixes are extra-harmonic or variably specified. My solution has the virtue of
deriving the variation by the same theoretical mechanism that all variation is derived
from: constraint ranking alone. In (2-34) is the ranking of constraints proposed for the
Babole pattern. Note that the only difference between Babole and Ntomba on this view is
that the position of the ALIGN WL and ALIGN WR constraints is reversed (compare (2-34)
with (2-29)).

(2-34) Alignment Ranking for Babole
{ALIGN SL || ALIGN SR || ALIGN WR >> LEX PATH >> ALIGN WL}

The constraint tableau in (2-35) illustrates how this ranking will isolate as optimal those
forms which harmonize only stem and prefix material. The telling contrast is between
Candidates #4 and #5. Harmonizing the Word-level suffix (by satisfying ALIGN WR) has
the effect of adding a fatal LEX PATH violation.
To graphically summarize the development of the chapter to this point consider the harmony patterns in the morphologically parallel forms in (2-36).
(2-36) Variation in Morphological Alignment in Bantu C

(i) Bolia e-[hɛm-b-e]-o ‘dérision’ No WORD edges

(ii) Ntomba e-[ɔŋ-g-e]-o ‘gite’ Left Word Edge Only

(iii) Babole e-[hɔl-e]-o ‘place of rest’ Right Word Edge Only

I turn next to consider Elembe-Nkutu and Losikongo, two closely related languages of the Mongo C-60 sub-family. In these two languages all final mid-vowel suffixes as well as prefixes harmonize.

2.2.5 Complete Harmony: Elembe-Nkutu / Losikongo

Elembe-Nkutu (Hulstaert 1990) and Losikongo (Hulstaert 1984) are spoken in Zaire and are very closely related to both Nkengo (Hulstaert 1970) and Lwankamba (Hulstaert 1977). See the Map 1 in Appendix A. for the precise location of each of these languages with respect to Nkundo, the subject of Hulstaert’s Grammaire du Lomongo.⁵²

Although we will be considering the harmonic systems of various of these languages in the study, for the moment we will consider only Elembe-Nkutu and Losikongo. The claim to be made in this section is that Elembe-Nkutu and Losikongo are examples of

---

⁵² Lomongo or Mongo is a name that refers to a large ethnic affiliation in Central Zaire and is sometimes used informally to refer to the C-60 group of languages. Lonkundo or simply Nkundo is the particular language that was the main object of Hulstaert’s 3-volume study (he gives a lot of information on closely related “Mongo” languages as well).
languages that have harmonic feature alignment to both *WORD* edges. I will begin by presenting data that shows the crucial contrast between *Elembe-Nkutu* and the three languages whose basic morphologically-keyed harmony systems we have seen so far in this chapter. In (2-37) we see that the final vowel *-e* in now-familiar verbal conjugations does harmonize. The negative and subjunctive verbal forms are among those that commonly have final *-e* cross-linguistically in Bantu C (see (2-16) (iii) and (v)).

(2-37) *Elembe-Nkutu Final -e Does Harmonize*

**Negatives**

\[
/\text{tó-fá-[-aŋ-E/} \quad [\text{tófáâŋgé}] \quad \text{'nous ne voulons pas'} \quad \text{(p. 242)}
\]
\[
/\text{tó-fá-[-én-E/} \quad [\text{áféné}] \quad \text{'nous ne voyons pas'} \quad \text{(p.242)}
\]
\[
/\text{inyô-fá-kend-E/} \quad [\text{inyô-fá-kend-é}] \quad \text{'vous n'allez pas'} \quad \text{(p.242)}
\]

**Subjunctives**

(i) \[
/\text{lô-[l-a-E/} \quad [\text{lólæ}] \quad \text{‘que vous couchez’} \quad \text{(page 243)}
\]
(ii) \[
/\text{lô-[kend-E/} \quad [\text{lôkende}] \quad \text{‘partons’} \quad \text{(page 243)}
\]

In addition to harmonizing final *-e*, *Elembe-Nkutu* harmonizes all mid-vowel prefixes in both nominal and verbal forms. Some examples are provided in (2-38).

(2-38) *Elembe-Nkutu Prefixes Harmonize*

(i) \[
\text{bo-songo} / \text{be-songo} \quad 3/4 \quad \text{‘canne à sucre’} \quad \text{(p. 230)}
\]
(ii) \[
\text{bo-sôngô} / \text{be-sôngô} \quad 3/4 \quad \text{‘manioc’} \quad \text{(p. 230)}
\]
(iii) \[
\text{e-feko} / \text{peko} \quad 7/8 \quad \text{‘outil en fer’} \quad \text{(p. 231)}
\]
(iv) \[
\text{e-téko} / \text{téko} \quad 7/8 \quad \text{‘puit’} \quad \text{(p. 231)}
\]
(v) \[
\text{e-mbô-[kɔf-am-a}^{34} \quad \text{‘il est accroché’}
\]

\[
[\text{rrtr}]
\]

---

33 The orthographic symbol "' t" in this example refers to a glottalized \[t\]. Note that \[t\] 'hardens' to \[‘ t\] just as \[f\] hardens to \[p\] in nominal class 8.

34 In *Elembe Nkutu* and *Losikongo* (and most C-60 languages), suffixal low vowels do not assimilate under harmony, in contrast to what we have seen for *Bolia*, *Ntomba*, and *Babole*. This variation is given a formal account in Chapters 4 and 5. For the geographical distribution of variable low vowel assimilation behavior see Chapter 4.
This last verbal form consists of two prefixes containing mid vowels, both of which have harmonized with the root \(-k\omega\)\(t\), `accrocher`. The prefix e/-e- is an agreement morpheme corresponding to a class 7 nominal subject, and the second is mbo / mbo, a grammatical formative prefix with the meaning “ineffectiveness” (Hulstaert 1990, p. 240). The examples in (2-39), taken from Losikongo, Hulstaert 1984, further illustrate the pattern of unrestricted prefixal harmony seen in many of the C-60 languages.

(2-39) Losikongo Examples of Prefixal Harmony in Verbs

(i) Two Syllables:

Perfect I: prefix -sO- and Final Vowel -A

(i) t5-so-kw[\(\text{\^e\(\text{n}\)}\)-a... ]

\[\text{[rtr]}\]

`nous vous avons vus` verb= -\(\text{\^e\(\text{n}\)}\)  p. 52

(note -kw- = -kO- 2nd person pl. obj. infix)

(ii) a-s\(\text{\^o}\)-[\(\text{\^o}\)-a]  

`elle a accouché` p. 58 (advanced root for contrast)

Perfect II: prefix -tO- and Final Vowel -A

(iii) t5-t5-[k\(\text{\^o}\)-a] ...

\[\text{[rtr]}\]

`nous avons coupé ...hier` verb= -k\(\text{\^o}\)  p. 60

(iv) moli \(\text{\^ e\(\text{t}\)}-[w\(\text{\^ a}\)]

`la chèvre est morte` p. 59 ("advanced" root for contrast)

(v) w\(\text{i\(n\)}\a b\(\text{\^ o}\)-t\(\text{\^ o}\)-[k\(\text{\^ a}\)

`le jour point` p. 59

35 It is sometimes difficult to find a variety of forms with multiple mid vowel prefixes. This is particularly true in smaller works of the “esquisse” genre. Hulstaert 1990 on Elembe-Nkutu is one such short grammatical sketch. In addition to the scarcity of data in some works is the fact that both high vowels (Chapter 3) and low vowels (Chapters 4 and 5) universally block [rtr] harmony in prefixes. In addition, examples with retracted roots are not consistently provided.

36 Clearly the low vowel is not phonetically advanced. Nonetheless [a] consistently patterns with the non-retracted root vowels [i], [u], [e], [o] in terms of not triggering vowel harmony. This will be accounted for in chapters 4 and 5. See fn. 37 as well.

37 Although the low vowel [a] generally patterns with advanced vowels phonologically across Bantu C (fn. 36), there is a small class of degenerate -CV- verb roots in some languages with a root vowel [a] yet having retraction harmony in affixes. Some of these verb roots have underlying retraction (2-39(v)), while others, (2-39)(iv), do not. My view is that [rtr], if lexically present, may be licensed in these cases in the root by the presence of the offglide in the onset, in this case ['] in \(-k\text{\^ a}-\), `pindre`. In these cases, such a licensing gambit reflects the probable historical presence of a retracted mid vowel.
(ii) Three Syllables: Motional Subjunctive Negative (page 57)

(vi) o-fóyó-[kwēla] ká lifoku 'de peur de tomber dans une fosse' (retracted root)

[rtr]

(vii) o-fóyó-[kúl-án-a]... 'que tu ne heurtes ...' (non-retracted root for contrast)
(viii) o-fóyó-[ta-a] 'que tu ne sois blessé' (low-vowel in root for contrast)

Like Elembe-Nkutu, Losikongo harmonizes final -e. Some examples are provided in (2-40).

(2-40) Losikongo Examples of Final -e Harmony

Present Negatives
(i) /á-fá-[óng-E/ [afóngé] 'il ne convient pas' (p. 64)
(ii) /mí-fá-[áng-E/ [mpángé]38 'je ne veux pas' (p. 64)

Durative
(iii) /bá-yO-[tő-E/ [báytőe] 'elles portent...' (p. 65)

2.2.5.1 Right and Left Word Edge Alignment

In (2-41) is the ranking of constraints proposed for the Elembe-Nkutu and Losikongo harmony pattern.

(2-41) Alignment Ranking for Elembe-Nkutu and Losikongo
{ALIGN SL || ALIGN SR >> ALIGN WR || ALIGN WL >> LEX PATH }

The constraint tableau in (2-42) illustrates how this ranking will identify as optimal those forms which harmonize all eligible suffixal and prefixal material (only mid vowels, since high and low vowels are excluded for phonological reasons). Even though the initial prefix in candidate #5 cannot be linked because of the phonological incompatibility

38 Note here a typical example of a low vowel verb root failing to induce retraction harmony.
between [rtr] and [low], it still is the best candidate because it satisfies both left and right alignment as fully as possible. For example, if the first person plural prefix, tO-, had been used in the example instead of the third person plural bá-, we would expect the fully harmonic form t5-ý5-t5-e, ‘nous apportons’. However only the third person plural form was provided.

(2-42) Constraint Tableau for Losikongo Word-Edge Alignment

<table>
<thead>
<tr>
<th>ba-ý5[t5-e ‘elles apporment’</th>
<th>PARSE</th>
<th>ALIGN</th>
<th>ALIGN</th>
<th>ALIGN</th>
<th>ALIGN</th>
<th>LEX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RTR</td>
<td>SL</td>
<td>SR</td>
<td>WR</td>
<td>WL</td>
<td>PATH</td>
</tr>
</tbody>
</table>

| 1. | ba-ýO-[tO-E | !* | | | | |
| 2. | ba-ýO-[tO-E | | !* | ** | * | |
| 3. | ba-ýO-[tO-E | | | *!* | ** | |
| 4. | ba-ýO-[tO-E | | | !* | * | ** |
| 5. | ba-ýO-[tO-E | | | | * | *** |

39 The phonological incompatibility between [low] and [rtr] will be formalized in terms of LICENSING failure based on the redundancy relation between the two features (Ito, Mester and Padgett 1995). This is treated in Chapters 4. and 5.
To summarize, I have claimed that the range of significant variation in the non-STEM mid-vowel harmony patterns in Bantu C languages can be best explained in terms of a theory which aligns featural material to the edges of morphological domains. The overall picture of morphologically based variation developed to this point can be seen in (2-43).

(2-43) Variation in Morphological Alignment in Bantu C

(i) Bolia: No WORD edges

\[
e-[h\text{̃}mb-\text{el}]-o \quad \text{’derision’}
\]

\{ALIGN SL || ALIGN SR >> LEX PATH >> ALIGN WL || ALIGN WR\}

(ii) Ntomba: Left Word Edge Only

\[
e-[\text{o}ng-\text{el}]-o \quad \text{’gite’}
\]

\{ALIGN SL || ALIGN SR || ALIGN WL >> LEX PATH >> ALIGN WR\}

(iii) Babole: Right Word Edge Only

\[
e-[h\text{̃}l-\text{el}]-o \quad \text{’place of rest’}
\]

\{ALIGN SL || ALIGN SR || ALIGN WR >> LEX PATH >> ALIGN WL\}

(iv) Elembe-Nkutu: Both Word Edges

\[
t-\text{[kend]-e} \quad \text{’allons’}
\]

\{ALIGN SL || ALIGN SR || ALIGN WL || ALIGN WR >> LEX PATH\}
In each case the crucial constraint ranking concerns which ALIGN constraints dominate LEX PATH. I claim that this approach provides the skeletal framework onto which all the other characteristics of the vowel harmony system of Bantu C are overlaid. The basic harmony system is profoundly morphological in nature, involving alignment of a root-specified [rtr] feature with the edges of various morphological domains. In subsequent chapters, we will see how very complex patterns result when other constraints of various types begin to interact with the basic system. Before turning to that task however, I examine in the following section the harmony system of Nkundo (Hulstaert 1962), which challenges the framework developed so far. Prefixal harmony is shown to extend exactly one syllable to the left of the verb root, pointing to a covert phonological domain edge.

2.2.6 Nkundo: One-Syllable-to-the-Left Harmony

2.2.7 The Phenomena

Hulstaert 1961 (Grammaire du Lomongo: Premiere Partie, Phonologie) presents a detailed and explicit account of the vowel harmony patterns of the C-60 language Lonkundo (or simply Nkundo). The mid vowel harmony patterns in stems are exactly what we have seen for all the other Bantu languages surveyed in this chapter. The examples in (2-44) will suffice to assure the reader that this is the case.

(2-44) Nkundo Mid Vowel [rtr] Harmony Patterns (Hulstaert 1961 p. 16-17)

<table>
<thead>
<tr>
<th>Stem</th>
<th>Class</th>
<th>Meaning</th>
<th>Stem</th>
<th>Class</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>bo-kongo</td>
<td>3</td>
<td>'copalier'</td>
<td>bo-kongo</td>
<td>3</td>
<td>'dos'</td>
</tr>
<tr>
<td>lo-foso</td>
<td>11</td>
<td>'peau'</td>
<td>lo-foso</td>
<td>11</td>
<td>'bruit'</td>
</tr>
<tr>
<td>bo-kele</td>
<td>3</td>
<td>'œuf'</td>
<td>bo-kele</td>
<td>3</td>
<td>'liquide'</td>
</tr>
<tr>
<td>e-kele</td>
<td>7</td>
<td>'impossibilité'</td>
<td>e-kele</td>
<td>7</td>
<td>'nain'</td>
</tr>
</tbody>
</table>
It might even be tempting to assume, based on these nominal forms, that vowel harmony was targeting the left edge of the word just as in Losikongo or Elembe-Nkutu (see (2-38)), since the nominal prefixes are harmonizing. Moreover, verbal and deverbal forms, as in (2-45), with a single prefix, appear to confirm this hypothesis. If [rtr] is present, it spreads to both prefixes and suffixes.

(2-45) Verbal and Deverbal Forms in Nkundo (Hulstaert 1961 p. 35-36)

(i) tó-sang-a 'nous disons'  
(ii) ó-kel-e 'que tu fasses'
(iii) e-lek-el-o 'passage'
(iv) lo-lang-o 'amour'

Note that suffixal low vowels fail to assimilate in Nkundo. Moreover, these suffixal low vowels uniformly block the spread of [rtr] harmony. These phenomena will be accounted for in Chapters 4 and 5. What is of interest to us now in the data in (2-46) is the fact that only a single syllable to left of the verb root is actually harmonizing, even when additional mid-vowel prefixes are present. I have bolded the harmonizing elements for focus and added a left square bracket to mark the left edge of the verb root; otherwise the examples and glosses are exactly as they appear in Hulstaert 1961.

(2-46) Prefixal Harmony in Nkundo Verbs (Hulstaert 1961 p. 38, premiere serie)

A. Negative Formative -fO

(i) tó-fó-[kôtôl-é] 'nous ne comprenons pas'
(ii) ó-fó-[lê] 'tu ne mange pas'

B. Object Pronoun Infixes

(iii) lô-lô-[sèngol-a] 'vous l’avez invite'
(iv) ifô-tô-[kônd-a] 'il nous compensera'
(v) a-faô-kô-[sôk-a] 'il ne t’offensera pas'
(vi) to-tô-[kwéy-âk-é] 'ne nous fais pas tomber'
C Other Grammatical Formatives

(vii) ɓɛ-fɔ-yɔ-[tswɛl-e]  ‘ils ne réussissent pas (continuellement)’
(viii) ɓo-yɔ-kɔ-[ɔnd-el-e]  ‘nous te prions (continuellement)’

The generalization that emerges from these first examples is that harmony is affecting exactly one syllable to the left of the initial verb root syllable. In set A., it is the negative morpheme, /-fO-/ that harmonizes, but note that the same negative morpheme fails to harmonize in C (vii). In set B., we see object prefixes harmonizing. When present, these are invariably in the root-adjacent position. In set C we see the continual aspect prefix harmonizing in (vii) when root-adjacent, but failing to harmonize in (viii) when its root-adjacent position is supplanted by the object prefix. It seems clear that the right generalization concerns prosodic structure (syllables) and not morphological structure.

The following examples confirm that the generalization must be stated over syllables and not morphemes. All contain a first person singular object prefix -n-. While there can be no doubt that this prefix is a morphological entity, contributing meaning to the utterance, it fails to block vowel harmony which still extends one syllable beyond the verb-initial syllable. The -n- prefix is being parsed as part of the onset for the initial verb root syllable.

(2-47) Verbal Forms with First Person Singular Prefix

\[
\begin{array}{c}
\sigma \\
\sigma
\end{array}
\]

(i) ɑ-fɔ-nj-[ɛs-ány-ɛ]  ‘il ne me surveille pas’

(ii) ɓ-o-[dɔmb-ɛl-ɛ]  ‘que tu demandes pour moi’
These data establish that the generalization does not involve a morphosyntactic position, or particular class of morphemes. That is, we may not say that harmony extends only to the pre-root slot/position and not beyond, since in these examples it is extending beyond the object infix to the next morpheme; again the generalization is clearly syllable-based (prosodic).

The data in (2-48) is therefore somewhat perplexing since it shows that object prefixes and other prefixes do block harmony when vocalic elision results in a surface syllabification that is parallel to the data in (2-47). Hulstaert call them “affixes devocalisés” and they occur before vowel-initial verb roots only. In (2-48)(i), for example, the object infix -lo-, becomes a labialized affricate [jw] before vowel-initial verb roots. Even though the syllabic configuration is exactly as in (2-47)(i), harmony fails.

(2-48) Vowel-Elided Prefixes Do Block Harmony

(i)  infix -lo- / lw / jw

\[ \sigma \rightarrow \sigma \]
\[ \tilde{a}f\sigma jw-[\tilde{e}s-\tilde{a}ny-\tilde{e}] \]
\[ [rtr] \]
\[ 'il ne vous surveille pas' \]

(ii) infix -to- / tsw

\[ \sigma \rightarrow \sigma \]
\[ \tilde{o}o-tsw-[\tilde{e}t-a] \]
\[ 'tu nous as raillés' \]

---

40 The first person singular object marker has the allomorph [nj] preceding vowel-initial roots.
Comparing (2-47i) and (2-48i) it is clear that the difference is between an elided and non-elided environment. I suggest that difference might reasonably be stated in terms of lexical and post-lexical “levels”. The prosodic and morphological surface structures are completely parallel. Informally stated, the vowel harmony process is “seeing” the root-adjacent morphemes in their pre-elided state and satisfying whatever harmony requirements there are (at that level). For the moment I will say that such elisions are post-lexical in nature and that vowel harmony processes must be seen as operating lexically. I will look at the lexical / post-lexical distinction in some detail in Chapter 6, sharpening the analysis to account for the full range of facts to be introduced.

To summarize concerning the Nkundo prefixal harmony data, it is clearly a syllable-based generalization requiring that harmony be extended one syllable to the left of the left stem edge. In a derivational framework, the Nkundo pattern could have been described by a simple rule spreading a feature one syllable to the left: a simple directional, non-iterative assimilation rule. This is precisely the kind of process that is impossible to express in an output-oriented theory of HARMONY-BY-ALIGNMENT. In the theory we are working with, an edge is required to target, and to have an edge; a domain is needed. We might consider the possibility of a Phonological domain edge for Nkundo as in (2-49).

41 An additional ALIGN constraint would be required to align [rtr] to the left of the phonological domain. The theory of Generalized Alignment (McCarthy and Prince 1993b) allows for alignment to edges of both Morphological categories (Mcat) and Phonological categories (Pcat).
Such a phonological domain extending one syllable to the left of the left stem edge is suggestive of the morphological domain MACROSTEM which involves one morpheme (of a particular kind, admittedly) to the left of the left stem edge. In the following section I consider the possibility of justifying a phonological domain that is analogous to the morphological macrostem.

2.2.7.1 Phonological Macrostem Hypothesis

The morphological domain MACROSTEM was introduced in Chapter 2. This category has been motivated in work on the morphology and phonology of eastern Bantu languages such as Shona (Myers 1987) and Kinande (Mutaka 1990, Black 1995). The macrostem constituent in these analyses consists of the traditional verb stem plus any object markers (prefixes). It is strictly a structural/morphological domain in the work of the cited authors. It is clear however, from even the limited data presented in (2-46), (2-47) and (2-48), that no such claim can be made for Nkundo. Many different kinds of morphemes are included in the prefixal harmony domain, not just object prefixes.

If we cannot appeal to a morphological domain, then we might posit a phonological domain analogous to the morphological one. Such a domain extending one syllable to the left of the verbal stem might be motivated as follows. First of all, the Object Markers are the only prefix morphemes that invariably harmonize (with the
exception of nominal class markers; I will discuss these below). If, as claimed in the literature cited, the MACROSTEM is a valid morphosyntactic category across Bantu generally, then it could be that Nkundo (and the other languages that have this harmony pattern) started out harmonizing to the left edge of the morphological macrostem domain and then developed an analogical phonological domain. In this view, at a certain point only the object markers would have undergone vowel harmony before the pattern generalized to any syllable adjacent to the stem. This would in effect constitute a phonological MACROSTEM. I will call this the phonological macrostem hypothesis.

2.2.7.2 Lexical Domain Hypothesis

A second approach that one might take to justifying the phonological domain in (2-49) involves the historical extension of harmony to nominal prefixes. I suggest in *Leitch 1996* that, based on the kind of data seen in this chapter, historically vowel harmony was only a property of morphological stems. It is highly plausible that many of the verbal inflectional prefixes of current Bantu languages were independent verbal words or particles that were cliticized or morphologized and absorbed by stages into the complex verbal morphology we see today. One aspect of this development is that harmony probably extended to prefixes in nouns before prefixes in verbs. This is reasonable since nominal prefixes are part of the lexical entry of a noun, most nouns

---

42 See also Givon 1972 for a hypothesis of affix grammaticalization in Bantu.

43 I thank Larry Hyman for pointing out in this context that there is an issue of whether some of these Bantu C languages have verbal prefixes at all. If in a particular language the corresponding verbal elements were clearly independent words, then the explanation for lack of harmonization for those elements could be developed along other lines. For example, one might reasonably explore a hypothesis that harmony is word-bound and that the variation is about what elements are 'outside' the verbal word.
having a characteristic singular / plural prefix pair associated with them. The
morphosyntactic ‘closeness’ of nominal prefixes and stems is related to the
subcategorization nature of prefix-stem relationship in nouns. Verb roots on the other
hand have no subcategorization relationship with any of the prefixes associated with
them. A particular verb form might have inflectional prefixes marking tense, aspect,
negation, and agreement with the subject noun, but these are entirely a function of the
meaning of the sentence and could never be associated with anything in the verb’s lexical
entry. The fixed lexicalized relationship between nominal stems and prefixes is likely
part of the reason that nominal prefixes underwent assimilation before verbal ones in the
evolution of vowel harmony. This idea could be implemented in a Harmony-by-
Alignment system by recognizing a phonological domain may have a special relationship
to a domain involving subcategorized elements. A fully inflected Bantu C verb, while
arguably a morphological word, is never a lexical entity (where lexical means “stored as
a unit in the lexicon”, under the assumption that subcategorized-for elements are stored
as part of the entry for a morphological word). Therefore inflected verbal forms could not
be phonological words in a language that insisted on congruence between a phonological
and lexical domains (in the above sense of lexical). A Bantu nominal form, on the other
hand, is always both a lexical and phonological word. The prosodic shape of canonical
nominals might be as in (2-50).

---

44 In articulatory terms the tongue root setting needs to be done once for each lexical item.
45 In this context, I will use the term ‘lexical’ to indicate that the affix has a subcategorization relation to the root.
46 It seems plausible that the strongest and least marked kind of word would be one where phonological, lexical, and
morphological criteria converge.
Bobangi is a C-30 language of Zaire documented in Whitehead 1899.

Whitehead provides data to show that only noun class prefixes harmonize while verbal prefixes do not. In fact, only nominal prefixes with back mid vowels harmonize (2-51), while front mid vowel prefixes do not, (2-52).

(2-51) Class 11 Nominal Prefix Harmonizes

<table>
<thead>
<tr>
<th>singular</th>
<th>plural</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo-bílá</td>
<td>mbílá</td>
<td>'palm nut'</td>
</tr>
<tr>
<td>lo-ngélè</td>
<td>ngélè</td>
<td>'brass rod'</td>
</tr>
<tr>
<td>lo-tómò</td>
<td>ntómò</td>
<td>'tasks'</td>
</tr>
<tr>
<td>lo-séndé</td>
<td>nséndé</td>
<td>'splinter'</td>
</tr>
<tr>
<td>lo-mbáló</td>
<td>mbáló</td>
<td>'tasks'</td>
</tr>
</tbody>
</table>

(2-52) Class 7 Nominal Prefix Does Not Harmonize

<table>
<thead>
<tr>
<th>singular</th>
<th>plural</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-sè sè</td>
<td>bi-sè sè</td>
<td>'cutter up for occasion'</td>
</tr>
<tr>
<td>e-lé má</td>
<td>bi-lé má</td>
<td>'fool'</td>
</tr>
<tr>
<td>e-lé lè</td>
<td>bi-lé lè</td>
<td>'eating without purpose'</td>
</tr>
</tbody>
</table>

Verbal prefixes, on the other hand, uniformly fail to harmonize with retracted verb roots, whether the prefixes have [o], (2-53)(i-iii), or [e], (2-53)(iv).

---

47 _Grammar and Dictionary of the Bobangi Language_ is published in English, so the glosses are provided exactly as Whitehead gave them.
Further confirmation is provided that this is indeed the case for Bobangi in that

Whitehead 1899 provides an explicit commentary on the differences between verbs and nouns with respect to vowel harmony:

Whitehead 1899, p.6

"hence it will be found that the formative prefixes for nouns and formative suffixes for verbs must be made to harmonize with whichever kind of vowel the original root may contain. The facts respecting this euphony will be better understood in the various sections of the etymology where it will be necessary to refer to them"

This type of system can be seen perhaps as the initial step in evolution from a Babole-type system where no prefixes harmonize on the way to a system like Losikongo where all prefixes harmonize. In the scenario of evolution pictured, harmony first extends to nominal prefixes because of the lexicalized nature of the prefix / stem relationship in nouns. At this initial stage a requirement that phonological domains be lexical dominates the requirement to parse a pre-stem syllable into the phonological word. This may be formalized as follows. There are two constraints to be considered:

\[ \{ \text{FR/RTR} \gg \text{ALIGN LPW} \gg \text{LEX PATH} \} \]

This ranking expresses the scenario: "harmonize except where some dominant constraint forbids it". It captures the insight that harmony is expected in nominal prefixes because of the ALIGN grammar, but is blocked when a dominant phonological constraint would be violated.
A phonological domain must correspond to a lexical domain. If \{\phi=\text{LEX} \gg \text{PARSE} \sigma\} then a stray syllable will not be incorporated into a phonological domain unless the resulting domain is lexical (where lexical means 'consisting of a root and subcategorized affixes'). Bobangi nominals of course may satisfy both constraints under any ranking. If the nominal prefix is parsed as a phonological word adjunct, the output is still lexical. However with verbal prefixes the constraints conflict. To satisfy the syllable parsing requirement, a prefix syllable must be included in the phonological domain, but such a domain is no longer lexical. Therefore the ranking \{\phi=\text{LEX} \gg \text{PARSE} \sigma\} is indicated for Bobangi, effectively allowing the creation of a phonological domain for vowel harmony just in nominals; in verbs no prefix syllable is parsed. For Nkundo and the other single prefix harmonizers, I posit the inverse ranking: \{\text{PARSE} \sigma \gg \phi=\text{LEX}\}. Here again both constraints are satisfied in nominal forms where the resulting phonological left edge is also a lexical left edge. However for verbs under this ranking, the requirement to parse a syllable outranks the need to preserve domain correspondence. The result: for Nkundo verbs, a phonological harmony domain is set up that corresponds to the phonological shape of nominals, but includes morphemes that are not subcategorized for. The question immediately arises: why then are not multiple prefixes parsed as phonological word adjuncts? I speculate that the domain shape must correspond to that for nominals, that is, a single syllable adjoined to a stem-initial foot. The spirit of my proposal here is that the prosodic shape of nominals is serving as a

---

49 "lexical domain" in this context means "a domain that corresponds to a lexicalized item which is stored as a unit in the lexicon". Stems are always "lexical" in this sense. Nominal forms are lexical in this sense. Inflected verbal forms are not.
template for the creation of an analogical prosodic domain in verbs. Therefore the limitation to a single prefix syllable could be formalized via a templatic constraint requiring that phonological words consist of a foot (whether binary or unbounded) and a single left adjunct syllable. I will leave the further formalization of this idea to future research.

The first stage of extending vowel harmony into verbal prefixes was when the stem-plus-one-syllable phonological domain shape in nouns generalized to verbs. In effect, this creates a phonological domain larger than the verbal stem but smaller than the morphological verbal word. Vowel harmony in Nkundo targets the left-edge of this phonological domain. In later stages of the development of vowel harmony, where harmony extends right to the left of edge of the morphological verb phrase (morphological word), it is no longer necessary to posit a phonological domain edge, but we cannot preclude the possibility either. Other evidence would be required to show that a phonological domain was relevant in any particular case. Although this introduces some indeterminacy into the account, it is possible that this corresponds to how the acquisition process proceeds. A learner first assumes a “generic” word-edge where morphological, and phonological criteria converge. Unless positive evidence is encountered, the domain for harmony would default to a morphological word edge, as in A&P 1994. Before going on to other matters, I note that both the macrostem-analogy idea and the lexical domain correspondence approach converge on the creation of a phonological domain exactly like the one we see in verbal harmony in Nkundo.\textsuperscript{50}

\textsuperscript{50} It remains to be seen whether independent evidence for this domain can be found for these languages. Nkundo does have a pattern of single-syllable prefixing reduplication that might be construed as evidence for my account. However
Although the Nkundo pattern presents a special challenge to my initial proposal that Bantu C vowel harmony involves pure morphological category alignment, one can reasonably argue that there is a phonological domain edge present in such languages, an analogy to the phonological word in nominal forms. Such an explanation rests on the hypothesis of early historical development of harmony in nominal prefixes because they are lexical in nature, a hypothesis which is supported by the facts, as I have outlined.

2.2.8 Why [rtr] rather than [atr]?

Now that the basic patterns for root-controlled harmony extending into suffixes and prefixes have been seen, I will take up the question of why [rtr] rather than [atr] must be seen as the active (dominant) harmonic feature in the system. Initially, one might consider that either [rtr]-dominant or [atr]-dominant 7 vowel systems are possible. If we did have an [atr]-dominant system, that is, one where root [atr] was harmonizing into various classes of prefixes and suffixes, what set of patterns might we expect to find? To illustrate the point I want to make, I will use an imaginary canonical derived nominal form that has only mid vowels.

(2-54) Generic Bantu C Nominal Forms

\[
\text{bO-[hEk}-\text{E]-E} \\
\text{bO- noun class prefix} \\
\text{-hEk- verb root} \\
\text{-el- applicative extension} \\
\text{-e word-level final vowel}
\]

The range of possible harmony patterns if [atr] were active are shown in (2-55).

---

more data would be needed for the various languages involved since single syllable prefixing reduplication and foot-prefixing reduplication are both common patterns in these languages.

75
(2-55) Possible Harmony Patterns Based on Dominant [atr]

\[
\begin{align*}
&\text{[atr]} \\
&(i) \text{bo-[hek-el]-e} \quad \text{Stem Only Pattern \hspace{1cm} Not Attested} \\
&(ii) \text{bo-[hek-el]-e} \quad \text{Stem Plus final -e \hspace{1cm} Not Attested} \\
&(iii) \text{bo-[hek-el]-e} \quad \text{Stem Plus prefix \hspace{1cm} Not Attested} \\
&(iv) \text{bo-[hek-el]-e} \quad \text{Complete Harmony \hspace{1cm} All Languages} \\
&(v) \text{bo-[hek-el]-e} \quad \text{No Harmony \hspace{1cm} Unattested} \\
&(vi) \text{bo-[hek-el]-e} \quad \text{No [atr] \hspace{1cm} Elembe-Nkutu}
\end{align*}
\]

Compare the patterns in (2-55) with those in (2-56). Every pattern predicted to be possible by the [rtr] analysis actually occurs, except (2-56)(v), which shows that STEM harmony is obligatory, necessary for either analysis. Only two patterns predicted to be possible under the [atr] analysis actually occur, but these are predicted under the [rtr] analysis as well.

(2-56) Possible Harmony Patterns Based on Active [rtr]

\[
\begin{align*}
&\text{[rtr]} \\
&(i) \text{bo-[hek-el]-e} \quad \text{Stem Only Pattern \hspace{1cm} Bolia}
\end{align*}
\]
I take this to be rather striking confirmation that the Bantu C family of languages requires a retraction-dominant analysis rather than an advancement-dominant analysis. It further underlines the importance of domain asymmetries in identifying dominant harmonic features in vowel harmony systems. If there were no domain effects an analysis with either [rtr] or [atr] would be descriptively adequate.

2.2.9 Typology issues in Harmony-by-Alignment

The analysis proposed in this chapter potentially refers to the 7 constraints in (2-57). Although the possibility of phonological domain left-alignment is raised by the analysis of Nkundo, there seems to be no principled way of (or reason for) distinguishing between right morphological and right phonological edges. Even with respect to the right word edge alignment phenomena, no phenomenon requires teasing apart a right
phonological edge from a right morphological edge in a particular language. Such a case would have to be possible within free reranking schema of OT but is not required in my analysis and I will not comment further here.

(2-57) Constraints Invoked in this Chapter.

ALIGN SL
ALIGN SR
ALIGN WL
ALIGN WR
LEX PATH

ALIGN ØDL
ALIGN ØDR

The factorial typology for 5 constraints (excluding possible phonological word/domain edge alignment) yields 5! or 120 constraint grammars. When we add the possibility of phonological word edges as well as morphological word edges, increasing the crucial constraint inventory from 5 to 7, the factorial typology jumps to 5040 grammars. What we actually see across a wide area of central Africa is variation with respect to whether prefixes harmonize or not (ignoring the Nkundo and Bobangi patterns), and whether final -e harmonizes or not, a total or 4 different patterns. Extensions and uncontroversial stem material invariably harmonize and prefixes never harmonize independently of stem material. As pointed out earlier, these observations correspond to two independent constraint rankings:

(2-58) Rankings Fixed for Bantu C

(i) ALIGN SL/SR>>LEX PATH  STEM harmony is obligatory
(ii) ALIGN SL/SR>>ALIGN WL/WR  No WORD harmony without STEM harmony
Once we factor out the “deep” rankings presumably inherited from a historical protosystem\textsuperscript{51}, we basically are left with free variation in the ranking of WORD edge alignment constraints with respect to LEX PATH\textsuperscript{52}. Ignoring the possibility of phonological domain edges, for the moment, the possible rankings of WORD edges LEX PATH are given in (2-59).

(2-59) Factorial Typology for 3 Constraints

(i) \text{ALIGN WL} >> \text{ALIGN WR} >> \text{LEX PATH} \quad \text{Losikongo?}

(ii) \text{ALIGN WR} >> \text{ALIGN WL} >> \text{LEX PATH}

(iii) \text{ALIGN WL} >> \text{LEX PATH} >> \text{ALIGN WR} \quad \text{Ntomba}

(iv) \text{ALIGN WR} >> \text{LEX PATH} >> \text{ALIGN WL} \quad \text{Babole}

(v) \text{LEX PATH} >> \text{ALIGN WL} >> \text{ALIGN WR} \quad \text{Bolia?}

(vi) \text{LEX PATH} >> \text{ALIGN WR} >> \text{ALIGN WL}

Note that asymmetries between ALIGN WL and ALIGN WR can only be discerned with respect to some third constraint that intervenes between them. Therefore (iii) and (iv) can be discerned in an interaction involving 3 constraints: LEX PATH intervenes between the two ALIGN constraints. Without additional data and constraints however we cannot discern between (i) and (ii) for Losikongo and between (v) and (vi) for Bolia. In later chapters as we consider the role of additional constraints of the Grounding and Faithfulness families, we will have more to say about ALIGN asymmetries.

\textsuperscript{51} In fact, I have hypothesized that the ranking \{ALIGN STEM >> ALIGN WORD\} is a universal.

\textsuperscript{52} There is variation with WORD-edge alignment because of the inherent ambiguity of the category WORD and because the non-lexical morphology of the verbal word historically evolved via the absorption and grammaticalization of extra-verbal elements. Naturally there was variation with respect to how stem-native phonological processes like vowel harmony extended to these absorbed elements. This history is reflected in the constraint rankings.
One question that might be raised is whether the “fixed” rankings in (2-58) are just accidents of history or chance or whether they are the result of meta-ranking principles at work in the grammar. Under the accidental interpretation, the other rankings are possible but happen not to be found in our sample. On the other hand a principle requiring that ALIGNMENT systems targeting morphological categories must respect the “embeddedness” of those categories is a reasonable principle. That is to say that even though we have evidence for variable ranking of right and left word edges in Bantu C, we do not get word-edge alignment without stem alignment.

This is easy to demonstrate with respect to the prefix domain. Imagine a form such as in (2-61) below, where every mora is an eligible harmony target, a mid vowel. The situation, as it is pictured, with [rtr] linked to the verb root mora, and multiply linked to all moras to the left up to the left word edge, is certainly possible under the free re-ranking of constraints axiom. We could force the stem-initial linking either through highly ranked ALIGN SL or PASRE ROOT RTR. ALIGN WL would be responsible for the left-word edge harmony. The ranking would be as in (2-60):

(2-60) Ranking for Prefixal Harmony without Stem Harmony
ALIGN WL || ALIGN SL >> LEX PATH >> ALIGN SR || ALIGN WR.

There would be in this case left stem-edge and left word-edge alignment but no corresponding right alignment, giving the configuration in (2-61).
(2-61) Prefix Harmony without Stem Harmony: Unattested.

\[ *[\mu \mu \mu [ [\mu ] \mu \mu \mu ]] \]

\[ \text{[rtr]} \]

However, a structure as in (2-61) is in fact completely unattested in Bantu C or any other Bantu tongue root harmony system I am familiar with. This is another way of saying that STEM harmony is somehow basic in the system and so you never have word-level prefixes harmonizing apart from stem suffixes. Since stem-harmony is presumably inherited from the proto-language, this is not surprising.

However, there may be a grammatical principle at work in addition to the historical explanation. When harmony is keyed to morphological edges, embedded domains such as STEM might be required to be saturated before harmony can be extended to non-stem material. For the moment I will only note that for Bantu C,

(i) STEM Harmony is obligatory
(ii) WORD Harmony is dependent on STEM Harmony

and leave for future research the question of whether the ranking limitations are purely historical reflexes or perhaps partly determined by cognitive or linguistic principles. In the next chapter we will look in detail at the behavior of high vowels within the harmony domains set up by the ALIGN system surveyed in this chapter.
3. High Vowels In Harmony Domains

In this chapter we will see how a highly ranked Grounded constraint HI/RTR (see (3-1)) and the faithfulness constraint PARSE HI interact with ALIGN SR and PARSE RTR to produce the common attested distributional patterns of high and retracted vowels seen in the Bantu C area. A third pattern, attested in the Bantu C/D. language, Mituku (Meeussen 1952) is also explained within the same framework of constraint ordering. This chapter is paired with Chapter 5, where again retraction patterning in nominals is in focus.

Although I will choose to revise the account presented here somewhat in Chapter 5 (once the full range of facts is known), the analysis of high vowel / retracted vowel patterning in this chapter represents an important alternative analysis within the overall framework being developed. Next I provide an account of the high-vowel opacity phenomena which is the standard behavior of high vowels in Bantu C [rtr] vowel harmony. Finally I consider a case where high vowels are transparent to [rtr] harmony, but only in a particular domain. Ntomba (Mamet 1955) has high-vowels that are transparent to [rtr] harmony, but only with respect to Left Word-Edge harmony. I will provide an analysis of the paired phenomena of opacity and transparency that relies both on phonetic incompatibility and prosodic domain edge effects.

3.1 HI / RTR and PARSE HI

3.1.1 The Grounded Condition HI/RTR

Phonological feature cooccurrence constraints in rule based autosegmental theories were formalized as conditions on targets and triggers in rule operations (see for example A&P
(1989, 1994). For example, a rule spreading a phonological feature α might apply whenever its structural description was met and when the target was characterized by a second feature β. In the “Grounded Theory” of A&P 1994 such feature cooccurrence restrictions were given an explicit formal role in rule operations; such conditions on rule operations could not be randomly formulated but had to be “grounded” in the sense of justified by articulatory, acoustic, or perceptual considerations. In a “constraints only” theory like OT, a feature cooccurrence constraint like HI/RTR becomes just another kind of constraint in a hierarchy. As we will see, one feature of the Bantu C vowel harmony paradigm is that HI/RTR is never violated\(^1\). Based on the sympathetic physiological relation between tongue body (height features) and tongue root (advancement /retraction features), there is a negative correlation between the privative tongue body height feature [hi] and the privative tongue root retraction feature [rtr]. In A&P 1994, this condition is taken to prohibit a path between the antagonistic features (see A&P 1994, page 144 for a formal definition of Path Condition).

(3-1) HI/RTR Grounded Constraint

If [hi] then NOT [rtr]: the feature [rtr] may not be on a path to the feature [hi]

The feature cooccurrence constraint in (3-1) will play an important role in the analysis of Bantu C vowel harmony. It is important because it provides the basis both for the analysis of the distributional patterns involving high and retracted vowels, and for characterizing

---

\(^1\) That is, we do not find the high retracted vowels [i] or [o]. The Bantu D. languages to the east of the Bantu C zone, including Kinande, (Mutaka 1990, Mutaka and Hyman 1990, Schlindwein 1987) and Kibudu (Kutsch Lojenga 1991) do have high vowels that are retracted.
the opacity of high vowels to [rtr] harmony. It is never violated in any of the cases we will consider; the high retracted vowels [i] and [o] are not seen at all in Bantu C.

3.1.2 PARSE HI

The other phonological constraint that will play a crucial role in the analysis is PARSE HI, a member of the FAITHFULNESS family of constraints. Like HI/RTR, PARSE HI is very highly ranked and thus never violated in the languages under consideration. A formulation for PARSE HI is given in (3-2) below.

(3-2) PARSE HI Constraint
The feature [hi] must be parsed in prosodic structure.

In the remainder of this chapter I will explore how these undominated constraints interact with the Harmony and Faithfulness constraints to produce a rich set of high vowel effects.

3.2 Hi Vowel Effects in [rtr] Harmony

The general effect of undominated HI/RTR and PARSE HI constraints in the Bantu C system is that the high vowels are: (i) free in their distribution with respect to all other vowels (with certain caveats (see §3.2.1)), and (ii) opaque to [rtr] harmony.

\[\text{\footnotesize In the wider picture of Niger Congo tongue root harmony systems, there are cases where [hi] is underparsed under pressure from ALIGN constraints seeking to extend the domain of some feature hostile to [hi]. Such a case is the Ola 1995 analysis of the Niger Congo languages Aduge (Abiodun 1983), and Eruwa (Agboola 1973).}\]
3.2.1 Distribution of High Vowels and Retraction

In this section, we will look at two kinds of asymmetries in the distribution of high vowels in [rtr] harmony domains: (i) variation in nominal stem patterns across languages (ii) a difference between verbal and nominal forms in the same language.

3.2.1.1 Align Asymmetries and PARSE [RTR]

As seen in (3-3), Babole (C-10), and Nkundo (C-60) have almost identical high vowel patterns in nominal stems, in particular, allowing initial high vowels with a retracted vowel following (underlined). This pattern is seen in various of the languages in my sample. The generalization is simply that high vowel / retracted vowel combinations are unrestricted, no V¹...V² combinations are disallowed.

(3-3) Babole / Nkundo Permissive High Vowel Patterns

However, it turns out that certain other languages, for example, Likuba C-20 (Adoua 1981) and Bobangi C-30 (Whitehead 1899, Guthrie 1967, Clements 1982, Churma 1984),

---

3 See Map 4, Appendix A, for the areal distribution of this variation property.

4 Hulstaert 1961 (page 20) admits that this pattern is somewhat rare in Nkundo and gives only two examples: lo-mpfɔ, froid, and bo-nsfɔ́łɛ, etourneau. I am assuming at this point that the rarity of these forms is related to other factors and that both [i...o] and [u...o] are licit in terms of the harmonic constraint grammar.

5 This gap is taken to be accidental in these languages. The sequence [u...ɔ́] is in fact quite possible in other Bantu C languages such as Ngombe C-40, Ntomba C-30 and Mituku C/D.

---
have an identical pattern except the underlined sequences are completely unattested. If
the initial vowel in a nominal stem is high, then the following vowel may not be [e] or
[ɔ]. In OT this particular kind of variation may be shown to follow from the ranking of
the faithfulness constraint PARSE RTR with respect to the ALIGN SR / SL constraints that
control harmony (Pulleyblank 1994). In (3-4) I present the constraint ranking which is
crucial in determining the permissive pattern of Babole and Nkundo.

(3-4) Constraint Ranking for Permissive Pattern
{PARSE RTR >> ALIGN SL}
{it's more important to parse [rtr] than to left align [rtr] in stems}

✓[i...ɔ] ✓[i...ɛ] ?[u...ɔ] ✓[u...ɛ]

In (3-5) is the crucial inverted constraint ranking that determines the restricted pattern
found in Likuba and Bobangi.

(3-5) Constraint Ranking for Restricted Pattern
{ALIGN SL >> PARSE RTR}
{it's more important to left align [rtr] than to parse [rtr]}

×[i...ɔ] ×[i...ɛ] ×[u...ɔ] ×[u...ɛ]

To demonstrate how the mini-rankings (grammars) in (3-4) and (3-5) work to determine
the attested patterns, we will consider the representative sequence [i...ɔ]. Our theoretical
and methodological assumptions about not manipulating underlying forms force us to
allow the positing of [rtr] in with a morpheme of the form [I...O]. Consider first the effect
of ranking PARSE RTR above ALIGN SL with respect to the Babole word, e-hi lɔ,

---

6 This gap as well is taken to follow from independent factors; I will not try to explain this difference between Lonkundo
and Babole.
The crucial constraint interaction is detailed in the tableau in (3-6).

Candidates that underparse [hi], (i.e. #3.), or allow a path linking [rtr] and [hi] (i.e. #2), will always be rejected since the constraints PARSE HI and HI/RTR are undominated. The ranking of ALIGN SR (shaded above) turns out to be irrelevant since it is equally satisfied by either linking [rtr] to the rightmost mid vowel or underparsing [rtr]. The crucial constraint interaction is: \( \text{\{PARSE RTR} \gg \text{ALIGN SL}\} \), resulting in the fact that candidate #1 is better than candidate #4.

(3-6) Tableau for Permissive Babole - Nkundo High Vowel Pattern

\[
\begin{array}{c|c|c|c|c|c}
\text{e-hi} & \text{'sleepiness'} & \text{\textit{(Babole)}} \\
\hline
\text{[hi]} & \text{[rtr]} & \text{PARSE HI} & \text{PARSE RTR} & \text{ALIGN SL} & \text{ALIGN SR} \\
\hline
1. & \text{[hi]} & \text{I \ldots O} & \text{[rtr]} & * \\
2. & \text{[hi]} & \text{I \ldots O} & \text{[rtr]} & !* \\
3. & \text{[hi]} & \text{I \ldots O} & \text{[rtr]} & !* \\
4. & \text{[hi]} & \text{I \ldots O} & \text{[rtr]} & !* \\
\end{array}
\]

Now, if we reverse the ranking of these two constraints such that \( \text{\{ALIGN SL} \gg \text{PARSE RTR}\} \), we get the more restricted pattern of Likuba and Bobangi. This is illustrated in the tableau in (3-7) where the constraint interaction optimizes underparsing of [rtr] when it cannot be left-aligned. The ranking of ALIGN SR turns out to be irrelevant for this
particular competition as this will be satisfied by any candidate in serious contention. I have thus ignored candidates that fail to satisfy ALIGN SR. We will see shortly that the ranking of ALIGN SR with respect to PARSE RTR is determined by the consideration of other forms. In candidate #4 of (3-7), failure to parse removes all danger of ALIGN violations, so a candidate that underparses [rtr] will always win. Candidate #1 satisfies right-alignment but at the expense of forcing a more highly ranked ALIGN SL violation.

(3-7) Tableau for Bobangi - Likuba Strict High Vowel Pattern

<table>
<thead>
<tr>
<th></th>
<th>HI-RTR</th>
<th>PARSE RTR</th>
<th>ALIGN SR</th>
<th>ALIGN SL</th>
<th>PARSE RTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>![hi]</td>
<td>I . . . O</td>
<td>![rtr]</td>
<td>![rtr]</td>
<td>![rtr]</td>
</tr>
<tr>
<td>2.</td>
<td>![hi]</td>
<td>I . . . O</td>
<td>![rtr]</td>
<td>![rtr]</td>
<td>![rtr]</td>
</tr>
<tr>
<td>3.</td>
<td>![hi]</td>
<td>I . . . O</td>
<td>![rtr]</td>
<td>![rtr]</td>
<td>![rtr]</td>
</tr>
<tr>
<td>4.</td>
<td>![hi]</td>
<td>I . . . O</td>
<td>![rtr]</td>
<td>![rtr]</td>
<td>![rtr]</td>
</tr>
</tbody>
</table>

But does the constraint ranking \{ALIGN SL >> PARSE RTR\} create problems in other areas of the analysis? We should consider the mirror-image sequence [O...I] under both rankings to verify that the attested [o...i] is in fact optimal in both cases. It turns out that that in (3-8) the ranking: \{PARSE RTR >> ALIGN SR\} is crucial to derive [o...i]. Here, it is clear that underparsing [rtr] as in candidate #1, will always be worse than simple failure to right align, as in candidate #4. Recall as well that the crucial ranking to derive the
The Likuba / Bobangi pattern however reveals a different reality in terms of constraint ranking. For the *[i...e] pattern we had to have \{ALIGN SL >> PARSE RTR\}, and for the
✓[e...i] pattern we need \{PARSE RTR \gg ALIGN SR\}. The overall ranking that results for Likuba / Bobangi is given in (3-9).

(3-9) Likuba / Bobangi Ranking
\{ALIGN SL \gg PARSE RTR \gg ALIGN SR\}

In the tableau in (3-10), we see that this constraint ranking succeeds in identifying the correct output for an [O...I] sequence where [rtr] is posited in the input.

(3-10) Likuba / Bobangi [O ... I]

<table>
<thead>
<tr>
<th></th>
<th>HI-RTR</th>
<th>PARSE HI</th>
<th>ALIGN SL</th>
<th>PARSE RTR</th>
<th>ALIGN SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>!*</td>
</tr>
<tr>
<td></td>
<td>O...I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>O...I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[hi]</td>
<td></td>
<td>!*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O...I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>[hi]</td>
<td><img src="image.png" alt="image" /></td>
<td>!*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O...I</td>
<td><img src="image.png" alt="image" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td><img src="image.png" alt="image" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Although this result is straightforward enough, the crucial ordering of ALIGN constraints proposed for Bobangi / Likuba pattern could have results for other areas of the phonology as well. An alignment asymmetry, once it is hypothesized, makes strong predictions about what other asymmetries are possible. For example, I will, in Chapter 4, derive the effect of suffixal low-vowel assimilation\(^7\) to retracted verb root vowels through the ranking of \{ALIGN SR >> PARSE LO\}. For the Bobangi / Likuba grouping, where \{ALIGN SL >> PARSE RTR >> ALIGN SR >> PARSE LO\}, it appears that lo-underparsing on both on the right and left stem edges is required (along with the restricted high-vowel pattern). On the other hand, for permissive high-vowel pattern languages like Babole and Nkundo, we can expect to see a full range of patterns with respect to [lo]-underparsing. These interactions between low-vowel / [rtr] distribution and high vowel / [rtr] distributions will be clarified and reanalyzed in Chapter 5.

3.2.1.2 Differences in Nouns and Verbs

A second issue that must be discussed with respect to patterning of high-vowels in harmony domains concerns an observed difference between nominal and verbal forms. Basically, though [i...e] is possible in Babole nominal stems, it is banned in verbal forms where the second vowel is a true suffix and not part of the lexical root. While there are nominal roots such as bo-símbe \(14\), ‘excuse’, there is no high-vowel-initial verb root that allows retraction in a mid-vowel suffix. Consider a verbal root that has an initial high vowel such as the Babole root -bimb-, ‘to hit’. The subjunctive form á-bimb-è, ‘let him

---

\(^7\) The suffixal low vowel assimilation analysis will involve other factors as well. In particular a principle capturing the incompatibility between [rtr] and [lo] will be needed to drive the underparsing of [lo] only under pressure from [rtr] harmony. This will be presented in the next chapter.
hit...", and all such high-vowel-initial verb roots can only and always have the non-retracted version of the subjunctive suffix -e. Our assumptions require us to allow the possibility of hypothesizing [rtr] even with high-vowel-initial verb roots, but in fact we never find such roots with retracted suffixes; hence the conclusion that [rtr] is being lost in these cases. How are we to characterize this difference between nominal and verbal forms? One way to handle it would be to claim that there is a morphological parsing requirement in effect. The requirement would be that [rtr] must be parsed in the lexical morpheme that it is underlyingly affiliated with. Formally, a learner might still hypothesize verb root forms with [rtr] and high initial vowels, but the constraint system would never select them as outputs. We may capture this difference between verbs and nouns by referring to the morphological category of ROOT which the two share in common. For nouns, the root morpheme is co-extensive with the stem in canonical non-derived CVCV forms i.e. (CV)-[[CVCV]rootstem. For verbs, on the other hand the canonical [CVC] root is always distinct from stem (which minimally requires inflection in the form of a final vowel)\(^8\). Therefore if we replace our generic PARSE RTR constraint with a PARSE RTR ROOT constraint\(^9\), we can isolate the optimal candidates in each case.

\((3-11)\) PARSE RTR ROOT Constraint

[rtr] must be parsed in the lexical root that it is underlyingly affiliated with.

Note that this constraint is related to and yet different from recent proposals in the OT literature (McCarthy and Prince 1995a, p. 116) about meta-constraints that seek to rank

---

\(^8\)To be explicit, a canonical verb root is by definition [CV(C)]. Therefore, for stems built from canonical verb roots, non-initial vowels will always be non-root vowels. There are therefore no canonical verb roots of the form [CiCe].

\(^9\)Akinlabi 1993 was the first to argue for the necessity of such morphologically oriented PARSE constraints.
root-related faithfulness constraints universally above affix-related faithfulness constraints. The idea is that it is more important to parse root-affiliated features than affix-affiliated features. Work on feature-elision at morpheme boundaries supports such proposals (see Casali 1996 for an example where this is worked out in great detail). The constraint in (3-11) on the other hand is related to the hypothesized morpheme-level affiliation of the tongue-root feature. It is underlyingly affiliated with the root and, however else it is constrained to behave, it must manifest this underlying root affiliation in the output. In the following subsections I provide constraint interaction tableaux to demonstrate that the proposal does account insightfully for the data.

3.2.1.2.1 Babole / Nkundo Ranking and PARSE RTR ROOT

The revised analysis for the Babole / Nkundo ranking is presented in (3-12) for verbs, and (3-13) for nouns. In the case of verbs, (3-12), the optimal candidate, #3., accepts both PARSE RTR ROOT and PARSE RTR violations but as a result is assessed no ALIGN violations. Candidate #2., which parses [rtr] outside the root, ends up violating both ALIGN SL and PARSE RTR ROOT. Although candidate #2 does satisfy the generic PARSE RTR constraint (which is ranked lower than {ALIGN SL || ALIGN SR}), it still loses. As the analysis develops, we will in fact be able to ignore the generic PARSE RTR constraint completely. I have included it here to demonstrate that it plays no role in selecting optimal candidates for these competitions. It becomes irrelevant once we introduce its much stronger cousin, the dominant morphologically-oriented PARSE RTR ROOT constraint.
(3-12) Initial High Vowel: Underparse [rtr] in Verbs (Babole / Nkundo)

*á-[hít]-ê

<table>
<thead>
<tr>
<th>Verb</th>
<th>hi</th>
<th>PARSE RTR Root</th>
<th>PARSE RTR</th>
<th>ALIGN SL</th>
<th>ALIGN SR</th>
<th>PARSE RTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>hi</td>
<td><img src="image1" alt="image" /></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hî]</td>
<td><img src="image2" alt="image" /></td>
<td><img src="image3" alt="image" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>hi</td>
<td><img src="image4" alt="image" /></td>
<td><img src="image5" alt="image" /></td>
<td>*</td>
<td><img src="image6" alt="image" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hî]</td>
<td><img src="image7" alt="image" /></td>
<td><img src="image8" alt="image" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>hi</td>
<td><img src="image9" alt="image" /></td>
<td><img src="image10" alt="image" /></td>
<td>*</td>
<td><img src="image11" alt="image" /></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>[hî]</td>
<td><img src="image12" alt="image" /></td>
<td><img src="image13" alt="image" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To foreshadow the discussion in later chapters, note that a candidate that introduces [rtr]k (which was underlying affiliated to a suffixk), would be irrelevant for the constraint PARSE RTR ROOT. This is because the constraint demands only that root-affiliated [rtr]j must be parsed in the rootj. Such constraints can be construed as supporting the maintenance of key featural contrasts that exist in lexical roots.

For nouns now, (3-13), the canonical shape of nominal stems (note the bracketing difference between verbs, (3-12), and nouns, (3-13)) interacts crucially with the PARSE RTR ROOT constraint to favor the misaligned but root-parsed candidate #2.
(3-13) Initial High Vowel: Parse \[rtr\] in Nouns (Babole / Nkundo)

"bo-[simbè]", 'excuse'.

<table>
<thead>
<tr>
<th>N</th>
<th>hi</th>
<th>PARSE RTR Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>I...E</td>
<td>PARSE RTR Root</td>
</tr>
<tr>
<td>N</td>
<td>rtr</td>
<td>PARSE RTR Root</td>
</tr>
<tr>
<td>1</td>
<td>hi</td>
<td>PARSE RTR Root</td>
</tr>
<tr>
<td>2</td>
<td>hi</td>
<td>PARSE RTR Root</td>
</tr>
<tr>
<td>3</td>
<td>hi</td>
<td>PARSE RTR Root</td>
</tr>
</tbody>
</table>

Henceforth I will assume that the morphologically oriented PARSE RTR ROOT constraint is in fact the correct approach.

3.2.1.2.2 Likuba / Bobangi Ranking and PARSE RTR ROOT

In the tableaux in (3-14) and (3-15), I demonstrate that the solution holds for the Likuba / Bobangi restricted pattern as well. Clearly, even without the stronger PARSE RTR ROOT constraint, the ranking already developed does not allow the troublesome vowel sequences \[i/u...e/o\] in either nouns or verbs. By just substituting the stronger constraint the overall approach remains viable. In (3-14) the crucial ranking of \{ALIGN SL >> PARSE RTR ROOT\} ensures that the winning candidate underparses \[rtr\]. The next best candidate is assessed an ALIGN SL violation because it accepts right-alignment.
Similarly, for nominal forms in (3-15), the fact that the right stem edge vowel is included in the root means that right aligning avoids a \textsc{parse rtr root} violation, as in candidate \#1. However failing to root-parse, as in candidate \#2, is still to be preferred since this avoids the higher ranked \textsc{align sl} violation.

\section*{(3-15) Likuba / Bobangi Ranking with Nouns}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
 & \textsc{hi} & \textsc{rtr} & \textsc{parse hi} & \textsc{align sl} & \textsc{parse rtr root} & \textsc{align sl} \\
\hline
\hline
\hline
\end{tabular}
\end{table}
3.2.1.3 Mituku High Vowels: A FR/RTR Asymmetry

Mituku is a Bantu language classified in Guthrie 1948 as D-13. It is spoken on the eastern edge\(^{10}\) of the Bantu Zone C (see Maps in Appendix A.). The data for this section is taken from the description of Mituku provided in Stappers 1973. Although classified as Bantu D (it is surrounded by Lengola, Bantu D (Stappers 1971) on two sides), it has the 7-vowel system and [rtr] vowel harmony patterns of the Bantu C paradigm. In (3-16) we see that Mituku has a partial permissive pattern like Babole and Nkundo and allows [i...o] and even [u...o]. However [i...e] and [u...e] are completely unattested.

(3-16) Mituku High Vowel Patterns\(^{11}\)

\[
\begin{array}{lll}
\checkmark [e...i] & \text{nyenji} & 9 & \text{`visite'} \\
\checkmark [o...i] & \text{njoli} & 9 & \text{`reve'} \\
 & \text{it\textbari} & 5 & \text{`oreille'} \\
\checkmark [e...u] & \text{njelu} & 11 & \text{`poile de barbe'} \\
\checkmark [o...u] & \text{njou} & 9 & \text{`elephant'} \\
\checkmark [i...o] & \text{nk\textbariyo} & 9/10 & \text{`sourcil'} \\
 & \text{nk\textbarindo} & 9/10 & \text{`bruit'} (\text{Babole dik\textbarindo}) \\
\checkmark [u...o] & \text{bos\textbarindo} & 12/13 & \text{`visage'} (\text{one example in Stappers 1973}) \\
\end{array}
\]

\[\times [i...e] \]
\[\times [u...e] \]

Sequences of <[hi]...[rtr]> vowels are permitted, but only if the rightmost vowel is [bk]. This pattern is striking when viewed alongside the languages considered so far. First, even in the languages that allow initial high vowels followed by retracted mid vowels, [i/u...e] was by far the most common pattern. In Mituku [i/u...e] is not just rare but

\(^{10}\) Mituku also borders the Bantu zone C language Ombo (Meeussen 1952).

\(^{11}\) The lexical noun database in Stappers 1973 for Mituku is admittedly quite small. However since the [i/u...e] patterns are completely absent, I feel that the generalization is justified. This can only be confirmed by access to additional data on Mituku.
actually impossible while the sequences [i/u...ə] are fine. A&P 1994 (page 154) discuss a phonological constraint BK/ATR which formalizes the sympathetic articulatory relationship between tongue root retraction and tongue body backness / frontness. Because the articulatory gesture of tongue root retraction has a natural backing effect on the tongue body and vice-versa, we may expect phonologies to reflect this grounded tendency. Thus a phonological constraint BK/ATR is an appropriate candidate for a universal constraint. In the framework of this study we are considering only privative [rtr] and [fr], so I will cast the grounded constraints as FR/RTR, defined below.

\[(3-17) \text{ FR/RTR Constraint} \]

\[\text{IF NOT FRONT THEN RTR} \]

The analysis must capture the fact that the system shows a preference for linking to the left under all circumstances. However, if linking to the left is impossible, because the leftmost stem vowel is [hi], then linking to the right is only acceptable with a “stronger” target for [rtr], a non-front vowel. Thus we see that as markedness increases with respect to harmonic alignment, there is a corresponding limit on the degree of markedness tolerated in targets. As far as linking to the initial root /stem position is concerned (presumably driven by both PARSE RTR ROOT and ALIGN SL), there is no such corresponding target restriction. Both [e...i] / [e...u] and [ə...i] / [ə...u] are perfectly good sequences.

How is a ranked constraint analysis to capture these generalizations? We begin by assuming the basic restrictive ranking \{ALIGN SL >> PARSE RTR >> ALIGN SR\} which gave the Bobangi/Likuba pattern: *[i...e], *[i...ə], *[u...e], *[u...ə]. Since left-alignment
through linking to the initial high vowel was impossible, the next best thing was to 
underparse [rtr] in all cases. Now for the Mituku pattern we want to introduce the FR/RTR 
requirement such that it dominates ALIGN SL. Under this revised ranking scenario, we 
accept an ALIGN SL violation in order to satisfy the requirement that a non-front vowel be 
retracted. Thus in the Tableau in (3-18), the crucial competition is between candidates #1 
and #3. Accepting an ALIGN-L violation (candidate #1) is better than violating FR/RTR 
via underparsing (candidate #3).

(3-18) [ i ... o] is Good in Mituku

<table>
<thead>
<tr>
<th></th>
<th>HI-</th>
<th>FR</th>
<th>ALIGN-</th>
<th>PARSE</th>
<th>ALIGN-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RTR</td>
<td>RTR</td>
<td>SL</td>
<td>RTR Root</td>
<td>SR</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>![hi]</td>
<td>[i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>[o]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[rtr]</td>
<td>![i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>![hi]</td>
<td>[i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>[o]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[rtr]</td>
<td>![i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>![hi]</td>
<td>[i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>[o]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[rtr]</td>
<td>![i]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the *[i...e] pattern in (3-19) we see that the familiar strict pattern ranking of Bobangi 
/Likuba is simply asserting itself since the FR / RTR constraint is irrelevant to this 
competition (there is no non-front vowel).
The analysis is thus able to capture formally the intuition that Mituku is a variation on the restricted pattern where the alignment-via-underparsing scenario is overwhelmed by a dominant grounded constraint favoring retraction of non-front vowels.

### 3.2.1.4 Typology of High-Vowel Asymmetry Effects

This discussion of the interaction of ALIGN and PARSE constraints should lead us to pose the following question in terms of an overall typology of constraint interactions: why do we not find the pattern gap *[e...i] in any language of this study? This is clearly predicted to be the result of a possible ranking. To focus the issue, consider in (3-20) the constraint rankings that have been proposed to account for the phenomena discussed in this chapter.

---

12 I credit Doug Pulleyblank with suggesting an analysis of the Mituku pattern, along these lines.
(3-20) Attested Constraint Rankings for High Vowel Patterns

\{\textsc{parse} \textsc{hi} \gg \textsc{parse} \textsc{rtr} \textsc{root} \gg \textsc{align} \textsc{sl} \parallel \textsc{align} \textsc{sr}\} \quad \text{[i...e], [i...o]} \quad \text{Babole / Nkundo}

\{\textsc{parse} \textsc{hi} \gg \textsc{align} \textsc{sl} \gg \textsc{parse} \textsc{rtr} \textsc{root} \gg \textsc{align} \textsc{sr}\} \quad \text{*[i...e], *[i...o]} \quad \text{Likuba / Bobangi}

\{\textsc{parse} \textsc{hi} \parallel \textsc{fr/rtr} \gg \textsc{align} \textsc{sl} \gg \textsc{parse} \textsc{rtr} \textsc{root} \gg \textsc{align} \textsc{sr}\} \quad \text{*[i...e], [i...o]} \quad \text{Mituku}

Ignoring BK/RTR for the moment, it is possible to consider other rankings of the \textsc{align} and \textsc{parse} constraints. For example, having \textsc{parse} \textsc{rtr} \textsc{root} dominated by both alignment constraints would result in a pattern where no retraction would be tolerated in any stem with a high-vowel: *\text{[i/u...e]}, *\text{[i/u...o]} *\text{[e...i/u]}, *\text{[o...i/u]}. Although a parallel pattern is attested in Babole and Likuba with respect to low vowels\textsuperscript{13}, the patterns in (3-21) are never seen anywhere in the Bantu zone C.

(3-21) Unattested Constraint Rankings / Patterns in Bantu C

\{\textsc{align} \textsc{sl} \parallel \textsc{align} \textsc{sr} \gg \textsc{parse} \textsc{rtr} \textsc{root}\} \quad \text{*[i...e], *[i...o], *[e...i], *[o...i]}

\{\textsc{align} \textsc{sr} \gg \textsc{parse} \textsc{rtr} \textsc{root} \gg \textsc{align} \textsc{sl}\} \quad \text{[i...e], [i...o], *[e...i], *[o...i]}

The feature [rtr] is never restricted from linking to a mid vowel in stem-initial position.

In a sense, what characterizes the Bantu C language family is a privileged relation between the stem-initial position (or perhaps the root-initial position) and various features such as [rtr] and tone. In a standard autosegmental account we might have encoded this fact by prelinking [rtr] or tone to the initial root/stem mora in underlying forms. However, in a theory like OT where the constraint system must capture every

\textsuperscript{13} This will need to be explained when we look at low vowels and low vowel /rtr/ asymmetries in Chapter 4.
output regularity, how is this generalization to be captured? We can start by factoring out from (3-21) the mini-ranking in (3-22).

(3-22) A Ranking Fixed for All Bantu C

{ PARSE RTR ROOT >> ALIGN SR }

The generalization expressed in (3-22) is simply that in all of Bantu C you never sacrifice [rtr] root- parsing to achieve right alignment. This is an interesting formal property of the constraint ranking system, as analyzed to this point. The impression that there is a favored relation between the left stem edge and [rtr] cannot be stated directly in terms of some ranking relationship involving the left stem edge. We cannot claim for example that ALIGN SL always dominates PARSE RTR since Babole and Nkundo contradict this under the current “permissive” pattern analysis where {PARSE RTR ROOT >> ALIGN SL}. So the particular character of Bantu C (that features are preferentially left-stem-aligned) can not seem to be captured with respect to ALIGN SL; this is contrary to my expectation and will be a major motivation for the reanalysis in Chapter 5. In addition, note that it is only by allowing a constraint like root-parsing that I can capture the effect that pre-linking would have achieved in a pre-OT framework; root-parsing mimics dominant left alignment because root affiliation and stem-initiality are co-extensive. These issues will be clarified and finally resolved in Chapter 5.

3.3 Opacity / Transparency of [hi] Vowels

High vowels in the Bantu C system normally block the transmission of [rtr] harmony. However there are two clear cases of transparency that must be accounted for. I will
develop the OT analysis of high vowel opacity using Babole (C-10) data as an example in
§3.3.1. In §3.3.2 I will present the striking case of Ntomba where high vowels in a
certain harmonic configuration are transparent to [rtr] harmony.

3.3.1 Hi Vowel Opacity Effects in Bantu C-10

In Babole (C-10), any suffixal low vowel [a] to the right of a retracted verb root
assimilates completely under [rtr] harmony to the preceding vowel. Mid vowels
harmonize with the root [rtr], if present. Our focus here is on high vowels, which
interrupt harmony sequences so that forms such as in (3-23) are produced.

(3-23) Babole Nominal Forms with Intermediate [hi] vowels

<table>
<thead>
<tr>
<th>Form</th>
<th>Gloss</th>
<th>Morphology</th>
<th>Verb Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-[tòkímélá]</td>
<td>'sweat'</td>
<td>e-tòkím-él-á</td>
<td>?-tòk-im-</td>
</tr>
<tr>
<td>e-[tékùmà]</td>
<td>'kind of fish'</td>
<td>e-tékùmà</td>
<td>?</td>
</tr>
<tr>
<td>mu-[ntékwa]14</td>
<td>'sharp dorsal fin spines'</td>
<td>mu-ntékwa</td>
<td>?</td>
</tr>
<tr>
<td>mu-[nsómbilá]</td>
<td>'succulent fruit'</td>
<td>mu-nsómbilá</td>
<td>?</td>
</tr>
</tbody>
</table>

Such examples could be multiplied from almost every Bantu C language. It is universally
true in Babole with only a few marked exceptions. An example is the Babole class 7
nominal e-ỳèkùlè, 'beard'. The rarity of such forms suggests that they must be
somehow marked as lexical exceptions. The form has opaque derivational morphology.
Nominal forms with overt intermediate high vowels are admittedly rare. This is an
artifact of the morphological structures involved; first, non-derived nominal stems are
normally exactly two syllables long; secondly, there are no productive suffixes that have
a high vowel. Longer nominal forms in Babole have several productive sources:

14 Whäl and muntekwa seem to be related words, which could explain why [rtr] harmony is blocked by [kw] in muntekwa (i.e., it is underlyingly /ku/).
• compounding
• reduplication
• derivation from extended verbal forms

Compounding and reduplication preserve the [rtr] specifications of the component "parts". An example of a lexicalized V-N compound is esëngé-ndzókâ, 'household lizard'. Note that the [rtr] value of the first member of the compound does not spread to the second member. An example of a reduplicated nominal is ehëdíhëdí, 'shadow', from the verb -hëdëm-, 'slip by secretly'. Note that the [rtr] value of the reduplicated stem is preserved. Forms like munsómblá in (3-23) have a derived 'feeling' even though the derivation is not transparent synchronically. The form etàkìmèlá, is transparently derived from the verb root -tàkìm- 'to sweat' plus -el-, the applicative morpheme. -tàkìm- is itself perhaps -tàk+ím-, where -im- may be a historical allomorph of the passive morpheme -am-. There is a whole class of verbs roots similar to -tàkìm-. These are listed in (3-24). Many have a stative or passive meaning, giving credence to a hypothesis that there is a historical passive suffix involved.

(3-24) Babole Verb Roots with Non-Initial High Vowels

<table>
<thead>
<tr>
<th>Root</th>
<th>Gloss</th>
<th>Past(^{15})</th>
</tr>
</thead>
<tbody>
<tr>
<td>-sédëm-</td>
<td>'become slippery'</td>
<td>di-sédëm+a, *sédëm+é</td>
</tr>
<tr>
<td>-hënim-</td>
<td>'be in a slippery state'</td>
<td>di-hënim+a, *hënim+5 / *hënim+é</td>
</tr>
<tr>
<td>-sõngim-</td>
<td>'nod the head'</td>
<td>di-sõngim+a, *sõngim+5 / *sõngim+é</td>
</tr>
<tr>
<td>-hõim-</td>
<td>'be submerged'</td>
<td>di-hõim+a</td>
</tr>
<tr>
<td>-sákim-</td>
<td>'shrug the shoulders'</td>
<td>di-sákim+a</td>
</tr>
<tr>
<td>-hëdim-</td>
<td>'slip by'</td>
<td>di-hëdim+a, *hëdim+é</td>
</tr>
<tr>
<td>-sõnim-</td>
<td>'be ashamed'</td>
<td>di-sõnim+a, *sõnim+5 / *sõnim+é</td>
</tr>
</tbody>
</table>

\(^{15}\)The high toned verbal prefix di- is the class five agreement prefix corresponding to a class 5 nominal subject. Such inflection is obligatory on verbs.
For the purpose of the present discussion, [rtr] harmony, when present, is clearly blocked by the intervening high vowel in this class of verbs and any nouns derived from them\textsuperscript{16}. This can be seen in (3-24) when we add the high-toned past tense suffix -á. Whatever the morphological history of such forms, it is clear that intervening high vowel [i] blocks [rtr] harmony. For the vowel [u], one example is the verb 'kôtumbod-', 'cough', where [u] clearly blocks harmony of [rtr].

To account for the high vowel opacity seen in forms like -kôtumbod-, 'cough' and the forms in (3-23) and (3-24), I will adapt the proposal of Pulleyblank 1994 for high-vowel opacity to [rtr] harmony in Yoruba. The account turns on the interaction of HI/RTR with the ALIGN SL \parallel SR constraints and LEX RTR. LEX RTR is a constraint that punishes insertion of non-lexical [rtr]. It is a member of the FAITHFULNESS family of constraints. Consider a form such as the imperative kôtúmbólá, 'cough!'. If the high vowel [u] were somehow transparent to [rtr] spread one might expect a form such as in (3-25)(a), where the constraint interaction already developed would give us suffixal harmony. However, to do so one would skip the high vowel. Pulleyblank 1994 (pgs. 16-17) argues that the 'gapped' representation in must be excluded on universal grounds (also Archangeli and Pulleyblank 1994).

\textsuperscript{16}I do not have examples of nominal forms derived from these verbs in my data base. We may assume that such nominals do exist though and that they would have the properties we see in etâkïmélá from (3-23), where the high vowel blocks [rtr] harmony.
(3-25) No Gapped Representations, HI/RTR

(a) *kɔtùmbɔlɔ

(b) *kɔtɔmbɔlɔ

Gapped Representations Excluded by GEN

*μ...μ...

Alternatively [rtr] might link to [u] as in (3-25)(b). However this is out because of the highly ranked HI/RTR constraint. Accepting this position, both (3-25)(a) and (3-25)(b) are excluded. An additional possibility for accomplishing right-alignment, inserting [rtr] on the right of the high vowel, is considered in (3-26). What prevents a configuration like this?

(3-26) Alignment Achieved through Insertion of [rtr]?

If the constraint LEX RTR (which assigns a cost to feature insertion) is ranked above ALIGN, then opacity would be guaranteed, since (3-26) would never be optimal. However the constraint ordering tactic turns out to be unnecessary in the case of STEM alignment such as we are dealing with here. An inserted and multiply linked [rtr] does nothing to
improve alignment, because alignment is only computed with respect to underlying root-affiliated [rtr]\(^1\) and morphosyntactic stem edges. Inserted [rtr]\(^1\) has no morphosyntactic affiliation and cannot satisfy stem alignment. The general proposal for STEM opacity is summarized in the constraint interaction tableau in (3-27), where the best candidate, #2, incurs three ALIGN SR violations but still wins. Undominated PARSE HI is assumed, but not included, to avoid clutter in the tableau. Comparing candidate #2 and candidate #4, it is apparent that even if LEX RTR were demoted below ALIGN SR, candidate #2 would still emerge as the optimal form. Candidates #2 and #4 have exactly the same number of ALIGN SR violations, since the inserted feature does not improve morphosyntactically defined alignment. We will see shortly that in the WORD domain, if we assume default phonological WORD, that the ranking of LEX RTR and word-edge alignment is indeed crucial for deriving high vowel transparency / opacity to [rtr] harmony outside of the STEM domain. The reader is reminded that sequences of mid and low vowels to the right of a retracted vowel will harmonize to the right edge of the harmony domain. Babole imperatives such as kōtúmbólá, 'cough!', with a medial opaque high vowel, therefore contrast with forms such as kós-é1-ém-é, 'be gathered for...', (with [rtr]), and kõh-é1-ãm-á, 'be taken for...', (without [rtr]).
3.3.2 Ntomba High vowel transparency

Given that high-vowel opacity to [rtr] harmony constitutes such a robust generalization in this language family, the data from Ntomba in (3-28) is surprising indeed. Recall from Chapter 2, that Ntomba was analyzed as a language that has unrestricted left word-edge
harmony; any and all mid vowel prefixes harmonize\textsuperscript{17}. What we see in the robust class of examples below is that a stem-initial high vowel is in fact transparent to [rtr] harmony in Ntomba\textsuperscript{18}. Some Nkundo forms are given to show that in other languages where harmony extends to nominal prefixes, an initial high vowel does block [rtr] harmony. The corresponding Bolia and Nkundo forms show that the high vowels in question are also high in related languages, but are opaque rather than transparent in the other languages.

(3-28) Prefixal Harmony with Hi-Vowel-Initial Nominal Stems

\begin{tabular}{ll}
lo-hùnge & 'nectarin' \\
lo-pumbe & 'petits poissons de toutes variétés' \\
mo-lùmbe & 'autre nom donné aux nigrilles' \\
bo-ndikò & 'd’une certaine profondeur' \\
bo-pimbo & 'arbre à briquet' \\
e-hiyo & 'ver de Cayor sous la peau' \\
e-hiyo & 'grande saison sèche' \\
mo-kieteno & 'peine, suffrance' \\
mo-likîli & 'un action fait vers soi-même' \\
mo-lîyo & 'sorte de petit poisson noire' \\
mo-limbô & 'odeur agréable' \\
me-nyîte & 'rides sur la peau, chair de poule' \\
mo-mieke & 'pluie fine' \\
mo-miemié & 'fouet' \\
mo-ngûle & 'eau salée obtenue de certaines herbes' \\
mo-nkinyè & 'lente de pou, de chique' \\
mo-pîo & 'rot, renvoi' \\
mo-ûleli & 'souffle, vent produit en souflant' \\
\end{tabular}

(Nku. lo-sûnge) (Bolia lo-pumbe, Nku. lo-fumbe) (Nku. bo-lûmbe) (Bolia bo-kiho) (Bolia bo-kinyè) (Bolia bo-pîo)

It is clear that if retraction is present in a stem, then an intervening high vowel does not prevent the prefix from harmonizing. The inflected verbal forms in (3-29) show that the

\textsuperscript{17} Like Bolia, Ntomba fails to harmonize final -e (right word edge suffix).

\textsuperscript{18} Note that Ntomba has the permissive pattern familiar from Babole and Nkundo, allowing [i/u...e/o] in stems, but with the twist that the initial vowel is transparent to retraction harmony.
phenomenon is not limited to nominal forms. Multiple verbal prefixes are harmonizing with a root [rtr] value across an intervening stem-initial high vowel.

(3-29) *Hi Vowel Transparency In Verbs (Mamet 1955 p.225-226)*

(i) camion a-mb5-mo-[piet-ê]
    truck cl1-PST-Ob3s-crush-FV
    ‘The truck crushed him’
    (rtr) (rtr)

(ii) o-m-[pioungny-o] lo-boko
    Su2s-Ob1s-twist-FV cl1-arm
    ‘you are twisting my arm’
    (rtr) (rtr)

(iii) a-mo-[piot3k-i] nkingô
    Su3s-Ob3s-strangle-FV c9-neck
    ‘he strangled him’
    (rtr) (rtr)

Examples (ii) and (iii) are especially interesting in that the high vowel is tone bearing, showing that it has moraic /syllabic status. We cannot, therefore, dismiss these examples as being mistakenly transcribed cases of stem-initial [p'].

I could find no examples of verbal forms with an intervening high-vowel prefix to verify that high-vowel prefixes would be transparent to [rtr] harmony as well. Such examples could easily be constructed since there are prefixes containing high vowels as well as ones containing mid vowels. However the crucial examples are absent in *Mamet 1955*. I will assume in the analysis that follows that all prefixal high vowels would in fact be transparent to [rtr] harmony. It is clear also that high vowels in the suffixal domain are opaque and not transparent to [rtr] harmony. Consider the morphologically parallel Ntomba forms in (3-30).
(3-30) High Vowel Opacity in Ntomba Suffixes

(i) e-[i]el-o ‘lieu de repos’

\[ rtr \]

(ii) e-[ong]el-o ‘gite pour la nuit’

\[ rtr \]

In (3-30)(i), the causative suffix -i- prevents [rtr] from spreading to the applicative suffix -el-. In the form for ‘gite’, on the other hand, without the causative, the applicative suffix harmonizes with retraction in the root -ong-, ‘dormir’. The pervasive pattern of high vowel opacity in suffixes is established through the data in (3-31) and (3-32). In the “affective” paradigm in (3-31), the contrast to note is between assimilation of suffixal -a with retracted roots (column I) and non-assimilation of suffixal -a when there is an intervening high vowel (column II). The non-retracted roots are provided to show that the underlying suffix is the low vowel -a.

(3-31) Hi Vowel Opacity in Affectives (MAMET 1955 p.50-51)

Non-Retracted Roots

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>bák-a</td>
<td>bák-i-a</td>
<td>baka-baka</td>
</tr>
<tr>
<td>kút-a</td>
<td>kút-i-a</td>
<td>kutí-kutí</td>
</tr>
</tbody>
</table>

Retracted Roots

<table>
<thead>
<tr>
<th>bel-e</th>
<th>bel-i-a</th>
<th>belé-belé</th>
</tr>
</thead>
<tbody>
<tr>
<td>tel-em-e</td>
<td>tel-i-a</td>
<td>belé-belé</td>
</tr>
<tr>
<td>téng-um-a</td>
<td>nyong-ut-an-a</td>
<td></td>
</tr>
</tbody>
</table>

Similarly, whenever the causative of a retracted verb root is formed, the intervening high vowel blocks suffixal assimilation of -a, as in (3-32)(i) or suffixal -el-, (3-32)(ii).

(3-32) High Vowel Opacity with Causative Suffix

(i) FV -a

-pul-a ‘grandir’ -pul-i-a ‘agrandir’
These examples establish that there is the "normal" opacity to [rtr] harmony in right alignment within stems. The opacity can be analyzed as presented in §3.3.1.

When we consider how to represent the [rtr]-left-aligned data in (3-28), though, several questions arise. Consider the representations in (3-33). The first representation achieves left word-edge alignment by violating HI/RTR. There is no explicit indication in Mamet 1955 that the initial high vowels in question are retracted or lowered in any way, therefore we may reject this possibility.

(3-33) How is ALIGN WL Transparency Achieved in Ntomba?

(i) HI/RTR violated? (ii) Gapped Rep.? (iii) Insert [rtr]?

\[
\begin{array}{c}
\text{bo-[pimbo]}^j \\
\mid \\
[rtr]^j \\
\end{array}
\quad
\begin{array}{c}
\text{bo-[pimbo]}^j \\
\mid \\
[rtr]^j \\
\end{array}
\quad
\begin{array}{c}
\text{bo-[pimbo]}^j \\
\mid \\
[rtr]^j \\
\end{array}
\]

The second option, (ii) achieves left word-edge alignment by "skipping" the high vowel and linking directly to the leftmost candidate vowel. I will continue to assume with Pulleyblank 1994, and Archangeli and Pulleyblank 1994, that such "gapped" representations are in fact excluded by UG and would not be produced by GEN as candidate forms for assessment by the constraint hierarchy. This representation could be permitted in an approach where *GAPPING is a violable constraint rather than part of
UG\textsuperscript{19}. This leaves the third option, where we find that a second [rtr] token is "inserted" to satisfy ALIGN WL. This solution is modeled on the proposal in Pulleyblank 1994 for high-vowel transparency to [-atr] harmony in Wolof, where, to achieve left-word-edge harmony, a second token of [-atr] is inserted. This will violate the FAITHFULNESS constraint LEX F: do not insert a non-lexical feature specification. Assuming that this is the correct way to proceed, we still have to show how we can derive opacity to high vowels in one direction, but transparency in the other. Recall from the discussion in Chapter 2, that Ntomba was determined to have the constraint ranking in (3-34). Only ALIGN WR failed to dominate LEX PATH, and there was no discernible crucial ranking between the other ALIGN constraints\textsuperscript{20}.

\begin{quote}
(3-34) Ntomba Constraint Ranking from Chapter 2.
STEM suffixes and prefixes harmonize but not final -e
\{ALIGN SL || ALIGN SR || ALIGN WL >> LEX PATH >> ALIGN WR\}
\end{quote}

Following the proposal in Pulleyblank 1994 for Wolof, we might explore the possibility that the Ntomba pattern results from the ranking of LEX RTR with respect to ALIGN constraints that target a phonological domain edge\textsuperscript{21}, rather than a morphological word edge. To give the effect of left word-edge oriented transparency, we must have \{ALIGN SL\(\phi\)D >> LEX RTR\} ([rtr] is inserted to satisfy left-word edge alignment, if necessary). To have suffixedal high vowel opacity to harmony, we need the ranking \{LEX RTR >> ALIGN

\textsuperscript{19} See Cole and Kisseberth 1994a and Smolensky 1993 for discussions of gapped representations in OT.

\textsuperscript{20} Although I assume, as discussed in Chapter 2, that STEM alignment constraints always dominate WORD alignment constraints.

\textsuperscript{21} I will refer to these constraints as ALIGN \(\phi\)DR and ALIGN \(\phi\)DL: align [rtr] to the right and left edges of a phonological domain D. The phonological domain edges are established either by a link between the feature [rtr] to a prosodic anchor, or by default by a morphological word edge. In contrast to the morphologically keyed constraints, these ones will take any kind of [rtr] whatsoever, including crucially, inserted [rtr] which has no morphological affiliation.
or perhaps {LEX RTR >> ALIGN WR}; that is, there is an indeterminacy with respect to the right word edge and there is never the need to invoke a phonological domain.22

The ranking of LEX RTR and the ALIGN STEM constraints is irrelevant since the ALIGN STEM constraints only refer to ROOT [rtr]. Putting these elements together we have the overall ranking in (3-35) (undominated HI/RTR and PARSE HI are assumed).

(3-35) Revised Ranking for Ntomba Opacity / Transparency
\{ ALIGN SL || ALIGN SR || ALIGN φDL >> LEX RTR || LEX PATH >> ALIGN φDR / WR?\}

This ranking will give the desired effect of transparency to a stem-initial high vowel with respect to left word-edge alignment, but opacity of suffixal high vowels with respect to right stem-edge alignment. This could be verified by considering the constraint interaction tableau for a form which had the relevant environments both prefixally and suffixally:

i. multiple mid-vowel prefixes
ii. root/stem initial high vowel
iii. stem level high vowel suffix followed by stem-level mid vowel suffix.

Such an example would allow us to see both the leftward transparency and rightward opacity of high vowels side by side. Such a hypothesized form is certainly possible given the morphological structure of Ntomba as we have seen it so far23. However, since no

---

22 Again we cannot preclude the possibility, but it seems that right word-edge phonological domain effects are missing in this group of languages. I speculate that this is related to the fact that prosodically, the phonologies are all left-dominant, with the left-stem edge being prosodically prominent. This left-edge prosodic orientation may be a kind of parameter that is set once for a language. Once set, it might dispose the system to allow complexity with respect to left edges but not right edges. Certainly to derive the stem-initial primary stress effect that is seen in many Bantu C languages, one would want to align a prosodic foot to the left edge of the morphological stem. Within that foot the left most syllable is the stress bearing head. So the system is left-oriented both at the stem level and foot level. The prosodic prominence issue will be raised again in Chapters 5 and 6.

23 See (3-30), (3-31), and (3-32) for examples of suffixal opacity in verbs. See (3-29) for examples of prefixal transparency in verbs. My constructed example is built from these examples.
example with precisely these characteristics is provided in *Mamet 1955*, I will 
demonstrate with a constructed form, (3-36) that has the right morphological and 
phonological characteristics. The root-affiliated harmonic [rtr]$^1$ fails to align to the right, 
blocked by an opaque high vowel, while an additional token of [rtr]$^1$ with no 
morphological affiliation is inserted and aligned to the left.

(3-36) Hypothetical Ntomba Form

\[
\text{o-mo-n-[kiet-i-el-a]} \quad \text{SU2s-OB3s-[HIT-CAUS-A}
\]

\text{\text{'you made him hit for me'}}

For the account to follow, it is crucial, as in *Pulleyblank 1994*, that a phonological 
domain edge be established by a linking of the relevant feature to a prosodic anchor, else 
the $\phi$-domain edge defaults to the morphological word edge. The phonological domain 
alignment constraint(s) are not concerned with morphological distinctions, hence can be 
satisfied by aligning an inserted [rtr]$^2$. In the case of Ntomba prefixal harmony, the left 
phonological domain edge defaults to the left morphological word edge. If we adopt this 
view, then the prefixal transparency of high vowels to [rtr] harmony can be accounted 
for. In the tableau in (3-37), one would expect the non-harmonizing candidate #2 to win 
since it is flanked on both sides by high vowels. However because of the crucial 
placement of LEX RTR, the optimal candidate is #4, where we find prefixes retracted 
despite the intervening high vowel. In this winning candidate, the highly ranked ALIGN 
SLD is satisfied by allowing less serious LEX RTR and LEX PATH violations. Note that

\text{[rtr]$^1$} \quad \text{[rtr]$^2$} 

---

24 The theory of transparency proposed in *Pulleyblank 1994* makes the strong prediction that transparency will not be found with respect to morphologically keyed harmony but only with respect to phonological domain edge alignment.
Candidate #4 is superior #3, not by virtue of better aligning \([rtr]^i\), but by reducing the violations of \([rtr]^i\), since the left edge of the \([rtr]^i\) domain is now established by the rightmost linking of \([rtr]^i\). In candidate #5, on the other hand, we see that in addition to creating a LEX RTR violation, inserting the additional token \([rtr]^k\) accomplishes nothing with respect to satisfying STEM RIGHT alignment.

(3-37) **Tableau for Prefixal Transparency / Suffixal Opacity**

<table>
<thead>
<tr>
<th></th>
<th>HI-RTR</th>
<th>PARSE ROOT RTR</th>
<th>ALIGN SL</th>
<th>ALIGN SR</th>
<th>ALIGN LφD</th>
<th>LEX RTR</th>
<th>LEX PATH</th>
<th>ALIGN ssφD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-mO-[kiEt-i-El-A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-mO-[kiEt-i-El-A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-mO-[kiEt-i-El-A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-mO-[kiEt-i-El-A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-mO-[kiEt-i-El-A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

116
Right phonological domain edge alignment violations are irrelevant for this particular constraint scenario and do not influence the outcome because of the low ranking of ALIGN SRϕD or ALIGN WR. With respect to Bolia and the other languages in the preceding chapter, the analysis need not change. The cases in chapter 2 where strict morphological word edge alignment was assumed relevant may remain intact. The high vowel transparency cases (as in the Pulleyblank 1994 analysis that I adopt) require a phonological domain edge. For different reasons, the cases of Bobangi and Nkundo in the previous chapter also required the positing of a phonological left domain edge. In Bobangi the phonological edge corresponds to a lexical word edge, giving the “nouns only” prefixal harmony effect. For Nkundo, I posited a ϕ-domain which was analogical to the lexical word domain, giving the “stem plus one” pattern in nouns and verbs. The question naturally arises whether all prefixal harmony effects should now be derived from phonological domain edge alignment. This would amount to claiming that, beyond the stem, only phonologically-keyed alignment domains are relevant. Also, while only phonological domain edges are relevant, those domains usually correspond to morphological or lexical domain edges. However, while this is tempting and would make a tighter alignment typology, I will maintain the view that both morphological and phonological alignment may be relevant beyond the stem. We will see that there are cases that seem to require a morphological word-edge analysis for prefixal harmony, as opposed to a phonological edge analysis. I will return to this possibility in later chapters, when those cases are discussed.
The ranking proposed for Ntomba derives prefixal transparency and suffixal opacity as required, but it should be noted that nothing in the schema precludes having transparency in the suffixal domain\(^{25}\) as well since it is only a question of the relative ranking of ALIGN SR \(\phi-D\) and LEX RTR.

There is one last point to clear up. Since the opacity/transparency analysis hangs on a particular relation, \{ALIGN \(\phi\) L/R >> LEX RTR\}, the prediction is made that the low vowel \([a]\) will also be transparent to [rtr] harmony in prefixes. My analysis of [low] vowels under [rtr] harmony will be that a phonological principle (to be elaborated in Chapters 4. and 5) determines [lo]/[rtr] incompatibility. For the moment I will call this constraint *[lo]/[rtr]. Ntomba, like many other Bantu C languages, extends [rtr] harmony onto low vowels in suffixes by underparsing the feature [lo] and assimilating a [front] / [round] (COLOR) feature from the preceding vowel. But in the pre-stem domain in Ntomba, low vowels never assimilate even though prefixes in general harmonize\(^{26}\). This difference with respect to low vowel assimilation can be captured through the variable ranking of PARSE LO with respect to the various ALIGN constraints (this is analyzed in Chapter 4.) However, even if the low vowel is retained in prefixes under

\(^{25}\) I note in passing that Mbosi Olée, C-20 (Fontaney 1988) seems to be just such a case where suffixal high vowels in the causative morpheme are transparent to [rtr].

\[i-\text{lemb}-\text{is-}a\] 'lose'
\[i-\text{wóm}-\text{is-}a\] 'dry'
\[i-\text{tšk}-\text{is-}o\] 'boil’ transitive
\[-\text{tšk-} \text{’boil’ intransitive}\]
\[i-\text{lár}-\text{is-}o\] 'ripen’
\[i-\text{tsól}-\text{is-}o\] 'drop’
\[-\text{tsól-} \text{’fall’}\]

Unfortunately only three relevant forms are provided. This case, if it turns to be robust would require the ranking \{ALIGN SR \(\phi\) >> LEX RTR\}. The unavailability of more data obliges me to defer further comment.

\(^{26}\) This is universally true in Bantu C; [lo]-underparsing, where present, occurs in stems and suffixes, never in prefixes. This means that the ranking \{PARSE LO >> ALIGN WL\} is invariable across the group. This generalization was also noted in Hyman 1996.
harmony, we expect the phonological principle of [rtr]/[lo] incompatibility to make low vowels opaque to [rtr] harmony generally, as we see in a large number of Bantu C languages\textsuperscript{27}.

Once we postulate the ranking \{ALIGN φDL \textasciitilde LEX RTR\} however, it is predicted that all prefixal material should be transparent to [rtr], since multiple new [rtr] tokens can always be added to satisfy ALIGN φDL. The strong prediction is made that there should be no possible harmonic blockers in the domain established by this analysis. Forms with a low vowel prefix in the proper configuration with respect to an [rtr] verb root and a preceding mid vowel prefix are rather difficult to find in Mamet 1955. The few forms which are available turn out to be contradictory on this very point. (3-38) shows transparency: the second person subject prefix is harmonizing over an intervening low-vowel.

(3-38) Low Vowel Transparency in Prefixes?
\begin{align*}
\text{ta-} & \text{bo}-\text{ba-}[\text{hek}-\text{ol}-\text{ok}-e] \\
\text{NEG-SU2pl-OB3pl-imitate-REV-AK-FV} & \quad \text{ta-} \text{bo}-\text{ba-}[\text{hek}-\text{ol}-\text{ok}-e] \quad \text{(p. 105)} \\
'\text{ne les imitez pas}' & \quad '\text{ne les imitez pas}' \\
\end{align*}

Examples (3-39) (i) and (ii), however, show opacity. The mid vowel subject prefixes fail to harmonize across an intervening third person plural object infix.

(3-39) Low Vowel Opacity in Prefixes?
\begin{align*}
(i) & \text{ta-t} \text{o-} \text{ba}-[\text{en-} \text{i}] \\
\text{NEG-SU1pl-OB3pl-see-EXT-FV} & \quad \text{ta-t} \text{o-} \text{ba}-[\text{en-} \text{i}] \\
'\text{Nous ne les avons pas vus}' & \quad '\text{Nous ne les avons pas vus}' \\
\end{align*}
\[ [\text{rtr}] \]

\textsuperscript{27} It is nonetheless true that ranking the [rtr]/[lo] incompatibility constraint below the harmony constraints would also result in transparency for the low vowel in some domain. There are thus two possible sources for transparency of low vowels to [rtr] harmony in my account, leading to indeterminacy in the analysis. The case of Londengese, presented in Chapter 4, with suffixal transparency of low vowels to [rtr] harmony, is analyzed as related to the [rtr]/[lo] constraint ranking rather than phonological domains and LEX RTR.
This kind of inconsistency in the data prevents us from drawing definitive conclusions about the status of low vowels with respect to transparency under prefixal harmony. Until further data can be obtained, I will assume that low vowels in the prefixal domain are transparent as in (3-38), and that a Pulleyblank 1994 inspired account of high vowel opacity can therefore be maintained for Ntomba. Both [i] and [a] will be transparent to [rtr] harmony in prefixes.

3.4 Summary

We have seen in this chapter that high vowels have a special status in the [rtr] harmony system of Bantu C languages. They are generally free in their distribution with respect to other vowels. In addition they almost always block the transmission of [rtr] harmony in all environments. These properties of the vowel harmony system were all shown to follow from the variable ranking of a small number of phonological constraints, including members of the following families:

- **FAITHFULNESS:** PARSE HI, PARSE LO, PARSE RTR ROOT, LEX RTR, LEX PATH
- **GROUNDING:** RTR/HI, FR/RTR
- **MCAT ALIGNMENT:** ALIGN SL, ALIGN SR, ALIGN WL, ALIGN WR
- **PCAT ALIGNMENT:** ALIGN $\phi$DL, ALIGN $\phi$DR

28 Clearly if Ntomba had prefixal opacity of low vowels to [rtr] harmony, the current analysis would need revision.
The opacity / transparency effects with high vowels were shown to follow from the relative ranking of ALIGN φ–DL and LEX RTR. The relevant rankings are given in (3-40).

(3-40) Rankings for Opacity / Transparency

**Ntomba** (transparency to left)
{ ALIGN SL || ALIGN SR >> ALIGN φDL >> LEX RTR || LEX PATH >> ALIGN φDR }

**Bolia** (opacity everywhere)
{ALIGN SL || ALIGN SR || LEX RTR >> ALIGN φDL || ALIGN φDR } >> LEX PATH }

**Lg. X** (transparency everywhere)
{ALIGN SL || ALIGN SR || ALIGN φDL || ALIGN φDR >> LEX RTR || LEX PATH }

Given this sort of schema, opacity / transparency effects are formally independent of the harmony domain variation established in Chapter 2. Prefixes may or may not harmonize as determined by the ranking of ALIGN φDL or ALIGN WL with LEX PATH. If prefixes harmonize, then we may have either transparency or opacity, as determined by the ranking of ALIGN φDL with LEX RTR. Suffixal transparency of high vowels to [rtr] harmony would involve invoking a right phonological domain edge. Although the data from Mbosi Olée presented in §§6.1.5.3.3 raises this possibility, I suspect that left-edge oriented systems will not invoke right phonological domain edges. Of course, this is somewhat speculative and requires empirical verification.
4. Low Vowels in Harmony Domains

In this chapter I examine the variable behavior of the low vowel [a] in the vowel harmony system documented and provide an account. I build on the foundation provided in Chapters 2. and 3. concerning the morphological and prosodic properties of harmony domains and the way that distributional asymmetries are captured within an OT analysis. A particular focus of this chapter will be explaining the unexpected incompatibility that exists between the low vowel [a] and the retracted vowels [ɛ] and [ɔ]. In §4.1 I present relevant data for the three patterns of low-vowel behavior in verbal morphology contexts. In §§4.2, I present an analysis of these three patterns. I argue that the assimilation pattern for suffixal low vowels seen in C-10, C-20, C-30, C-40, and some of C-60, is due to the low ranking of the faithfulness constraint PARSE LO with respect to HARMONY¹:

\{HARMONY \gg PARSE LO\}. I also provide an explanation for the vowel-copy phenomena seen in the assimilation pattern. The suffixal low-vowel retention pattern seen in C-60, C-70 and C-80 is also shown to follow from the ranking of PARSE LO; however, this time PARSE LO is ranked higher than the [rtr] HARMONY constraints with the result that low vowels are retained and in fact block the transmission of [rtr] harmony. Underlying both patterns is a phonological principle of [lo]/[rtr] incompatibility. I provide an account of the underlying phonological incompatibility in terms of licensing failure (Ito, Mester, and Padgett 1995, Steriade 1995) and contrast the LICENSING driven pattern with the familiar GROUNDING driven pattern where [lo] and [rtr] are sympathetic (Yoruba: Archangeli and Pulleyblank 1989, Pulleyblank 1993, 1994). Finally, I consider a variation of the low-

¹ Where HARMONY is a cover term for the family of harmony inducing ALIGN RTR constraints.
retention pattern, Ndengese, C-80, where the low vowel is transparent to [rtr] harmony.

In Chapter 5., I examine the attested distributional patterns of low vowels with retracted vowels in nominal stems. I show that the attested low-vowel patterns follow from the ranking principles developed in Chapters 2. and 3. once variably ranked PARSE LO and LICENSING are acknowledged.

4.1 Low Vowel Behavior In Verbal Suffixes

In this section I will be considering the cross-linguistic variation in the behavior of suffixal low vowels when the verb root is of the retracted class. I will show how the two main patterns follow from the variable ranking of PARSE LO once a phonological constraint driving [lo] / [rtr] incompatibility is recognized.

4.1.1 The Assimilation Pattern For Low Vowels

Consider the pattern of suffixal low vowel assimilation in Babole, (4-1). The point to note is that with the root vowels {[i], [e], [a], [o], [u]}, a suffixal low vowel [a] remains as such. If the root vowel is {[e], [o]}(indicated by bolded arrows), however, any suffixal low vowel assimilates completely to the preceding vowel.

(4-1) Suffixal Low Vowel Assimilation in Babole (C-10)

<table>
<thead>
<tr>
<th>Imperative</th>
<th>Gloss</th>
<th>Applicative -El-A</th>
<th>Passive -Am-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>sīl-ā</td>
<td>&quot;sharpen!&quot;</td>
<td>sīl-ēl-ā</td>
<td>-sīl-ām-ā</td>
</tr>
<tr>
<td>kēl-ā</td>
<td>&quot;make!&quot;</td>
<td>kēl-ēl-ā</td>
<td>-kēl-ām-ā</td>
</tr>
<tr>
<td>➔ hék-ē</td>
<td>&quot;cut!&quot;</td>
<td>hék-ēl-ē</td>
<td>-hēk-ēm-ē</td>
</tr>
<tr>
<td>sōl-ā</td>
<td>&quot;do!&quot;</td>
<td>sōl-ēl-ā</td>
<td>-sōl-ām-ā</td>
</tr>
<tr>
<td>➔ kōs-ā</td>
<td>&quot;gather!&quot;</td>
<td>kōs-ēl-ē</td>
<td>-kōs-ēm-ā</td>
</tr>
<tr>
<td>kōh-ā</td>
<td>&quot;take!&quot;</td>
<td>kōh-ēl-ā</td>
<td>-kōh-ām-ā</td>
</tr>
<tr>
<td>tsūm-ā</td>
<td>&quot;dip!&quot;</td>
<td>tsūm-ēl-ā</td>
<td>-tsūm-ām-ā</td>
</tr>
</tbody>
</table>
This pattern, though widespread in Central Africa, has mainly escaped a formal explanation in the theoretical phonological and Bantu literature.\(^2\) Although I will illustrate primarily with data from the Bantu C-10 language, Babole, exactly the same pattern is found in Likuba (C-20), Bobangi (C-30), Bolia (C-30), Ntomba (C-30), and Ngombe (C-40), as well as in all other languages that I have surveyed from these subgroups\(^3\). There is in fact an areal generalization to be made with respect to the low vowel assimilation pattern in Bantu C overall: it is the languages to the North and West of Bantu zone C that show the suffixal low vowel assimilation pattern.\(^4\) Hulstaert 1963, on the other hand makes a distinction between "terrains", land-dwellers and "riverains", river-dwellers, among the larger Mongo (C-60) ethnic identity. He identifies the low vowel assimilation pattern as belonging to the "riverain" Mongo groups. In the present study, there is the larger perspective of hindsight and it is clear that there is an areal distinction that goes beyond the so-called "Mongo" grouping. In partial confirmation of this hypothesis, I note that the 7-vowel Bantu A. language Londo (Kuperus 1982, 1985), of Central Western Cameroon, has the assimilation pattern. On the other hand the 7-vowel Bantu D. language Mituku from southeastern Zaire (Stappers 1973) has the low vowel retention / opacity pattern\(^5\). These overarching areal characteristics meet and to some degree mix in the C-60 Mongo group documented by Hulstaert and his co-workers.

\(^2\) An exception is the Government Phonology analysis of vowel harmony in Lobala in Morgan 1995. See Map 1 in Appendix A for the location of Lobala relative to the other languages in this study.

\(^3\) The widespread trade language of equatorial Congo and Zaire, Lingala (C-36), also has the noted assimilation pattern.

\(^4\) See the Map in (4-34) documenting low vowel behaviors.

\(^5\) Larry Hyman has pointed out to me in personal communication that retention of suffixal low vowels is in fact the conservative pattern inherited from the proto-language (Meeussen 1967). The low vowel assimilation pattern is an innovation. The innovative low vowel assimilation pattern is restricted to Guthrie zones A, B, and C except for a few exceptions.
4.1.1.1 Data for the Assimilation Pattern

The assimilation pattern for suffixal low vowels in Bantu C can be characterized as follows:

“any low vowel in a verbal suffix assimilates completely to the vowel preceding it under [rtr] harmony”

The suffixes that are relevant for this pattern include:

- pre-final aspectual morpheme -ak-
- passive “extension” morpheme -am-
- reciprocal / stative extension -an-
- final vowel -a

In (4-2) below, (repeated for the reader’s convenience from (4-1)), consider the representative Babole imperative forms in the first column.

(4-2) Suffixal Low Vowel Assimilation in Babole (C-10)

<table>
<thead>
<tr>
<th>Imperative</th>
<th>Gloss</th>
<th>Applicative -El-A</th>
<th>Passive -Am-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>síl-á</td>
<td>‘sharpen!’</td>
<td>síl-él-á</td>
<td>-síl-ám-á</td>
</tr>
<tr>
<td>kèl-á</td>
<td>‘make!’</td>
<td>kèl-él-á</td>
<td>-kèl-ám-á</td>
</tr>
<tr>
<td>hék-é</td>
<td>‘cut!’</td>
<td>hék-él-é</td>
<td>-hék-ém-é</td>
</tr>
<tr>
<td>sòl-á</td>
<td>‘do!’</td>
<td>sòl-él-á</td>
<td>-sòl-ám-á</td>
</tr>
<tr>
<td>→ kòs-5</td>
<td>‘gather!’</td>
<td>kòs-él-é</td>
<td>-kòs-ám-5</td>
</tr>
<tr>
<td>kòh-ó</td>
<td>‘take!’</td>
<td>kòh-él-ó</td>
<td>-kòh-ám-á</td>
</tr>
<tr>
<td>tsùm-á</td>
<td>‘dip!’</td>
<td>tsùm-él-á</td>
<td>-tsùm-ám-á</td>
</tr>
</tbody>
</table>

Note that the imperative suffix is simply the low vowel except when the root vowel is [e] or [o] (the forms indicated by right-pointing arrows). The applicative front mid-vowel suffix -el/-el- assimilates only to the [rtr] value of the preceding vowel under harmony and no other features are affected (see bolded forms in “applicative” column). In contrast the low vowel in the passive morpheme assimilates completely or “copies” all the features of the preceding vowel. This can be seen most clearly by contrasting the bolded
applicatives with corresponding imperatives and passives. In the Ntomba data in (4-3), the imperative suffix vowel is -a and the emphatic form has the prefinal -ak-, both of which assimilate to a root retracted vowel. Recall from Chapter 2 that Ntomba final vowel -e fails to harmonize in all cases, explaining the disharmonic sequence in imperative negative example, (4-3)(v).

(4-3) Ntomba C-30 Suffixal Low Assimilation (Mamet 1955)

<table>
<thead>
<tr>
<th>IMPERATIVE</th>
<th>EMPHATIC (FINAL VOWEL -a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) dk-á 'ecoute!'</td>
<td>dk-ák-á 'ecoute donc!'</td>
</tr>
<tr>
<td>(ii) en-é 'vois!'</td>
<td>lék-ék-é 'mange donc!'</td>
</tr>
<tr>
<td>(iii) ong-ó 'dors!'</td>
<td>kótól-ók-ó 'regarde bien!'</td>
</tr>
</tbody>
</table>

IMPERATIVE NEGATIVE (FINAL VOWEL -e)

| (iv) t-o-[búng-ák]-é mbóka | 'ne perds pas la route' p. 37 |
| (v) t-o-[lék-ék]-é bi-ínza | 'ne mange pas la nourriture' p. 37 |

However, even in languages like Ntomba that have unrestricted prefixal harmony (see §§2.2.2), low vowels in prefixes do not assimilate like suffixal ones, but rather are retained. Recall from Chapter 2 that although the data in Mamet 1955 is somewhat ambiguous as to whether prefixal low vowels are opaque or transparent to [rtr] harmony, there is no ambiguity about whether they assimilate; they categorically do not.

(4-4) Ntomba Prefixal Low Vowels do not Assimilate

(i) ta-bó-ba-[hek-ól-ök]-e
   NEG-SU2pl-OB3pl-imitate-REV-AK-FV
   'ne les imitez pas' (p. 105)

(ii) ta-to-ba-[én-in-i]
    NEG-SU1pl-OB3pl-see-EXT -FV
    'Nous ne les avons pas vus' (p. 4)

(iii) o-ba-[hengeny]-e
    SU2sg-OB3pl-exiter-FV
    'va les exciter' (p. 107)
This observation about prefixal low vowel non-assimilation turns out to hold for all the Bantu zone C: no low vowel prefixes ever assimilate as the suffixal low vowel examples above do. In Bolia as well, the pattern of suffixal low assimilation can be seen in the applicative examples in (4-5).

(4-5) Bolia C-30 Examples of Suffixal Low Assimilation

**Applicatives** kl-a / el-e

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Suffix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>kand-el-a</td>
<td>'lier pour'</td>
<td>kand-a</td>
<td>'lier'</td>
</tr>
<tr>
<td>ket-el-e</td>
<td>'entailler pour'</td>
<td>ket-e</td>
<td>'entailler'</td>
</tr>
<tr>
<td>tum-el-a</td>
<td>'boucher pour'</td>
<td>tum-a</td>
<td>'boucher'</td>
</tr>
<tr>
<td>hón- el-e</td>
<td>'décorder pour'</td>
<td>hón-o</td>
<td>'décorder'</td>
</tr>
</tbody>
</table>

**Reversives:** ol-a / el-o

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Suffix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>kak-ol-a</td>
<td>'décrocher'</td>
<td>kak-i-a</td>
<td>'accrocher'</td>
</tr>
<tr>
<td>lip-ol-a</td>
<td>'ouvrir'</td>
<td>lip-a</td>
<td>'fermer'</td>
</tr>
<tr>
<td>homb-ol-o</td>
<td>'rembourser'</td>
<td>homb-o</td>
<td>'emprunter'</td>
</tr>
<tr>
<td>hom-ol-o</td>
<td>'dégainer'</td>
<td>hom-i-a</td>
<td>'rengainer'</td>
</tr>
</tbody>
</table>

Finally consider the data in (4-6) from Boso Njanoa Ngombe (Motingea 1988), a representative language of the C-40 cluster. Both the “futur éloigne” suffix -ab- and the “habituel” aspect suffix (prefinal) -ak- are assimilating to the preceding vowel under [rtr] harmony.

(4-6) Ngombe C-40 Suffixal Low Vowel Assimilation

(i) Futur éloigné /-ab-i/

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-[tít-ab-i]</td>
<td>'(Dieu) descendra...'</td>
</tr>
<tr>
<td>e-[kók-ab-i]</td>
<td>'(le fleuve) sèchera un jour...'</td>
</tr>
<tr>
<td>na-[haj-ób-i]</td>
<td>'je demanderai un jour...'</td>
</tr>
<tr>
<td>na-[somb-ób-i]</td>
<td>'je reviendrai tôt ou tard...'</td>
</tr>
</tbody>
</table>

(ii) Habituel /-ak-ab-i/

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-[dú-ak-ab-i]</td>
<td>'Elle viendra fréquemment...'</td>
</tr>
<tr>
<td>bo-[léj-ek-éb-i]</td>
<td>'Nous penserons souvent...'</td>
</tr>
</tbody>
</table>

127
These data have been provided to show that the C-10, C-20, C-30, and C-40 clusters are characterized by suffixal low-assimilation under [rtr] harmony. This is the assimilation pattern that must be accounted for. However, before doing so I will present the other widespread pattern in Bantu C so that the account provided deals with both cases. In another large group of languages, suffixal low vowels are retained and are opaque to [rtr] harmony.

4.1.2 Retention / Opacity Pattern for Suffixal Low Vowels

If the suffixal low assimilation pattern is associated with those languages to the North and West of the Bantu zone C, the low retention pattern characterizes the C-50, C-60, C-70, C-80 clusters of the zone. Only the C-50 and C-60 (Mongo) zones have languages from both patterns. I will now present illustrative data from each of these subgroups.

4.1.2.1 Nkundo (Hulstaert 1963)

The best documented of all Bantu C languages is Nkundo, for which we have the celebrated three-volume grammar of Gustaaf Hulstaert. The issue that I am focusing on for the moment is simply that, in contrast to the languages in §§4.1.1.1, Nkundo retains suffixal low vowels and that these are opaque to [rtr] harmony. Below I provide extensive data to substantiate this claim. The suffixes under consideration will be the ones already encountered: the prefinal -ak-, the passive / stative -am-, the reciprocal / stative -an-, and the final vowel -a. Recall from the discussion on Nkundo in Chapter 2 that a single syllable to the left of the verb stem harmonizes and that all mid vowel suffixes
harmonize. In (4-7)(ii), the present tense suffix vowel -a is retained and does not assimilate.

(4-7) Nkundo Suffixal Vowel -A

(i) tó-sang-a 'nous disons'
(ii) tó-kend-a 'nous partons' *tó-kend-é
(iii) tó-bin-a 'nous dansons'
(iv) o-omb-a 'tu enveloppes' *ó-omb-ó
(v) tó-om-a 'nous tuons'
(iv) ó-étsw-a 'tu te lèves'

In contrast all mid-vowel suffixes in verbs and nominals harmonize unless a high or low vowel intervenes. In the examples to follow, note that, in particular the final vowel -e fails to harmonize when it follows any suffix with a low vowel. Otherwise the final vowel -e does harmonize with a retracted root in Nkundo. In particular, note that the negative and subjunctive final vowel -e definitely harmonizes with retracted roots: this can be seen in (4-8).

(4-8) Negative and Subjunctive Final Vowel -E Harmonizes

**Negative**

(i) a-fó-téfél-e 'il ne parle pas' (1965, 331)
(ii) a-fó-kel-e 'il ne coule pas' (1965, 331)

**Subjunctive**

(iii) ó-kel-e 'que tu fetus' (1961, 35)
(iv) ó-sek-e 'que tu ries' (1961, 35)

Although the negative final vowel -e harmonizes generally, it fails to harmonize when there is an intervening low vowel as with the passive examples in (4-9).
(4-9) Passive Extension - AM - (1967, p. 249) with Negative Final - e

(i) bokáli bófénámé /bó-fén-ám-é/ 14-Neg-SEE-Pass-FV
   'un mâne n’est pas vue’

(ii) lókendo lófókdéndámé /ló-fó-kénd-ám-é/ 11-Neg-GO-Pass-FV
   'le voyage n’est pas fait’

(iii) nkoi áfólóndámé /á-fól-ónd-ám-é/ 3s-Neg-FOLLOW-Pass-FV
   'le léopard n’est pas suivi’

Similarly, the subjunctive final vowel -e fails to harmonize with an intervening low vowel reciprocal extension, (4-10). Note that the applicative mid vowel suffix is harmonizing as expected.

(4-10) Reciprocal Extension - AN - (1967, p. 288)

a) tókendelane tó-kend-el-an-e 1pl-GO-Appl-Recip-FV
   ‘visitons-nous (réciiproquement)’

It is not just the final vowel -e that fails to harmonize when a low vowel intervenes. Since the suffix combination PASSIVE - APPLICATIVE is possible, one can see in (4-11) that the applicative is failing to harmonize over the low vowel in the passive morpheme.

(4-11) Passive + Applicative

-fót-am-el 130

Many verbal Tense/Mode/Aspect configurations incorporate the prefinal aspectual morpheme -ak-. Negative and Subjunctive habitual forms like those in (4-12) further illustrate the blocking effect of any low vowel suffix on [rtr] harmony.

130
(4-12) Negative and Subjunctive Habitual (Hulstaert 1961, p. 36)

(i) áfomeláké á-fó-mel-ak-e 'II ne fume pas (habituellement)
    3s-Neg-SMOKE-Hab-FV
(ii) tɔfengoláké t-o-fengol-ak-e 'ne reprimande pas'
    Neg-2s-REPRIMAND-Hab-FV
(iii) ákendáké á-kend-ak-e 'qu'il aille (continuellement)'
    3s-ALLER-Hab-FV

Parallel to this, in nominal forms as in (4-13), though the nominal final vowel suffix -o
does harmonize in Nkundo, an intervening low vowel suffix prevents harmony from
spreading to the final vowel.

(4-13) Suffixal Opaque Low in Derived Nominals  (Hulstaert 1961, p. 35-36)

(i) e-lek-el-o 'passage'
(ii) e-fɛtsw-el-o 'purification'
(iii) bɔ-sók-ak-o 'offense'
(iv) lo-kot-ak-o 'action de mordre'
(v) bɔ-tel-eng-an-o 'bredouillement'
(vi) bɔ-kɔk-ɔs-an-o 'fidelité'

The preceding data all make the same point concerning Nkundo: a suffixal low vowel
does not assimilate, but is rather retained and is opaque to [rtr] harmony, preventing
harmony on eligible mid vowel suffixes to the right.

I will now provide more limited data from the other low-retaining Bantu C
subgroups in order to establish that this pattern has the wide geographical distribution
that I am claiming. The first group to be considered is C-50, which is actually a “mixed”
group with respect to the low vowel assimilation / retention patterns: some languages
show retention of suffixal low vowel suffixes while at least one shows the assimilation pattern.

### 4.1.2.2 C-50 Suffixal Lows

Among the languages classified by Guthrie as C-50 are Likile, Mombesa, Gesogo, Lokele, and Olombo. These languages are found in the Haute Zaire province of the northwestern corner of Zaire.

(4-14) **Likile Suffixal -A is Retained** (Carrington 1977)

- e-[kend-a] ‘il voyage’
- ba-[kend-ak-indee] ‘ils voyagaient’

In the Olombo (Carrington 1947) forms in (4-15), the alternating prefix o/o is an infinitive prefix. Note that the prefix is harmonizing when the root is retracted, and that suffixal low vowels are retained.

(4-15) **Olombo Suffixal -A is Retained** (Carrington 1947, p. 112)

- o-[sil-a] fe ‘finir complètement’
- o-[und-a] ngwi ‘saisir sans relâcher’
- o-[eng-an-a] chaa ‘être tout a fait convenable’
- o-[song-am-a] sänge ‘réunir ensemble’
- o-[ot-a] hou ‘entrer a l’intérieur’
- o-[mel-a] meú ‘avaler complètement’

(4-16) **Mombesa Suffixal -A is Retained** (DeBoeck 1951, 141-142)

(i) -lamb- ‘to cook’
- kókó e-ká-[lamb-a] kē ngó... ‘die kip die ik kookte ...’ ‘the hen that I cooked...’

(ii) -fél- ‘to rot, decay’
- nóli ....é-ka-[fél-a] ‘die vogel ... is rot’ ‘the bird ... is decaying’

---

6 The suffix -indee is marks one kind of past tense and has the unusual property of underlying non-alternating retraction. There is no indication in the Likile data provided by Carrington that this suffix has any harmonic properties.
Although no relevant verbal forms are provided in Carrington 1972a for Lokele, the nominal forms in (4-17) show that [a] is *not* assimilated on the right edge of at least some nominal stems (parallel to nominal stems in Nkundo).

(4-17) Lokele Final [A] is Retained in Nominals

<table>
<thead>
<tr>
<th>Nominal Stem</th>
<th>Stem Form</th>
<th>Case</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>bo-enda</td>
<td>be-enda</td>
<td>3/4</td>
<td>‘fish snout’</td>
</tr>
<tr>
<td>bo-endá</td>
<td>be-endá</td>
<td>3/4</td>
<td>‘visitor’</td>
</tr>
<tr>
<td>lw-enja</td>
<td>f-enja</td>
<td>11/10</td>
<td>‘palm frond strip’</td>
</tr>
<tr>
<td>o-kota</td>
<td>not provided</td>
<td></td>
<td>‘chef’</td>
</tr>
</tbody>
</table>

Carrington 1972b, on the other hand, clearly shows suffixal assimilation of low vowels in verbs, as the verbal infinitive paradigm in (4-18), and the inflected verbal forms in (4-19) show.

(4-18) Assimilation of Suffixal Lows in Lokele Infinitives

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-lek-a</td>
<td>‘traverser’</td>
</tr>
<tr>
<td>o-el-a</td>
<td>‘être cuit’</td>
</tr>
<tr>
<td>o-sam-a</td>
<td>‘aimer’</td>
</tr>
<tr>
<td>o-lemb-e</td>
<td>‘vouloir’</td>
</tr>
<tr>
<td>o-song-o</td>
<td>‘épouser’</td>
</tr>
<tr>
<td>o-ss-o</td>
<td>‘prendre’</td>
</tr>
</tbody>
</table>

(4-19) Low Assimilation in Verbal Forms

<table>
<thead>
<tr>
<th>Infinitive</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i-a-[són-ak-á lo-kásá/</td>
<td>‘j’ai écrit une lettre’</td>
</tr>
</tbody>
</table>

---

7 I cannot tell whether the nominal forms here have a suffixal final -a or whether the nominals are underived. We will see in the next chapter that this difference is crucial under one analysis. It seems likely that the forms in (4-17) are not derived, while those in (4-18) clearly have a suffixal -a. More data would be needed to confirm any hypothesis, but this does suggest perhaps that root-affiliated [low] is not underparsing while non-root [low] is. This theme will be taken up again in Chapter 5.

8 Boa (Kamango 1973, Nkabvwakabili 1986), also considered a C-50 language, but located toward the C-40 area, also shows the suffixal low assimilation pattern. This underlines the fact that while the Guthrie subgroupings reflect some micro-areal patterns, they are mainly useful as a way of referring to languages in geographic proximity.
The final C-50 language to be considered is Gesogo⁹ (Harries 1955, Stoop 1989). It is clear from Harries 1955 that Gesogo retains suffixal low vowels as seen in the data in (4-20).

(4-20) Gesogo Low-Vowel Suffixes are Retained (data from Harries 1955)

-long-  ‘to decorate’

gé agá: [logaga] bindó béändé  ‘he decorated his body’ p. 431.
agá:-long-an-a  ‘he decorated...’

-nen-  ‘to leave’
to-[nen]-a mbo nong₃nongs₃  ‘if we leave in the morning’ p. 434

-lemb-  ‘to love’
-lemb-an  ‘to love one another’

-gel-  ‘be important’
a- ti-[gel-an-e]  ‘he was not important’ text, page p. 435

These data establish that most of the C-50 languages retain suffixal low vowels. I will now consider the representative C-70 languages Ombo and Tetela.

4.1.2.3 Ombo C-70 (Meeussen 1952)

The Ombo language is located at the extreme south-east corner of the Bantu C group.¹⁰ Although forms showing the opacity effect with mid vowels to the right of a low vowel are lacking in Meeussen 1952, there are numerous examples as in (4-21) that show that

---

⁹ Gesogo is also known by the name Topoke. See Tassa 1994.

¹⁰ See Maps in Appendix A for precise location of Ombo with respect to the other languages nearby. Ombo has (i), unrestricted prefixal harmony, (ii), retention of suffixal low vowel [a] with opacity to [rtr] harmony, and (iii) harmony of the final vowel -e.
suffixal low-vowels are retained rather than assimilated. Note that Ombo has unrestricted prefix harmony like Ntomba.

(4-21) Ombo Retention of Low Final Vowel

(i) to-mbo-[lel-él-a] 'nous pleurons'
(ii) to-mbó-[lif-él-á] 'nous enfermons...'
(iii) to-mbó-[lel-él-a] 'nous laissons'
(iv) to-mbó-[lem-él-á] 'nous lions...'

The future morpheme in (4-22) (i) is harmonizing with the verb root retraction. In the form (4-22)(ii), the presence of a low vowel object prefix -a- blocks harmony from extending to the future prefix.

(4-22) Low Vowel Prefix Blocks Harmony

(i) tákondó[knqnl]a t-ákondó-[knqnl-a] 'nous ramasserons'
1pl-Fut-RAMASSER-FV

(ii) tákondó[nt5l]a t-ákondó-[nt5l-a] 'nous l'apporterons'
1pl-Fut-Obj:6-APPORTER-FV

Invoking our analysis from Chapter 2, Ombo must have both left and right word-edge harmony since the final subjunctive vowel and all prefixes harmonize in the examples in (4-23). The high vowel object prefix in (4-23) (iii) is blocking [rtr] harmony, confirming the areal standard high vowel opacity pattern for Ombo. Example (4-23) (iv), as expected, shows that a mid-vowel object prefix does not block harmony.

(4-23) Subjunctives Showing Harmony Blocking Effects

(i) tófolote tó-folot-e 'tirons!'
1pl-TIRER-FV

(ii) tóknqnlé tó- kŋnl-e 'ramassons!'
1pl-RAMASSER-FV

135
These examples suffice: (i) to show that Ombo is indeed a low-retaining language, and
(ii) to sketch Ombo's essential harmony properties.

4.1.2.4 Tetela C-70: [a] retention and opacity in [rtr] domains

Tetela\(^\text{11}\) (Jacobs 1964, Labaere 1987, Labaere and Shango 1989) is a very large
language cluster to the extreme southeast of the Bantu zone C. Tetela has the unusual
property of having a number of non-alternating retracted suffixes (which however do not
trigger retraction). I will return to the question of Tetela non-harmonic retraction in
Chapter 6. For now I just want to establish that Tetela participates in the low-retention
pattern rather than the low-assimilation pattern. I will intentionally avoid introducing the
whole range of Tetela suffixes at this point. In the data in (4-24), note that in (ii) suffixal
final vowel -\(a\) is retained under [rtr] harmony and mid vowel prefixes do harmonize.

\(^{11}\) Tetela has the Nkundo pattern of prefixal harmony (one syllable to the left of the stem). It retains low vowels suffixally
with opacity to [rtr] and harmonizes the final vowel -\(e\).
Note that the sense of (iii) is "caused us reciprocally to see each other" but this simply is the decomposed meaning of English "introduce". This example is perhaps not so good because the causative can block transmission of [rtr] harmony since it often underlingly has a high vowel.

In contrast to the above, mid vowel suffixes in Tetela do harmonize with a retracted verb root. Contrast an advanced verb root in a verbal form with final vowel -e in (i) with a retracted root in the same paradigm, (ii).

(4-25) Mid Vowel Suffixes do Harmonize in Tetela (Jacobs 1964 p.142)

(i) átálélé á-tá- [lel-é] 'al wenende' ‘he used’
    3s-Tns-[USE-FV]
(ii) átšômbé á-tá- [šmb-é] 'al vegend' ‘he swept’
    3s-Tns-[SWEEP-FV]

These examples suffice to show that low vowels are retained in Tetela while mid vowel suffixes harmonize as expected.

4.1.2.5 Londengese C-80: Low Retention and Transparency

The examples in (4-26) show that Londengese (Goemaere 1981, Hulstaert & Goemaere 1984) combines the suffixal low vowel retention pattern and the now familiar prefixal harmony pattern.

(4-26) Londengese Examples of Low Vowel Retention

Parfait (p. 23)

(i) tomonanga to-mo-nang-a 'nous avons fait'
    Ipl-Perf-[FAIRE-FV]
However, Londengese is different from all the other languages in this study that retain suffixal low vowels in [rtr] harmony domains; in Londengese there is transparency rather than opacity to [rtr] harmony. The data in (4-27) illustrates this transparency for various verbal forms with suffixal low vowels. The verbs in set (a) are negative imperatives which have obligatory -ak- prefinal followed by final vowel -e. In set (b) the morpheme -ak- has the habitual meaning common in Bantu C. In set (c), the meaning is again aspectual in nature, construed by the authors as “renforcé”.

(4-27) Londengese Low Vowel Transparency to [rtr] in Suffixes

(a) Imperative Negative\(^{12}\) (Hulstaert and Goemaere 1984 p. 26.)

- to-[ton-ak-e] ‘ne refuse pas’
- t-[ok-ak-e] ‘n’écoute pas’
- t-enj-ak-e ‘ne tire pas’
- t-[ongw-ak-e] ‘ne vole pas’
- to-no-k-e ‘ne bois pas’
- to-ya-k-e ‘ne viens pas’
- to-le-k-e ‘ne mange pas’

(b) L’habituel Distanciel (Hulstaert and Goemaere 1984 p. 45)

- a-yo-tepy-ak-e ‘qu’il aille parler continuellement’
- a-y-os-ak-e ‘qu’il aille prendre continuellement’

(c) Subjonctif Renforcé (Hulstaert and Goemaere 1984 p. 45)

- n-kend-ak-e ‘dois-je partir’

\(^{12}\) Hulstaert and Goemaere 1984 interpret the suffixal material for all the forms in (4-27) as a single suffix, -ake. For consistency with assumptions already adopted in this study, I interpret this as -ak-e. Nothing in this reinterpretation affects the point about the transparency of the low vowel.
Additional data from a reduplication pattern confirms that low vowels are transparent to the harmonic feature [rtr]. For disyllabic stems such as in (4-28), two patterns of forming the diminutive are possible. In the first pattern, instead of the regular noun class prefix, we find the diminutive singular prefix i- or the diminutive plural prefix to-. In the second pattern, we find prefixing reduplication of the initial syllable of the stem along with the diminutive prefixes.

(4-28) Londengese Diminutives (Hulstaert and Goemaere 1984, p. 41)

<table>
<thead>
<tr>
<th>Regular</th>
<th>Class 19</th>
<th>Class 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>mfumbe</td>
<td>'esclave'</td>
<td>i-fumbe</td>
</tr>
<tr>
<td>bo-mpopo</td>
<td>'vent'</td>
<td>i-mpopo</td>
</tr>
</tbody>
</table>

Polysyllabic Stems: Pattern 2

<table>
<thead>
<tr>
<th>Regular</th>
<th>Gloss</th>
<th>Class 19</th>
<th>Class 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>mfumbe</td>
<td>'esclave'</td>
<td>i-fu-fumbe</td>
<td>to-fu-fumbe</td>
</tr>
<tr>
<td>doi</td>
<td>'goutte'</td>
<td>i-lo-loi</td>
<td>to-lo-loi</td>
</tr>
<tr>
<td>ntaa</td>
<td>'chèvre'</td>
<td>i-ta-taa</td>
<td>to-ta-taa</td>
</tr>
</tbody>
</table>

For nominal stems that have the prosodic shape CV, however, we find again a different pattern for diminutives, this time involving both the Class 19/13 prefixes and reduplication of the initial stem consonant and insertion of a "default" vowel [a].

Nominal stems of the CV type obligatorily form diminutives this way.

(4-29) Diminutive Reduplication for CV Nominal Stems (page 41)

<table>
<thead>
<tr>
<th>Regular</th>
<th>Gloss</th>
<th>Class 19</th>
<th>Class 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>bo-ta</td>
<td>'arc'</td>
<td>i-ta-ta</td>
<td>to-ta-[ta</td>
</tr>
<tr>
<td>lo-o /lo-bo/</td>
<td>'amende'</td>
<td>i-ba-bo</td>
<td>to-ba-[bo</td>
</tr>
<tr>
<td>bo-wɔ</td>
<td>'bras'</td>
<td>i-wa-wɔ</td>
<td>tɔ-wa-[wɔ</td>
</tr>
<tr>
<td>i-ye</td>
<td>'feu'</td>
<td>i-ya-ye</td>
<td>tɔ-ya-[ye</td>
</tr>
</tbody>
</table>

13 This form is somewhat curious in that the stem-initial [b] drops out in the regular form, but is present in both the base and reduplicant of the reduplicated diminutive forms.
In particular, note that, if the stem is retracted, then the diminutive Class 13 plural prefix is retracted too, despite the presence of an intervening low vowel in every case. This transparency need not be seen as a special property of reduplicated forms involving prosodic morphology, however, since I have already established low vowels are transparent to [rtr] harmony in the non-reduplicative morphology of ordinary suffixes.

Finally, Londengese shows transparency with respect to ordinary prefixal low vowels as well. I provide some examples below. In (4-30), the verbal prefix -ya- indicates 'action-at-a-distance'. Clearly the retraction from the verbal root is spreading onto the Class 7 prefix e-/e-.

(4-30)  e-sombre  e-ya-[nde njale  'le bateau remonte la rivière là-bas'  p. 52

In (4-31), the prefix -ta- indicates incomplete action. This particular verb form takes the final vowel -e, which harmonizes with the retracted verb root. What interests us is that the first person plural subject agreement morpheme to-/to- is also harmonizing across the intervening low vowel prefixes in each of the following examples.

(4-31)  to-ta-[kend-e  'nous ne sommes pas encore partis'  (p. 52)

(4-32)  (t)to-ya-[krop-a  'nous nous aimons...'  (p. 57)
The generalization that I will take from these data is that Londengese shows transparency to the low vowel in every domain14, just as Nkundo showed opacity in every domain.

What is required is an explanation of why [a] is transparent to [rtr] harmony in this one language alone, while it is opaque in all of the other low-retaining languages seen (Likile C-50, Nkundo C-60, Ombo C-70, Tetela C-70).

4.1.3 Summary of Low Vowel Distributions

In this section I have established that there is a far-reaching areal generalization to be made concerning the behavior of suffixal low vowels in 7-vowel Bantu languages. This

14 The transparency of low vowels to [rtr] harmony in Londengese raises the issue of whether high vowels are transparent as well. If transparency were explained via [rtr] insertion, as for Ntomba high-vowel transparency in Chapter 3, then one would expect high vowel transparency paralleling the low vowel transparency in prefixal and suffixal domains in Londengese. A first area where one might look for high vowel blocking effects is with the causative morpheme. In Babole, the causative morpheme is expressed either as palatalization or affrication of a root final consonant. These derived affricated or palatalized consonants uniformly block [rtr] harmony in Babole. I attribute the opacity of Babole causatives to the fact that they are derived from a high vowel in the historical causative morpheme *-is-. Curiously, Londengese has a similar pattern for forming causatives, but the resulting palatalized and affricated segments are transparent rather than opaque. This can be seen because the causative in Londengese has an alternating final vowel -E in the causative construction. The following data is from Hulstaert et Goemaere 1984, p. 53.

<table>
<thead>
<tr>
<th>-sin-</th>
<th>écrire</th>
<th>-sin-y-e</th>
<th>faire écrire</th>
</tr>
</thead>
<tbody>
<tr>
<td>-somb-</td>
<td>acheter</td>
<td>-somb-y-e</td>
<td>faire acheter</td>
</tr>
<tr>
<td>-amb-</td>
<td>raconter</td>
<td>-amb-y-e</td>
<td>faire raconter</td>
</tr>
<tr>
<td>-sok-</td>
<td>être fatigué</td>
<td>-sok-y-e</td>
<td>fatigué</td>
</tr>
<tr>
<td>-tul-</td>
<td>forger</td>
<td>-tuje</td>
<td>faire forger</td>
</tr>
<tr>
<td>-bot-</td>
<td>engendrer</td>
<td>-botse</td>
<td>faire engendrer</td>
</tr>
<tr>
<td>-pit-</td>
<td>abimer</td>
<td>-pitse</td>
<td>faire abimer</td>
</tr>
<tr>
<td>-kend-</td>
<td>aller</td>
<td>-kenje</td>
<td>faire aller</td>
</tr>
</tbody>
</table>

While this is suggestive of transparency to an underlying (historical) high vowel, it is inconclusive since the derived status of the palatals and affricates could involve underlying [e] mid vowel rather than a high vowel. Unfortunately there is not a single example of a form with an overt intervening high vowel and retraction in Hulstaert et Goemaere 1984. I will leave the matter open for future research. The transparency of low vowels to [rtr] harmony will be shown to follow from variable ranking of a LO/RTR incompatibility constraint which is independently required in my account.
generalization is expressed in the map in (4-34). All the languages to the North of the gray demarcation line assimilate suffixal low vowels (italicized). This is true even of languages as far north as Balondo in Cameroon (Kuperus 1982, 1986). It is also true of some Bantu B. languages of Zaire such as Tiene (Ellington 1977) which have 7 vowels and are adjacent to the Bantu C area. To the south of the gray demarcation line all 7-vowel Bantu languages retain suffixal low vowels under harmony. This includes non-Bantu C but geographically close languages with 7 vowels such as Mituku (D-13, Stappers 1973). In the next section I provide an analysis of the variation in low vowel behavior, showing that it is driven by the variable ranking of a single faithfulness constraint, PARSE LO with respect to HARMONY and a LO/RTR incompatibility principle.

(4-34) Suffixal Low Vowel Behaviors in Bantu C 7-Vowel Harmony Systems
4.2 Bantu C Low Vowels Under Harmony: The Analysis

4.2.1 Introduction

In this next section I develop an analysis of the variation seen in the previous section. First I introduce and argue for a phonological principle of “negative licensing” that underlies the incompatibility between the features [low] and [rtr] throughout the system; for the moment I shall symbolize this incompatibility in the abbreviation *RTR/LO. Next I show that given (i), the harmony producing ALIGN constraints from the first two chapters, and (ii) *RTR/LO, the [lo]/[rtr] incompatibility constraint, the variable behavior of low vowels in harmony domains follows quite simply from the relative ranking of the faithfulness constraint PARSE LO. The account will work like this: for the low vowel assimilation pattern, I will propose the ranking \{HARMONY || *RTR/LO >> PARSE LO\}. To satisfy HARMONY and to respect *RTR/LO, the feature [low] is underparsed and the place feature (α) of the vowel to the left is copied. This is pictured in (4-35).

(4-35) Low Vowel Assimilation Pattern (Babole, Ntomba, Bolia, etc.)

RTR HARMONY \[\rightarrow\] PARSE LO

*RTR/LO

---

15 I will argue shortly that an independent principle “COLOR” (see (4-58)) requires the “spreading” of the features [fr] or [rd] of the previous vowel when [lo] is underparsed under harmony.
The low retention / opacity pattern results from the ranking \{\text{PARSE LO} \parallel \text{*RTR/LO} \gg \text{HARMONY}\}. Harmony can not be achieved in these languages at the expense of the feature [low] and highly ranked *RTR/LO guarantees that opacity is enforced.

\begin{equation}
(4-36) \text{Low Retention and Opacity (Nkundo, Tetela, Ombo)}
\end{equation}

Finally, the ranking \{\text{HARMONY} \parallel \text{PARSE LO} \gg \text{*RTR/LO}\} will mean that to achieve harmony *RTR/LO will be violated and the transparency pattern will result as in (4-37).

\begin{equation}
(4-37) \text{Low Retention and Transparency (Londengese)}
\end{equation}

Before taking each of these proposals one by one and showing in detail how they work, I will first motivate a phonological principle of negative licensing and show how it applies to the (incompatible) relationship between [rtr] and [low].
4.2.2 Characterizing \([rtr]/[lo]\) Incompatibility in Bantu C

In \(A&P\) 1994 and related work on Tongue Root (TR) vowel harmonies, phonetically grounded feature cooccurrence constraints play a major role. "Grounded" constraints encode implicational relationships between tongue height features ([hi] or [lo]) and tongue retraction features, for example, [rtr], as in (4-38)

**(4-38) Grounded Constraints on Tongue Height and Retraction**

\[
\begin{align*}
(i) & \quad \text{LO} / \text{RTR} & \text{IF LO THEN RTR (Sympathetic)} \\
(ii) & \quad \text{RTR} / \text{LO} & \text{IF RTR THEN LO (Sympathetic)} \\
(iii) & \quad \text{HI} / \text{RTR} & \text{IF HI THEN NOT RTR (Antagonistic)} \\
(iv) & \quad \text{RTR} / \text{HI} & \text{IF RTR THEN NOT HI (Antagonistic)}
\end{align*}
\]

Besides encoding sympathetic or antagonistic articulatory relationships between the tongue body and the tongue root, such constraints express markedness facts. For example, while systems with a low vowel commonly exhibit phonological retraction of that [lo] vowel, languages which contrast advanced and retracted high vowels are somewhat rarer. In other words retracted low vowels are the unmarked case while retracted high vowels are marked. Given (4-38)(i) and (ii) above, languages like Yoruba that allow the low vowel [a] and retracted [e] or [o] in the same harmony domain are expected, the low vowel being a perfect target, and in some cases even a trigger, for [rtr] harmony. In the data in (4-39), the vowel [a] may be either to the left, (i), or to the right, (iii), of a retracted mid vowel in the harmony domain. In fact a mid vowel to the left of

---


\(^{17}\) *A&P 1994 is agnostic about privative features. I am assuming privative features and therefore appeal only to privative [rtr]. I agree with Steriade 1995's conclusion that [atr] and [rtr] are privative features and there is no inherent markedness relation between them. I do not adopt her position (her position follows Goad 1993) that [rtr] is not a feature used to build underlying contrasts in vocalic systems.*

\(^{18}\) *See A&P 1994, p. 153.*
[a] must be retracted, as in (iii), showing the significance of the constraint LO / RTR in the
grammar of Yoruba.\footnote{This is interpreted as [rtr] "spreading" from /a/ to a vowel on the left, whether or not morpheme-level [rtr] is present underlyingly. For the pre-optimality Archangeli / Pulleyblank analysis of Yoruba see \textit{A&P 1989}, \textit{A&P 1994}. For the Optimality Theory re-analysis of Yoruba see \textit{Pulleyblank 1993}, 1994. See also \textit{Goad 1993} for a different analysis of the Yoruba facts eschewing [rtr] and using only the feature [low] within a novel feature geometric proposal.}

\textit{(4-39) Yoruba Low Vowels (data from Pulleyblank 1993)}

\begin{tabular}{lll}
(i) & \textit{âjè} & \textit{\[a\j e\]} & 'witch' \\
    & \textit{\text{âbèrè}} & \textit{\[abère\]} & 'needle' \\
    & \textit{\text{aʃʊ}} & \textit{\[aʃʊ\]} & 'cloth'
\end{tabular}

\begin{tabular}{lll}
(ii) & \textit{\text{àfè}} & \textit{[afe]} & 'Spotted grass mouse' \\
    & \textit{\text{\text{àwɔ}} & \textit{\[awo\]} & 'plate' \\
    & \textit{\text{àdɪ}} & \textit{\[adi\]} & 'palm-nut oil'
\end{tabular}

\begin{tabular}{ll}
(iii) & \textit{\text{èbà}} & \textit{[eba]} & 'food made from gari'
    & \textit{\text{\text{egba}} & \textit{[egba]} & 'whip'
    & \textit{\text{èrāpò}} & \textit{[erakpo]} & 'type of plant'
\end{tabular}

In OT (\textit{Prince and Smolensky 1993, M&P 1993a}), the importance of a constraint in a
particular grammar is determined by its ranking with respect to other constraints. For the
Yoruba pattern above, \{LO / RTR >> LEX RTR\} means that the grammar identifies as
optimal forms where low vowels are \textbf{phonologically} retracted, even if a non-lexical [rtr]
element must be inserted to satisfy the requirement (insertion being a \textbf{FAITHFULNESS}
violation). In terms of the \textit{A&P 1994} “grounding” framework, [lo] and [rtr] may only
exist in a sympathetic or, at worst, neutral relationship. There is no question of
formulating a grounded feature cooccurrence filter *{[lo]/[rtr]}: such a constraint would
in fact falsify Grounding Theory, which attempts to base phonological processes in
phonetic realities. There is no obvious phonetic reason for the [lo]/[rtr] incompatibility of
Babole and other Bantu C languages. To be perfectly clear, the effect needed is pictured
in (4-40); some \textbf{phonological} principle (constraint) is barring what should be the most
phonetically natural of configurations.
Moreover, the constraints governing [lo]/[rtr] interaction are limited in the A&P 1994 theory to the sympathetic constraints LO/RTR and RTR/LO. We must therefore look beyond Grounding Theory to explain this pattern of [lo]/[rtr] hostility. In what follows I will appeal to an idea developed in Ito, Mester and Padgett (IMP) 1995. IMP 1995 seeks to solve an outstanding puzzle in the phonology of Japanese involving the features [son] and [vd].

4.2.2.1 Negative Licensing in Japanese [son] / [vd] Interactions

The problem involves the interaction between two phonological processes in Japanese. The first, Rendaku voicing, voices an initial obstruent in the second member of certain types of compounds, illustrated in (4-41).

(4-41) Rendaku (Sequential) Voicing in Japanese (IMP p. 6)

\[
\begin{array}{lll}
\text{i)} & \text{ori kami} & \Rightarrow & \text{ori+gami} & \textquote{paper folding} \\
\text{ii)} & \text{oo sumo} & \Rightarrow & \text{oo+zumo} & \textquote{grand sumo tournament} \\
\text{iii)} & \text{yama tera} & \Rightarrow & \text{yama+dera} & \textquote{mountain temple} \\
\text{iv)} & \text{mizu teppo} & \Rightarrow & \text{mizu+deppo} & \textquote{water pistol}
\end{array}
\]

The second process, dubbed Lyman's Law, restricts native Yamoto vocabulary to having one voiced obstruent per root. The point of interest to IMP is that Lyman's Law blocks Rendaku voicing in examples such as (4-42).
Lyman's Law (one voiced obstruent per root) OCP effect

a)  \( \text{\textit{s}iro+\text{tabi}} \) \quad *\( \text{\textit{s}iro+dabi} \)
b)  \( \text{ore+kugi} \) \quad *\( \text{ore+gugi} \)
c)  \( \text{mono+sizuka} \) \quad *\( \text{mono+jizuka} \)
d)  \( \text{maru+haduka} \) \quad *\( \text{maru+baduka} \)

In a previous derivational account (Itô and Mester 1986), both sonorants (4-41)(i-iii), and voiceless obstruents (4-41)(iv), were taken to be "underspecified" for [vd] since neither triggered Lyman's Law and inhibited Rendaku voicing like the bolded voiced obstruents in (4-42). This was adduced as support for a theory of underspecification of redundant features. However, data such as those in (4-43) and (4-44) show that voicing "spreads" in NC clusters, both within morphemes, (4-43), and across morpheme boundaries, (4-44). Moreover such voiced clusters (underlined in (4-43)) trigger Lyman's Law, showing that the relevant voicing assimilation is not simply a late phenomena. This makes it difficult to claim uniform underspecification of [vd].

(4-43) NC voicing Morpheme Structure Constraint

a)  \( \text{tombo} \) \quad *\( \text{tompo} \) \quad 'dragonfly'
b)  \( \text{\textit{s}indo-i} \) \quad *\( \text{\textit{s}into-i} \) \quad 'tired'
c)  \( \text{unzari} \) \quad *\( \text{unsari} \) \quad 'disgusted'
d)  \( \text{kaggae} \) \quad *\( \text{kanjkae} \) \quad 'thought'

(4-44) NC voicing with Gerundive -te

a)  \( /\text{yom+te}/ \) \quad yonde \quad 'reading'
b)  \( /\text{sin+te}/ \) \quad sinde \quad 'dying'

These contradictory facts lead IMP 95 to formulate the underspecification paradox in (4-45).

(4-45) Underspecification Paradox

\( \text{haya-gane} \) : [vd] must be absent in [nas] to circumvent Lyman's Law
\( \text{\textit{\textit{s}irooto-kaggae}} \) : [vd] must be present in [nas] (Rendaku blocked via Lyman’s Law)
Essentially, how can [vd] be present in one case and absent in the other? To address this question, *IMP 95* propose the following negative licensing constraint, based on the implicational relation between sonorancy and voicing.

(4-46) *Son Voi Licensing Cancellation* (*IMP 95*, p. 16)

\[
\text{If } F \supset G, \text{ then } \neg (F \land G) \\
\text{If a feature } F \text{ implies the specification of } G, \text{ then it is not the case that } F \text{ licenses } G. \\
\text{If } \text{SON } \supset \text{VD}, \text{ then } \neg (\text{SON } \land \text{VD})
\]

Although we expect sonorants to be voiced by their very nature, a converse set of facts may obtain such that sonorants fail to license [vd]. *IMP 95* puts it like this:

"... redundant feature specification is determined in our view by a conflict between licensing constraints militating against the presence of redundant features and constraints requiring the presence of those very same features. The ranking of these constraints with respect to each other tips the scales either in favor or specification or of underspecification" (*IMP 95*)

In the account they develop, the requirement that sonorants, in this case nasals, be phonologically specified for voicing, is codified in the constraint NASVOI. Although the Licensing constraint militates against the phonological voicing of nasality in bare nasals, in NC clusters the [vd] element may be "licensed" by the obstruent member of the cluster, as in (4-47a). NASVOI is also satisfied in the multiply linked structure. In the bare nasal segment however, b), if Licensing dominates NASVOI, then the requirement of phonologically specified nasal voicing, NASVOI, must be sacrificed to satisfy Licensing: the constraints are now in conflict with each other.
**Interaction of Licensing and NasVoi**

Licensing $\Rightarrow$ NasVoi $\Leftrightarrow$ underspecification of redundant voicing in bare nasals

<table>
<thead>
<tr>
<th>a.</th>
<th>Licensing $\Rightarrow$ NasVoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>d</td>
</tr>
<tr>
<td>v</td>
<td>d</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b.</th>
<th>Licensing $\Rightarrow$ NasVoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the following subsection I extend this negative licensing idea to the [lo]/[rtr] feature relation.

### 4.2.2.2 Negative Licensing in Interactions between [lo] and [rtr]

According to *A&P 1994* both (4-48)(i) and (ii) are valid "Grounded Path Conditions".

(4-48) **Grounded Path Conditions:** [Vowel Height]/RTR and RTR/[Vowel Height]

(compiled and adapted from *A&P 1994* (8), p. 148 and (11), p. 150)

(i) LO/RTR Condition  
   If [low] then [rtr]

(ii) RTR/LO Condition  
   If [rtr] then [low]

Although (4-48)(ii) is a "weaker" implicational condition in that it is more frequently violated cross-linguistically, all constraints in Optimality Theory are considered present in every grammar. It is on the "weaker" condition, (4-48)(ii), that I will develop a first proposal for [rtr]/[lo] licensing constraint parallel to the [son]/[voicing] licensing constraint of *IMP 95*. The reason for choosing (4-48)(ii) initially will be clarified immediately below. The important point for the moment is that the constraint formulated in (4-49)(ii) is taken to be operative in the phonology of Babole. It says that [rtr] may not license [lo] because, universally, [rtr] implies [lo] (*retraction implies lowness* parallels...
sonorancy implies voicing). The two possible grounding conditions and corresponding licensing failure constraints are given in (4-49).

\[ (4-49) \text{Babole } \{[\text{rtr}] / [\text{low}]\} \{[\text{low}] / [\text{rtr}] \} \text{ Licensing Cancellation} \]

(i) \text{LO /RTR LICENSING FAILURE}  
If \([\text{lo}] \supset [\text{rtr}]\), then \(\neg ([\text{lo}] \lambda [\text{rtr}])\)  
If \([\text{lo}]\) implies \([\text{rtr}]\) then it is not the case that \([\text{lo}]\) licenses \([\text{rtr}]\)

(ii) \text{RTR /LO LICENSING FAILURE}  
If \([\text{rtr}] \supset [\text{lo}]\), then \(\neg ([\text{rtr}] \lambda [\text{lo}])\)  
If \([\text{rtr}]\) implies \([\text{lo}]\) then it is not the case that \([\text{rtr}]\) licenses \([\text{low}]\)

But why not choose the "stronger" condition, (4-48)(i), as the basis for a licensing constraint, (4-49)(i)? This would seem to be a better choice since \text{LO/RTR} is at least unviolated in the Babole vowel inventory.\textsuperscript{20} To understand why the weaker constraint must be considered, look at a simple mid-vowel/low-vowel sequence, as in (4-50). Even if \([\text{lo}]\) is failing to license \([\text{rtr}]\), the mid vowel on the left \textit{would} license it (circled link in (4-50)). Parallel to the voice-linked NC structure in \textit{IMP 1995}, \([\text{rtr}]\) would still be licensed in multiply \([\text{rtr}]\)-linked structures like (4-50).

\[ (4-50) \neg (\text{Lo} \lambda \text{RTR}) \text{ Predicts that this Representation is Well-Formed: FALSE} \]

But \([\text{rtr}]\) is licensed in this link

---

\textsuperscript{20} One might observe that the constraint \text{RTR/LO} plays no active role in determining the Babole inventory (i.e., there \textit{are} the non-low retracted vowels \text{[e]} and \text{[a]} - \text{RTR/LO} is violated in the inventory) and that therefore a licensing constraint built on \text{RTR/LO} can not be playing an active role either. As far as I know, no general theory about how related constraints are ranked with respect to each other has ever been formulated. The general approach in OT is that all constraints are present and may be freely ranked. Therefore there is no apriori reason to disallow \text{RTR/LO}-based LICENSE just because \text{RTR/LO} is lowly ranked and impotent in Babole.
A solution based on the implication LO/RTR seems therefore impossible, given the properties of licensing in IMP 1995. There are two options available at this point and I will explore each briefly.

4.2.2.2.1 Indirect Licensing and the RTR/LO Condition

Steriade 1995 has proposed that there are two basic types of featural licensing. The first type corresponds to the licensing relation between sonorancy and voicing in IMP 95. It is called indirect licensing in Steriade 1995 since the licensee can be licensed via a single autosegmental link. The feature may be multiply linked, but it need only be licensed in one of the links. If Babole is analyzed as having the indirect type of licensing parallel to IMP 95, then using the preferable “strong” grounded condition and corresponding licensing constraint (4-49)(i) is not possible, because of the problem described in (4-50). However, even given indirect licensing, if the “weaker” implication, [RTR]/[LO], is used so that it is [rtr] that is failing to license [lo]21, the analysis can circumvent the problem in (4-50). There is a unique link to [lo] (as circled in (4-51)). In this case there is a licensing violation22 under harmony; if [rtr] fails to license [lo], the structure in (4-51) will be bad, as required.

21 This seems to fit in with the general picture of the morphologically-keyed features being somehow dominant in the system. Root morphemes are defined by presence of [rtr] or [atr] and by the presence of High or Low tone. Other vocalic features such as [low], [round] play no parallel role in defining root morphemes.

22 The implication, of course, is that a multiply linked low could not be prohibited from linking to [rtr].
\( (4-51) \quad \neg (\text{RTR} \land \text{Lo}) / \text{Indirect Licensing} \quad \text{Predicts that this Rep. is Bad: \text{TRUE}} \)

4.2.2.2.2 Direct Licensing and LO/RTR

A perhaps more felicitous way of formalizing the incompatibility between [low] and [rtr] is possible by pressing into service the distinction between indirect and direct licensing proposed in Steriade 1995. In direct licensing, the licensee ([rtr] in the present case) must be licensed by a licenser (non-low vowel in the present case) in every link. I propose then that the Bantu C paradigm under consideration involves direct licensing failure based on featural redundancy relations. Under this view, [rtr] must be licensed in each of its autosegmental links to a prosodic anchor in order for a representation to be good. In the path-language of A&P 1994, if [rtr] is on any path to [lo], the entire structure will be ruled out. This means that the structure from (4-50), (reproduced below in (4-52)), will now be ruled out since [rtr] is on a path to [lo]. Under indirect licensing this structure would be good since the link between [rtr] and the mid vowel would be sufficient to license it.

\( (4-52) \quad \text{Direct Licensing and LO/RTR Rule Out This Representation} \)

\[
\begin{array}{c}
\ast \\
[\text{lo}] \\
[\text{O} \ldots \text{A}] \\
[\text{rtr}]
\end{array}
\]
I will henceforth assume that the account with direct licensing and LO/RTR-based licensing failure is correct and to be preferred over the weaker Indirect Licensing and RTR/LO account.

To sum up the account so far, I have claimed that the [lo]/[rtr] and [rtr]/[lo] redundancy implications are universally available through the grounded constraints LO/RTR and RTR/LO, respectively. The corresponding Licensing constraints formalized in (4-49) are also universally available to grammars. What I informally abbreviated as the incompatibility *LO/RTR can now be replaced by the constraint *LO LICENSE RTR (read as "[low] fails to license [rtr]"). Henceforth this constraint will be abbreviated to just "LICENSE". The unique aspect of Babole and the other Bantu C languages under consideration is that LICENSE holds a position high enough in the constraint hierarchy to make its presence felt. In particular, the constraint ranking {HARMONY || LICENSE >> PARSE LO} asserts that it will be better to underparse [lo] than to violate LICENSE under harmony. As I will show in the detailed analyses to follow, this will have wide ranging consequences in the analysis of both verbal and nominal forms. In the rest of this study, I will assume that the phonological constraint LICENSE is what drives [rtr] / [lo] incompatibility in Bantu C 7-vowel harmony systems.

23 One final word on [rtr] licensing. Steriade 1995 (also Cole and Kisseberth 1994a) proposes a vocalic feature category "peripheral" which singles out [a] [i] and [u]. The mid vowels (non-high, non-low) are non-peripheral in Steriade's sense. A case could be made that [rtr] is not directly licensed by non-peripheral vowels in Bantu C because that is where the salience of an [rtr] contrast is maximized. Again this idea appeals to the kind of constraints that might be involved in maintaining the most salient feature combinations in segment inventories. The spirit of this is close to the negative redundancy licensing of IMP 1995: [lo] and [rtr] are not good together because they are too indistinct. Note that this approach if pursued, would mean a different way of handling high vowel / retraction incompatibility; licensing failure of [rtr] by [peripheral] would replace HU/RTR. I will not formalize an approach based on the notion "peripheral" since its formalization in terms of constraint ranking would not differ from LICENSE.

24 At the same time, it should be understood that if some other principle turns out to be responsible, the constraint interaction analysis should remain largely valid (assuming that a principle with an equivalent effect is substituted).
4.2.2.3 Lowness and Retraction in the Phonetic Output

One final point needs to be made here. Just as bare nasals are phonetically voiced in Japanese, so low vowels are phonetically retracted in Babole and the other languages under consideration. The phonological grammar of these languages leads one to recognize the (licensing-driven) incompatibility between the features under consideration. At the same time the account needs to be augmented with the addendum that (i) voicing on nasals and, (ii), retraction on low vowels are implemented either in a subsequent phonological “level” or in the phonetic component. It is crucial to both accounts that the phonological requirements of negative licensing be suspended or overridden by the phonetically driven requirements of grounding by the output of the phonetics. In phonetic implementation, bare nasals are voiced in Japanese and low vowels are retracted in Bantu C. I will return to this question in Chapter 6., where I take the position that while redundancy based negative licensing enforces the incompatibility between distinctive [rtr] and [low] in the morphology, redundant [rtr] is implemented on all low vowels at the output of the morphology prior to the constraint interaction for a post-lexical component.

4.2.3 Constraint Analysis of the Low Vowel Patterns in Verbs

Having proposed and argued for a phonological principle underlying [rtr] / [lo] incompatibility, I will now turn to providing an analysis of the three documented patterns for low vowels in verbal harmony domains: (i) assimilation with vowel copy; (ii) retention with opacity; and (iii) retention with transparency. In the next chapter I will
turn to the distribution of low and retracted vowels that are seen in nominal stems, showing how the analysis developed so far can be extended to provide an elegant way of dealing with some complex facts. Before going any further however, I will make explicit my assumptions about the vocalic feature schema that will be used in the analysis.

4.2.3.1 Vocalic Feature Framework

Recall first of all that we are concerned with a vowel inventory which is exactly like that in (4-53) for each of the languages involved.

(4-53) 7-Vowel System of Bantu C

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>ε</th>
<th>o</th>
<th>c</th>
<th>o</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Hi]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>▲</td>
</tr>
<tr>
<td>[Rd]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>▲</td>
<td>▲</td>
<td>▲</td>
</tr>
<tr>
<td>[Fr]</td>
<td>▲</td>
<td>▲</td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Lo]</td>
<td></td>
<td></td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[RTR]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>▲</td>
<td>▲</td>
<td></td>
</tr>
</tbody>
</table>

The position that I will take is that the feature system underlying the vowel inventory is essentially the same for all the languages in this study. While this is not a necessary assumption, it is a reasonable one, and makes most sense in the context of the overall analysis. I adopt the featural specification of vowels in (4-54).

(4-54) Specification of 7-vowel System
I will assume, following much recent work, that these features are privative (Goad 1993, Lombardi 1991, Steriade 1993, 1995 etc.), and that they may combine freely subject to various constraints (the ‘combinatorial’ specification approach of A&P 1994). Vocalic feature constraints significant to the segment inventory include those in (4-55).

(4-55) Feature Cooccurrence Constraints Respected in the Segment Inventory

* [Fr, Rd] If [fr] then not [rd] (excludes [y], [œ] front rounded vowels)
* [Hi, RTR] If [hi] then not [rtr] (excludes [i], [ʊ] high retracted vowels)
* [Hi, Lo] If [hi] then not [lo] excluded because assumed contradictory
* [Lo, Fr] If [lo] then not [fr] (excludes [æ])
* [Lo, Rd] If [lo] then not [rd] (excludes [o])

COLOR Non-Low vowels must have a [Bk], [Fr] or [Rd] specification (this disfavors segments consisting of [rtr] alone or [high] alone and centralized non-low vowels “barred-i”, [i], and “schwa”, [ə].

LICENSE Excludes any segment combining [low] and [rtr]

Note that these constraints are not considered to be constraining the segment inventory as it constitutes an input to phonology, but strictly (as mandated in OT) as constraining output. This goes hand in hand with the view (A&P 1994) that segment inventories are derived rather than primitive.

---

25The vowels listed in (4-54) do not exhaust the combinatorial possibilities of 5 features given the feature cooccurrence constraints in (4-55). There are also various “sparsely” specified segments such as that defined by “no” features, a so-called ‘empty’ segment. Possible segments corresponding to [Fr] alone, [Rd] alone, are also generated by this schema but are not in focus in this study.

26This is adapted from Padgett 1996. See also Kirchner 1993. The implementation here is that low vowels do not have a [front], [back], or [round] specification in the unmarked case. Non-low vowels however do have such a specification in the unmarked case.
4.2.3.2 Constraint Interaction for Low-Underparsing and V-Copy

Consider the constraint interaction that was sketched in §§ 4.2.1 (p. 143) to account for the suffixal low vowel assimilation pattern seen in Babole data like (4-56). Note that the Past Passive and Subjunctive Passive for the root -hék-, ‘cut’, differ only tonally; the assimilation process neutralizes the difference between the final vowels -a, and -e in just this case.

(4-56) V-Copy in Babole Verbal Morphology

<table>
<thead>
<tr>
<th>Past</th>
<th>Gloss</th>
<th>Applicative</th>
<th>Past Passive</th>
<th>Subjunctive Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>-s₁l</td>
<td>‘sharpen’</td>
<td>-s₁l-él-á</td>
<td>-s₁l-ám-é</td>
</tr>
<tr>
<td>b.</td>
<td>-kèl-á</td>
<td>‘made’</td>
<td>-kèl-él-á</td>
<td>-kèl-ám-á</td>
</tr>
<tr>
<td>c.</td>
<td>-hék-é</td>
<td>‘cut’</td>
<td>-hék-él-é</td>
<td>-hék-ém-é</td>
</tr>
<tr>
<td>d.</td>
<td>-s₁l-á</td>
<td>‘do’</td>
<td>-s₁l-él-á</td>
<td>-s₁l-ám-í</td>
</tr>
<tr>
<td>e.</td>
<td>-kós-δ</td>
<td>‘gather’</td>
<td>-kós-é₁l-é</td>
<td>-kós-ém-δ</td>
</tr>
<tr>
<td>f.</td>
<td>-kòh-á</td>
<td>‘take’</td>
<td>-kòh-él-á</td>
<td>-kòh-ám-á</td>
</tr>
<tr>
<td>g.</td>
<td>-tsùm-á</td>
<td>‘dip’</td>
<td>-tsùm-é₁l-á</td>
<td>-tsùm-ám-é</td>
</tr>
</tbody>
</table>

The constraint interaction sketched in (4-57) will mandate the underparsing of [low], as this is the least costly way of resolving the constraint conflict.

(4-57) nj-kós-óm-e ‘let me be gathered...’

However note that the mora that once anchored the feature [lo] is now without any features except [rtr]. The feature(s) of the vowel to the left of the [rtr]-only mora are
providing the [rd] specification. But what constraint ensures this result? This is where the role of the constraint COLOR can be discerned. As it stands the second mora in the representation in (4-57) violates the requirement that a non-low mora have a [back] / [front] / [round] specification, (4-58).

(4-58) **COLOR**

A non-low vowel must have a [front] or [back] or [round] specification.

Like all constraints, COLOR might itself be violable under certain conditions, but it will be respected in the constraint interaction studied here. Given this background, I can now formulate the constraint interaction that will yield vowel copy as seen in the low vowel assimilation pattern. The first point to be made is that "spreading" rather than default "insertion" is the desired outcome. If the system were optimized to favor default insertion, the same output final imperative vowel in (4-56)c. and (4-56)e. would be expected, perhaps [-e ] (under the common assumption that front vowels are less marked than round ones\(^\text{27}\)). In terms of constraint interaction, preferential spreading can be implemented by ranking \textit{LEX} (\textit{do not insert a feature}) above \textit{LEX PATH} (do not insert a path/association line). The ranking \{LEX $\phi$ $\gg$ LEX PATH\} thus ensures that spreading (path insertion) involves a less costly violation than feature insertion. To this point, the mini-ranking \{COLOR $\parallel$ LEX$\phi$ $\gg$ LEX PATH\} is established, with no crucial ranking

\(^{27}\) This would be implemented in OT by 'exploding' the \textit{LEX} $\phi$ family of constraints into LEX FR, LEX RD, etc., such that LEX RD $\gg$... LEX FR (LEX FR would be the lowest ranking constraint of the family). Then if a place feature had to be inserted to satisfy COLOR it would be [front] under this approach. Note that Steriade 1995 does not accept a markedness difference between [back] and [front]; so this is not an uncontroversial question.
relationship between COLOR and LEX\$. In order to satisfy COLOR, we insert a path (spread) rather than insert a feature. Factoring this into the larger constraint interaction, we have the overall ranking in (4-59). The high ranking of PARSE RTR is determined by the fact that [rtr] is not underparsed as a way of resolving the constraint conflict.

**(4-59) Crucial Constraint Rankings**

\[
\begin{array}{c|c|c}
\text{PARSE RTR} & \text{ALIGN L Stem} & \text{PARSE LO} \\
& \text{ALIGN R Stem} & \text{LEX}^\uparrow \\
rtr/lo Licensing & \text{LEX}^\uparrow & \text{LEX Path} \\
\text{COLOR} & & \\
\end{array}
\]

LICENSE and ALIGN L/R act in concert, potentially forcing violations of PARSE LO and COLOR. The COLOR violation however can be avoided by path insertion, incurring only a humble LEX PATH violation. There is no crucial ranking relationship between ALIGN SL/SR, LICENSE, LEX \& and COLOR, (indicated by stacking the non-ranked constraints in the schema in (4-59)). Similarly there is no ranking between PARSE LO and LEX PATH. In constraint Tableaux, while crucial rankings are maintained in the left-to-right ordering of constraints, not all left-to-right orderings indicate crucial ranking. In the tableau in (4-60), I show how the low-underparsing / vowel copy analysis works with a simple form involving a single low vowel suffix. The constraint ranking from (4-59) will select candidate #4. as optimal; it satisfies COLOR through path insertion (spreading) from the left.
(4-60) Deriving V-copy Through COLOR Constraint

Something more needs to be said about candidates #4 and #5. Nothing so far in the
constraint interaction selects #4 as preferable to #5. If the account could refer to cyclicity
or morpho-lexical levels, the problem would be solved because after the cyclic addition
of each suffix the only way that COLOR could be satisfied would be from the left, since
nothing yet exists to the right. Of course this is somewhat contrary to at least some
versions of an output oriented theory like OT. Clearly in (4-57), the passive morpheme is
receiving the features of the vowel to the left, not from the vowel to the right. If a wider
range of forms were considered it would be obvious that spreading is always "from the
left” yielding a “parasitic” color harmony effect. Under [rtr] harmony, when lo-
derunderparsing is mandated, a COLOR feature must be found from the same direction as the
harmonic feature. I suggest that the formal solution to this puzzle lies in the relative
complexity of the kinds of output structures seen in candidates #4 and #5. Consider the
structures in (4-61). I have added indices showing the morphological affiliation of each
feature in the representations.

(4-61) Morphological Affiliations of Features in Competing Structures
A. Candidate #4

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

Candidate #5

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

B. \( \mu^i [i, i] \ldots \mu^j [i, i] \ldots \mu^k [i, k] \) \\
C. \{i, i, i\} \ldots \{j, i, i\} \ldots \{k, i, k\}

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

\[
\begin{array}{c}
[rd]^i \\
[lo]^j \\
[fr]^k \\
[O^i...A^i...E^k]
\end{array}
\]

The crucial point concerns the configuration of mora “j” in each case, the mora where
[lo] is underparsed and features are taken from the right or left. In every case except mora
“j” of candidate #5, at least one index is common between the prosodic anchor and the
dependent features or between the dependent features. In the case of mora “j” in #5
however, the feature indices of the dependent features are respectively “i” for [rtr] and
“k” for [fr]. This gives a indices triplet \{j, i, k\} for mora “j” of candidate #5. I suggest
that cross-linked representations like mora “j” of candidate #5 are universally disfavored
compared to shared-link structures as in mora “j” of candidate #4 (with an indices triplet
Interestingly, using this kind of criteria to assess representational complexity isolates the problem exactly; the indices triplet for the other moras in the competing structures are exactly the same; only mora "j" shows a difference, and that difference favors candidate #4, as required. Instead of a descriptive constraint like PARASITIC which would essentially stipulate that a COLOR feature must come from the same direction as [rtr], the *CROSSLINK approach suggested above derives the parasitic harmony effect by direct reference to the representational complexity of the outputs; the simpler structure will always be one which finds a needed feature specification from the same direction as the harmonic feature source. Since candidates #4 and #5 in (4-60) tie on all other counts, the ranking of *CROSSLINK is irrelevant; it will select candidate #4 regardless of its ranking.

To summarize, the optimal candidate, #4., accepts both PARSE LO and LEX PATH violations, but avoids more serious LICENSING, ALIGN, COLOR, and *CROSSLINK violations. In all constraint interaction descriptions to follow, I will not include the candidates that violate *CROSSLINK, since I have demonstrated that structures that maximize shared structure are preferred.

4.2.3.2.1 An Alternative Explanation for Suffixal Low Vowel Assimilation

An alternative account (Donca Steriade pc.) not based on [lo] / [rtr] hostility, involves parasitic harmony as discussed in Cole 1987, Kaun 1995, Steriade 1995. On this view, the low vowel assimilation pattern in (4-56) might result from the tendency of highly similar elements to assimilate completely. Under this view, because [a], [e] and [o] all share [rtr] (or perhaps [lo] as in Goad 1993), the central vowel [a] will assimilate the [fr]
or [rd] features it lacks. Besides the descriptive nature of “parasitic”\(^{28}\) in this proposal, a potential problem is that it still assumes a compatible relationship between [rtr] and [lo]. Nothing in the ‘parasitic’ harmony account explains the low vowel retention / opacity pattern of languages like Nkundo, but it follows naturally from [lo]/[rtr] incompatibility approach. In the account presented here, the Nkundo pattern is obtained by re-ranking the constraints such that \{LICENSE \parallel PARSE LO >> HARMONY\}; [rtr] harmony is sacrificed in order to respect dominant PARSE LO and LICENSE. The difference in the two languages is captured succinctly and simply via the position of PARSE LO in the constraint hierarchy. In the “similar-elements-assimilate-completely” approach the assimilation pattern is derived directly. However it remains to be seen how the transparency and opacity variants could be derived; the opacity effect especially would seem problematic for this view since no principle of incompatibility exists between the harmonic feature and assimilatory target. A viable explanation along these lines might be possible, but that must be left for further research. At any rate the present approach captures the systematic generalizations straightforwardly and intuitively. I will now give a fuller explanation of my account for the low-retention and opacity pattern.

4.2.3.3 Constraint Interaction for Low Vowel Retention / Opacity Pattern

I have argued that [rtr] and [lo] are essentially incompatible in Bantu C phonology and that one may attribute this to the failure of [low] to directly license [rtr] due to the

\(^{28}\) In addition the notion of “highly similar” is not given a precise definition.
redundancy relation between them. If this is true then a slight change in the ranking of the relevant constraints will yield the Nkundo pattern, repeated in (4-62).

\[(4-62)\text{ Low Retention and Opacity (Nkundo, Tetela, Ombo, Likile, etc.)}\]

\[\text{á-fó-[lɔnd-ám-é] 'Il n'est pas suivi'}\]

<table>
<thead>
<tr>
<th>PARSE LO</th>
<th>RTR HARMONY</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ə ... a ... e]</td>
<td>[lo]</td>
</tr>
<tr>
<td>O ... A ... E</td>
<td>[rtr]</td>
</tr>
</tbody>
</table>

The constraint tableau shows how the single change of promoting PARSE LO above HARMONY yields the low-retention and opacity pattern. Any candidates that violate LICENSE, such as candidate #2., are bad. Candidates that either underparse [lo] as in #3 or combine low underparsing with feature spreading (as in #4) are worse than simply doing nothing, precisely because HARMONY is now less highly valued than PARSE LO. The best candidate, #5, fails to achieve right alignment but respects all the higher ranking constraints.
Thus having PARSE LO ordered above HARMONY yields the low vowel retention and opacity pattern, but only of course if LICENSING (or some other analogous constraint) prohibits [low] - [rtr] linkings.
4.2.3.4 Constraint Interaction for Retention / Transparency Pattern

Finally, I must account for the low vowel retention and transparency pattern that was seen in Londengese. The ranking \{HARMONY \parallel PARSE LO >> LICENSE\} will mean that to achieve harmony LICENSE can now be violated; the transparency pattern will result.

(4-64) Low Retention and Transparency (Londengese) t-ongw-ak-e 'ne vole pas'

```
\text{PARSE LO} \quad \Rightarrow \quad \text{LICENSE}
```

The tableau in (4-65) shows how this idea would be formalized in terms of constraint violation. Since LICENSE has is now ranked beneath HARMONY and PARSE LO, harmony is achieved at the expense of LICENSE in candidate #2. Low underparsing (candidates #3 and #4) and failure to harmonize (candidate #2) are suboptimal under this ranking.
Within the overall conceptual framework of this study, it is clear that the principle driving [low] / [rtr] incompatibility is “weak” in Ndengese. Unfortunately for my account, it furthermore seems to be absent entirely. It would be more interesting perhaps if LICENSE had not disappeared completely from the constraint interaction, but showed its effect in some domain. For example, it would be a more compelling account of
Londengese low vowel transparency to [rtr], if opacity was preserved in prefixes. Then one could demonstrate that the LICENSE constraint was only being violated in the unmarked stem suffix domain, while being respected in the more marked prefixal domain. However the data presented in Hulstaert and Goemaere 1984 is inconsistently represented with respect to this very point. At times prefixal low vowels are represented as opaque to [rtr] harmony and at times as transparent to [rtr] harmony. While the robustness of the data concerning suffixal transparency is such that an analysis may be reasonably based on it, the question of transparency for prefixal low vowels must remain open for further research.

4.2.3.5 A Low-Only Analysis of Bantu C Vowel Harmony?

Before going on to the next chapter, I would like to briefly consider an alternative analysis based on Goad 1993’s proposal that [lo] replace [rtr] in all cases of vowel harmony of this sort. First of all, to be fair, Goad’s proposal is cast in an autosegmental framework where representational properties of the feature geometry play more of an explanatory role than in OT. Even so I think that an instructive comparison is possible. Crucially for what concerns me, Goad 1993 proposes features and representations in (4-66) for the vocalic segments in the Yoruba 7-vowel system.

\[\text{(4-66) Goad 1993 7-Vowel Representations} \]

\[
\begin{align*}
&[\text{a}] \\
&\text{VOC} \\
&[\text{open}] \\
&[\text{lo}] \\
\end{align*}
\]  
\[
\begin{align*}
&[\text{e}] \\
&\text{VOC} \\
&[\text{open}] \\
&[\text{front}] \\
&[\text{lo}] \\
\end{align*}
\]  
\[
\begin{align*}
&[\text{e}] \\
&\text{VOC} \\
&[\text{open}] \\
&[\text{front}] \\
&[\text{lo}] \\
\end{align*}
\]
Harmony of the sort I have been discussing is \([lo]\)-harmony in Goad 1993. Her proposal is that the low vowel has categorically the representation in (4-66). This works well enough for the autosegmental analysis of Yoruba, since \([lo]\) does spread from the low vowel, inducing obligatory retraction to the right (but not to the left). The other aspect of Yoruba harmony in any autosegmental account involves some characterization of a “floating” or morpheme level harmonic feature; in Goad, this must be \([lo]\). Putting aside the problem of constraining inputs in OT, what would Bantu C harmony look like in Goad’s analysis? If there is a rule that spreads \([lo]\), then it should spread all instances of \([lo]\) from roots into suffixal and prefixal vowels. But the key property of rainforest Bantu 7-vowel systems as brought out by this thesis and other researchers is that \([lo]\) rarely\(^{29}\) spreads from the low vowel. In fact what is found is the rather rigid suppression of retraction in the neighborhood of \([a]\). It seems that what would be required, given the commitment to the representations in (4-66), would be a crucial distinction between the underlying linked or unlinked status of \([lo]\). That is, one would have to say that morpheme-level (floating or unlinked) \([lo]\) must spread by rule while linked low vowel \([lo]\) may never spread. The difference between Babole and Yoruba would be then presumably involve the setting of parameters such that Yoruba-type systems allowed spreading of linked and unlinked low, while Babole-type systems allowed spreading of only unlinked \([lo]\). Even in an autosegmental rule-driven approach such a stipulation seems to miss the main point about the Bantu C low vowel \([a]\): it is phonologically not retracted at all but patterns with the mid and high vowels with respect to vowel harmony,

\(^{29}\) There is only one case in my database, that of Mbosi Olée (Fontaney 1989). This will be discussed in Chapter 6.
never being a trigger. Any system that representationally encodes the phonetic retraction of low vowels is going to have to say something to explain why the low vowel's behavior is completely and systematically distinct from that of [e] and [o]. Consider another scenario, this time the case where a suffixal low vowel follows a "retracted" (= floating [lo]) verb root. In this chapter, three types of behavior have been documented when this configuration is found: (i) opacity, (ii) transparency, (iii) assimilation. I am not certain how these each of these phenomena would be analyzed in a framework such as *Goad 1993*, however note the basic configuration shown in (4-67).

(4-67) Rules of [lo] Association and [lo] Spread

```
INPUT —> OUTPUT

\[\begin{array}{c}
& [\epsilon] &\ldots  & [a] \\
VOC & | & VOC \\
| & \uparrow & | & \uparrow \\
[lo] & & [lo] & & [lo]
\end{array}\]
```

Normal assumptions about the OCP here would result in an output configuration where the [lo] specifications are fused and the resulting specification is shared by the two [open] nodes. Given the inherent structural relationship between [open] and [lo], it is hard to see what could prevent this result. However, this is exactly what is not seen in Bantu C (except the single marked case of transparency, Londengese, this chapter). The common scenario cast in *Goad 1993*’s terms would be low vowel transparency to [lo]-spread. I will leave to others to propose a detailed autosegmental account of the Bantu C
facts along these lines. Initially, it seems to me that such an account would need to be elaborated somewhat to be viable\textsuperscript{30}. If on the other hand Goad 1993 were recast in OT, then the device of distinguishing between underlying linked and unlinked [lo] becomes unavailable since inputs cannot be constrained. Even granting that these technical difficulties can be overcome, a real problem exists with the paucity of the database. Even A&P 1989, which conceptually provides much the backdrop for [rtr] / [lo] interactions and hence for this study, could not anticipate a scenario where those two features were phonologically incompatible. Since the first languages that appeared in published analyses showed some harmonic retraction effect from low vowels, it was assumed that low vowels should (universally) induce retraction if a language had [-atr] harmony ([rtr] in my system). The cases of Wolof and Yoruba discussed by Archangeli and Pulleyblank and then reanalyzed by Goad 1993 were certainly of this type. What this thesis brings to light is that there are many languages with [rtr] vowel harmony where, in fact, low vowels \textit{never} induce retraction and are moreover incompatible with harmonic [rtr]. In such a 7-vowel harmony system, the lower mid vowels are not phonologically [low]; they pattern as (retracted) mid-vowels. The underlying system of contrasts uses a tongue retraction feature to create an additional set of “lower” mid vowels because that is where a retraction distinction is most salient. As I have shown in this chapter, the result is that the [rtr] distinctive feature is only relevant phonologically for the mid vowels and is not licensed on low vowels. As will be seen in the final chapter of this study, it is not the case

\textsuperscript{30}For example, for the low-vowel assimilation cases a process of parasitic harmony would have to be invoked. Recall that in my analysis, the parasitic harmony effect is derived, not stipulated. For the low vowel opacity cases something additional again would need to be said, perhaps keyed to domain parametrization of the OCP, such that one had OCP fusion for the transparency cases and OCP non-relevance for the opacity cases. The principle of 1.0/\textit{rtr} licensing failure greatly simplifies the analysis of the complex variation seen in Bantu C..
that "redundant" or "phonetic" retraction effects from low vowels are impossible in languages such as these. I will argue however, that where a phonological licensing constraint of the kind proposed is in force (dominant) in the lexical-morphological phonology, redundant or phonetic low vowel retraction effects will only be manifested in a subsequent distinct phonological component. The conceptual framework adopted for this study posits a constraint-governed relationship between features like [low] and [rtr]. This means that phonologically either the phonetically-driven GROUNDING constraints or the contrast-preserving LICENSE constraint may be dominant. In the last chapter I will explore cases where both kinds of constraints make their presence felt in the same language. Before turning to that however, in the next chapter, data on low vowel patterns in nominal stems will bring into even sharper focus the issue of [low]/[rtr] incompatibility. I will end up refining some of the analysis from Chapter 3 concerning high-vowel / retracted-vowel asymmetries in the light of the new data.
5. Low Vowel / Retracted Vowel Distribution in Nominals

In this second of two chapters concerned with low vowels, I will consider the distribution of low vowels and retracted vowels in nominal stems. Recall from Chapter 3. that while all languages allowed non-derived nominal sequences like [e...i/u] and [ɔ...i/u], some did not allow the inverse sequences [i/u...e] and [i/u...ɔ]. This effect was attributed to the fact that if ALIGN SL dominated PARSE RTR ROOT, then root parsing could be sacrificed to prevent left-edge misalignment. At the beginning of this section, I want to explore whether similar effects are found for low vowels, since both high and low vowels are incompatible with tongue root retraction in the system, although for different reasons. We saw in the last chapter how the variation between low vowel assimilation (Babole-type) on the one hand, and low-vowel retention and opacity (Nkundo-type) on the other hand can be analyzed as a function of the relative importance (position in the constraint hierarchy) of PARSE LO. We will see in this section how the analysis of both high vowel and low vowel patterns under harmony must be substantially elaborated and revised to account for the nominal stem data concerning low vowels.

5.1.1 Babole I: Symmetrical non-occurrence of [e/ɔ] and [a]

In Babole C-10, Likuba C-20, Bobangi, Ntomba, Bolia, C-30 and most of the other low-assimilation languages, the sequences in (5-1) are impossible in nominal stems.

(5-1) Impossible Low Vowel Sequences in C-10, C-20, C-30, C-40

*[e...a], *[a...e]
*[ɔ...a], *[a...ɔ]
I provide examples of Babole forms involving low vowels in (5-2). These data are typical of the other languages having this pattern.

(5-2) Babole Forms Involving Low Vowels

<table>
<thead>
<tr>
<th></th>
<th>V...V</th>
<th>Word Form</th>
<th>Number</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>i...a</td>
<td>e-i-mà</td>
<td>n. 7</td>
<td>'egotism'</td>
</tr>
<tr>
<td>b</td>
<td>a...i</td>
<td>nkúí</td>
<td>n. 9/6</td>
<td>'paddle'</td>
</tr>
<tr>
<td>c</td>
<td>e...a</td>
<td>di-lèngù</td>
<td>n. 5/6</td>
<td>'game'</td>
</tr>
<tr>
<td>d</td>
<td>a...e</td>
<td>di-tambilé</td>
<td>n. 5/6</td>
<td>'sole of the foot'</td>
</tr>
<tr>
<td>e</td>
<td>a...a</td>
<td>di-pólá</td>
<td>n. 5/6</td>
<td>'large clay jar'</td>
</tr>
<tr>
<td>f</td>
<td>o...a</td>
<td>e-óndà</td>
<td>n. 7/10, 8</td>
<td>'blow with the fist'</td>
</tr>
<tr>
<td>g</td>
<td>a...o</td>
<td>di-pópò</td>
<td>n. 5/6</td>
<td>'wing'</td>
</tr>
<tr>
<td>h</td>
<td>u...a</td>
<td>e-túlù</td>
<td>n. 7/10, 8</td>
<td>'whirlpool'</td>
</tr>
<tr>
<td>i</td>
<td>a...u</td>
<td>bo-ótsù</td>
<td>n. 14/6</td>
<td>'theft'</td>
</tr>
</tbody>
</table>

The pertinent information to be drawn from (5-2) is that all [V...V] combinations involving low vowels are licit in this group except for the low / retracted combinations. The analysis developed for suffixal low vowel assimilation in the previous section can be invoked to account for *[e...a]* and *[o...a]* since the feature [lo] was being underparsed to resolve the constraint conflict between Licensing and Stem Harmony (in particular Align SR). However, can the underparsing explanation be extended to account for the symmetrical absence of mixed low and retracted vowels in nominals? In the following two constraint tableaux, I picture an [E...A] sequence, (5-3), and an [A...E] sequence, (5-4), both with underlying [rtr], to show that if Align SL and Align SRS both dominate Parse Lo, then [lo] might be underparsed on both Stem edges to satisfy Harmony. In Tableau (5-3), given the constraint ranking for Babole developed in the last section, the optimal candidate will be the one that achieves harmony through underparsing of [lo]: this is candidate #4. I have included the Grounded Constraint Lo/Rtr just to show that the best candidate actually has multiple Lo/Rtr violations since the phonological constraint...
LICENSE dominates the phonetically-driven GROUNDING constraint. My assumption for the moment is that both vowels are in the nominal root (that is, the rightmost vowel is not a suffix).

(5-3) Babole Output [e...e] from Input [E...A] with [rtr]: Low Underparsing on Right

<table>
<thead>
<tr>
<th>[fr]</th>
<th>[lo]</th>
<th>PARSE</th>
<th>ALIGN</th>
<th>ALIGN</th>
<th>LICENSE</th>
<th>PARSE</th>
<th>LO/RTR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RTR</td>
<td>SL</td>
<td>SR</td>
<td></td>
<td>LO</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>[fr]</td>
<td>[lo]</td>
<td></td>
<td></td>
<td>!*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>[fr]</td>
<td>[lo]</td>
<td></td>
<td></td>
<td>!*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>[fr]</td>
<td>[lo]</td>
<td></td>
<td></td>
<td>!*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>[fr]</td>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The constraint interaction sketched in (5-3) mimics exactly the analysis developed for the verbal forms in the previous chapter. In the optimal candidate, #4, the vowel on the left is supplying a COLOR feature for the vowel on the right. For simplicity I have omitted the constraints controlling feature copying under harmony since it was discussed in detail in the last chapter. In the reversed sequence configuration in (5-4), the constraint configuration still selects candidate #4. as optimal. The analysis crucially depends on being able to eliminate candidate #1. in both tableaux through a LICENSE violation. Thus the solution for nominals as

1 Note that there is no crucial ranking of LICENSE with respect to ALIGN SR, ALIGN LS, or PARSE RTR RT. LICENSE must only dominate PARSE LO.
well depends on the extension of the ‘direct’ licensing concept to the LO/RTR feature implication. In this case the low vowel on the left is being underparsed if harmonic [rtr] is present, generating the gap *[a...ə/e]. Again the need for a color feature once low is underparsed is handled by linking the feature [fr] from the rightmost vowel, giving the output [e...e].

(5-4) Babole Output [e...e] from Input [A...E] with [rtr]: Low Underparsing on Left

<table>
<thead>
<tr>
<th></th>
<th>PARSE</th>
<th>ALIGN</th>
<th>ALIGN</th>
<th>LICENSE</th>
<th>PARSE</th>
<th>LO/RTR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RTR</td>
<td>SL</td>
<td>SR</td>
<td></td>
<td>LO</td>
<td></td>
</tr>
<tr>
<td>[lo]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[fr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A ... E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. [lo] [fr] | | | | | |

2. [lo] [fr] | | | | | |

3. [lo] [fr] | | | | | |

4. [lo] [fr] | | | | | |

This constraint configuration does generate the attested vowel cooccurrence pattern. In particular it explains why the low vowel [a] never appears in any stem where there is retraction.

However this solution is problematic. Since we are dealing here with a pattern gap, rather than an alternation, it is impossible to say with certainty what the output associated with such an input would look like. While the proposed constraint analysis does make one right
prediction: there are no nominal stems of the form *[e/o...a], or *[a... e/o], it would be best to have confirming evidence from another source. The only kind of evidence that might help here would be historical or comparative evidence. If forms with sequences *[a... e], or *[a... o] were found in a related language that were cognate to Babole forms having [e... e], or [e... o] respectively, it would confirm the analysis of symmetrical underparsing of [lo]. However, no such evidence has been found, so I will offer an alternative analysis in the next section and briefly explore its consequences.

5.1.2 Babole II: *[a...e/o] via [rtr]-Underparsing.

Another possible way to explain the gap *[a...e/o] is by hypothesizing that it is [rtr] rather than [low] which is being underparsed for the [A...E/O] input sequences with [rtr] (thus exploiting the suggestive parallel to the *[i/u...e/o] gaps). For reasons that will be clear shortly, it is important to maintain a low-underparsing account for the *[e/o...a] gap (exploiting the parallel to the suffixal low vowel alternation pattern for verbs). Focusing for the moment on the *[a...e/o] gap in Babole nominals, what constraint ranking would result in loss of input [rtr] for low-initial stems? The ranking in (5-5), recall, mandates symmetrical underparsing of [low] as the best way of solving the constraint conflict, since PARSE LO is the ranked below both STEM HARMONY constraints.

(5-5) Symmetrical Underparsing of [low]
{PARSE RTR ROOT || LICENSE >> ALIGN SL || ALIGN SR >> PARSE LO || LEX PATH}
To begin, I first consider the ranking in (5-6) that gave [rtr] underparsing for high vowel initial stems in Chapter 3\(^2\). The constraint PARSE RTR ROOT intervened between ALIGN SL and ALIGN SR, creating a left-dominant alignment asymmetry: \{ALIGN SL >> PARSE RTR RT >> ALIGN SR >> PARSE LO\}. Although with this ranking it is now possible to violate PARSE RTR to respect ALIGN SL and dominant LICENSE, low-underparsing is still preferable. How about demoting PARSE RTR RT below PARSE LO (dotted arrow in (5-6))? This is too radical since we would then have [rtr] underparsing everywhere, excluding even [ɛ/ɔ...i/u] type sequences.

\[(5-6)\] A Ranking for PARSE RTR RT?
\{ LICENSE >> ALIGN SL >> PARSE RTR RT >> ALIGN SR >> PARSE LO || LEX PATH \},

The solution to this dilemma is in recognizing that there may be two PARSE LO constraints involved. One implementation of this idea involves “exploding” generic PARSE LO into morphologically oriented sub-constraints PARSE LO RT \(^3\) (parse root [low]) and PARSE AFFIX LO following the proposal in McCarthy and Prince 1995. The general idea is that the relation \{FAITH ROOT >> FAITH AFFIX\} constitutes a fixed universal meta constraint ranking. For the purpose of my account, with the ranking in (5-7), suffixal [lo] would be underparsed to satisfy ALIGN SR, but [rtr] would be underparsed to satisfy ALIGN SL. This is the desired outcome.

\[(5-7)\] Exploding PARSE LO
\{ LICENSE >> ALIGN SL || PARSE RT LO >> PARSE RTR RT >> ALIGN SR >> PARSE AFF LO || LEX PATH \},

\(^2\) Recall that languages that strictly disallowed [i/u...e/ɔ] were analyzed as having the ranking \{ALIGN L >> PARSE RTR ROOT >> ALIGN R\}: [rtr] was underparsed rather than failing to left align. I want to apply the same ranking logic to the low vowel sequences.

\(^3\) Different, note, from PARSE RTR RT which insisted that a root affiliated feature be parsed in the root.
To show in detail how this would work for a nominal form with an initial low vowel and input [rtr], I present the constraint interaction corresponding to (5-7) in tableau format in (5-8). The proposed PARSE LO elaboration and ranking selects the [rtr]-underparsing candidate #2 as optimal. The column for the affixal low parsing constraint is shaded to show its irrelevance to the scenario, since there are no affixal low vowels present in any of the candidate representations being evaluated.

(5-8) Babole: Output [a...e] from Input [A...E] with [rtr]

<table>
<thead>
<tr>
<th>[lo]</th>
<th>LICENSE</th>
<th>ALIGN SL</th>
<th>PARSE RT LO</th>
<th>PARSE RTR ROOT</th>
<th>ALIGN SR</th>
<th>PARSE AFF LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>[rtr]</td>
<td>A ... E</td>
<td>![ ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>![ ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>![ ]</td>
<td>![ ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>![ ]</td>
<td>![ ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>![ ]</td>
<td>![ ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is no ambiguity as to whether the initial [a] above is a root affiliated vowel. However, when we look at nominals with a stem final [a] in (5-9), the issue of whether the final low vowel is suffixal or not becomes crucial immediately. If the stem final vowel is taken to be root material then [low] may not be underparsed (the bracketed violation in candidate #4 in (5-9)). The correct output for the Babole-type pattern is in fact candidate #4.; for confirmation glance.
ahead to the table in (5-11). If it could be claimed that all stem-final low vowels in nominals were suffixal, then the problem would be solved. There is some evidence⁴ that this is the case, so I will assume that it is true for the moment. Note that this does render candidate #4 optimal in (5-9). The Babole nominal forms therefore parallel the behavior of Babole verbal forms reviewed in the last chapter: suffixal [low] vowels underparse under [rtr] harmony.⁵

(5-9) Babole: Output [ε...ε] from Input [E...A] with [rtr]

<table>
<thead>
<tr>
<th></th>
<th>[fr]</th>
<th>[lo]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E...A</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>3.</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>4.</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
</tbody>
</table>

This solution works but crucially depends on being able to claim that every nominal with a final -a is derived. To avoid the dilemma concerning the suffixal / root status of stem-final low vowels, another way of approaching the problem might be considered. I have been assuming

---

⁴ See (5-11) and the accompanying discussion concerning the status of final [a] in nominals in Nkundo, in particular Hulstaert 1961’s implication that final [a] is always suffixal.

⁵ The vowel-copy constraints are not shown for simplicity sake, but they would guarantee vowel copy exactly as in the verbal morphology cases in the last chapter.
that the crucial distinction for low vowels was morphologically based, as reflected in the formulation of \{PARSE RT LOW >> PARSE AFF LOW\}, but perhaps the crucial distinction is prosodic rather than morphological. The stem-initial position does have a special status in much of Bantu C and frequently is noted to be the site of primary stress/accent.\(^6\) This stem-initial prominence effect can be most easily discerned when the tones in a word are all low or all high. If the stem initial position is indeed a "strong" position, in the sense of Steriade 1995, then generic PARSE LO can be decomposed into PARSE STEM INITIAL LOW\(^7\) (PARSE \(^{ST-INIT}\) LO) and PARSE LO (see also Casali 1996 for a full implementation of "strong position" parsing). This analysis does not distinguish between ROOT and suffixal lows, but between stem-initial lows and all other lows.\(^8\) If this "strong position" parsing approach is adopted, the question of whether stem final vowels are suffixal or not disappears. I will henceforth adopt this approach since it does not rely on the unprovable root / non-root distinction.\(^9\)

To sum up briefly, I have been considering alternative constraint-ranked analyses to explain the gap *[a...e/o]* that exists in nominal forms in languages like Babole: (i) the

---

\(^6\) Languages where stem-initial stress/accent is documented include Bobangi (Whitehead 1899, p. 5), Londengese (Hulstaert and Goemaere 1984, p. 9), Ntomba (Mamet 1955, p. 11), Bola (Mamet 1960, p. 16). These authors are careful to distinguish this metrical prominence effect from the tonal system, which is distinct. I suspect that most of the Bantu C languages have stem-initial metrical prominence, but that in many descriptions the prominence effect is masked by tonal effects.

\(^7\) I assume that it is possible to derive the metrical prominence effect via left alignment of a prosodic foot (whether binary or unbounded) to the left edge of the stem, as elsewhere in the OT metrical literature (Prince and Smolensky 1993, McCarthy and Prince 1993b), but I will not pursue the formalization here. See Kenstowicz 1995 for a recent published OT metrical analysis which provides a excellent overview of the OT take on prosodic issues.

\(^8\) Something additional will need to be said concerning prefixal low vowels which never underparse. Because prefixal harmony relates to ALIGN WL and because word edge alignment is always dominated by stem edge alignment in Bantu C, the ranking \{PARSE LO >> ALIGN WL >> LEX PATH\} will guarantee that prefixal [low] will not underparse, even if general prefixal harmony is attested. Otherwise it may be a special property of inflectional affixes that is related to their syntactic status.

\(^9\) I ask the reader to note that the morphologically oriented solution works well enough if its undergirding assumption turns out to be correct. I am adopting the prosodic distinction because it is plausible and avoids the uncertainty of the morphological approach. In any event there may be an overlap between these two approaches in that the single root vowel in most deverbal nouns is also stem initial. Further data and research is required to provide a unequivocal answer. The prosodic approach correctly predicts that all non-initial low vowels will have the same behavior with respect to assimilation; either they all assimilate as in the Babole pattern, or they all fail to assimilate, as in the Nkundo pattern.
symmetrical low underparsing account, and (ii), the asymmetrical low underparsing account.

Comparative evidence may ultimately prove critical in deciding which analysis is correct. If it turns out that Babole stems sequences [e...e] and [ə...ə] are cognate to [a...e] and [a...ə] sequences, respectively, in other languages, it may favor the symmetrical low-underparsing story. On the other hand, if cognate sequences [a...e] and [a...ə] correspond to Babole [a...e] and [a...ə] respectively, the [rtr]-underparsing story would be favored. For the remainder of this chapter I will assume that, corresponding to the ranking \{ALIGN SL || PARSE ST-NIT LO >> PARSE RTR\}, \{low\} on the left edge of the stem is never underparsed. The variation in low vowel patterns in nouns can be strictly determined by ranking of PARSE LO with respect to ALIGN SRS and other constraints. I will now turn directly to an analysis of these other patterns.

5.1.3 Nkundo Nominals: [e...a] is OK / [a...e] is Bad

Consider in (5-10) Nkundo forms involving low vowels and compare them with the Babole forms in (5-2). The difference between the two languages is simply that Babole does not allow [e/o...a] sequences in nominals, while Nkundo does (the bolded forms below).

\footnote{I note that the ranking \{ALIGN SL >> PARSE RTR\}, if adopted for the whole of Bantu C, has radical consequences for the high-vowel analysis in Chapter 3. It implies that every language should have the restrictive pattern banning [i/u...e/ə]. This is fine for languages that do in fact have the restrictive pattern. But for languages that permit sequences like this, the retraction must be analyzed as not being of the underlying root-affiliated harmonic class. There is some evidence that this is in fact the case. For one thing, forms with [i/u...e/ə] sequences never constitute a robust class in any Bantu C. language unless the language has an independently existing productive [rtr] suffix. When a language does have a non-alternating [rtr] suffix, it is never harmony-inducing (Tetela, the primary example of this, is discussed in the next chapter). One may assume therefore that all [i/u...e/ə] sequences are specially marked lexically with non-harmonic, non-root [rtr] that is historically derived from a retracted suffix. In addition this corresponds to the proposal in Hulstaert 1961 (p. 19) where all such sequences in Nkundo are taken to be derived from a moribund historical retracted suffix. At stake is the question of how a learner handles a marginal class of forms. I assume that rather than abandoning the base ranking \{ALIGN SL >> PARSE RTR >> ALIGN SR\} for such forms, he analyzes them as involving a different [rtr] from the harmonic kind. Thus these forms as such then are not relevant for the ALIGN STEM constraints which seek to align only root-affiliated [rtr]. Reanalysis as root-affiliated [rtr] would be one possibility for the learner to process such marginal forms within the existing grammar.}
(5-10) Nkundo Nominal Forms Involving Low Vowels.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>i...a</td>
<td>bo-liá</td>
<td>n. 14</td>
<td>‘langouste’</td>
</tr>
<tr>
<td>b.</td>
<td>a...i</td>
<td>bo-sài</td>
<td>n. 14</td>
<td>‘doigt’</td>
</tr>
<tr>
<td>c.</td>
<td>e...a</td>
<td>mpèlã</td>
<td>n. 9</td>
<td>‘hautes eaux’</td>
</tr>
<tr>
<td>d.</td>
<td>e...a</td>
<td>bo-lekã</td>
<td>n. 14</td>
<td>‘nasse’</td>
</tr>
<tr>
<td>e.</td>
<td>a...e</td>
<td>e-sängé</td>
<td>n. 7</td>
<td>‘main de bananes’</td>
</tr>
<tr>
<td>f.</td>
<td>a...a</td>
<td>lo-kásá</td>
<td>n. 11</td>
<td>‘feuille’</td>
</tr>
<tr>
<td>g.</td>
<td>o...a</td>
<td>e-fôyá</td>
<td>n. 7</td>
<td>‘espace’</td>
</tr>
<tr>
<td>h.</td>
<td>ã...ã</td>
<td>li-kòngá</td>
<td>n. 5</td>
<td>‘lance’</td>
</tr>
<tr>
<td>i.</td>
<td>a...o</td>
<td>kàò</td>
<td>n.1</td>
<td>‘pan’</td>
</tr>
<tr>
<td>j.</td>
<td>u...a</td>
<td>li-úkã</td>
<td>n. 5</td>
<td>‘singe’</td>
</tr>
<tr>
<td>k.</td>
<td>a...u</td>
<td>i-àkú</td>
<td>n. 1?</td>
<td>‘échoppement’</td>
</tr>
</tbody>
</table>

In the last chapter evidence was presented that Nkundo and closely related languages retain suffixal low vowels with retracted verb roots. In addition, nouns derived from verbs by adding a suffixal -a showed the same behavior. The question now arises whether tautomorphemic [e/ə...a] sequences in nominal stems are also good in languages like Nkundo. The following examples are taken from Hulstaert’s Grammaire Lomongo Partie 1 (Phonologie). The table contrasts “Terrien” (land-dweller) dialects that have suffixal low retention (like Nkundo) with “Riverain” (river-dweller) dialects that have low-underparsing. Babole cognates provided wherever possible from my own field materials clearly indicate that Babole lines up with Hulstaert’s “riverain” Mongo dialects with respect to right-edge low vowel behavior.

(5-11) Nkundo Nominals with [e/ə...a]

<table>
<thead>
<tr>
<th>Nkundo</th>
<th>Gloss</th>
<th>var.</th>
<th>Riverains</th>
<th>Lang.</th>
<th>Page</th>
<th>Babole</th>
</tr>
</thead>
<tbody>
<tr>
<td>ba-feka</td>
<td>cl. 6</td>
<td>‘dos’</td>
<td>ba-feke</td>
<td>Elinga</td>
<td>p. 20</td>
<td>mo-lékè</td>
</tr>
<tr>
<td>bo-leka</td>
<td>cl. 14</td>
<td>‘nasse’</td>
<td>bo-leke</td>
<td>Elinga</td>
<td>p. 21</td>
<td>mo-lékè</td>
</tr>
<tr>
<td>bo-nkéna</td>
<td>cl. 14</td>
<td>‘sp. arbre’</td>
<td>bo-nkéne</td>
<td>Elinga</td>
<td>p. 21</td>
<td></td>
</tr>
<tr>
<td>Bo-téka</td>
<td>cl. 14</td>
<td>‘Flandria’</td>
<td>Bo-téke</td>
<td>Elinga</td>
<td>p. 21</td>
<td></td>
</tr>
<tr>
<td>bônga</td>
<td>cl. ?</td>
<td>‘piste’</td>
<td>bôngo</td>
<td>Nkundo</td>
<td>p. 21</td>
<td></td>
</tr>
<tr>
<td>bòkoka</td>
<td>cl. 14</td>
<td>‘arbre couché’</td>
<td>bòkòko</td>
<td>Nkundo</td>
<td>p. 21</td>
<td>e-kòkòs</td>
</tr>
<tr>
<td>bòsá</td>
<td>cl. ?</td>
<td>‘poil’</td>
<td>bòsò</td>
<td>Nkundo</td>
<td>p. 21</td>
<td></td>
</tr>
<tr>
<td>li-kòngá</td>
<td>cl. 5</td>
<td>‘lance’</td>
<td>li-kòngò</td>
<td>Nkundo</td>
<td>p. 21</td>
<td>di-kòngò</td>
</tr>
<tr>
<td>li-tòná</td>
<td>cl. 5</td>
<td>‘tâche’</td>
<td></td>
<td>Nkundo</td>
<td>p. 90</td>
<td></td>
</tr>
</tbody>
</table>
Are these nominals derived or non-derived? Clear evidence is hard to find. The Babole cognates, for example, are not derived from a verb root that I can independently identify, but this itself is not proof that the nominals were not historically derived. Hulstaert’s own description of the phenomena for Nkundo is as follows:

"La terminaison dérivative -a et les desinences verbales -a, -aka, et -ake sont pareillement -e, et -ekte chez ces riverains" (page 20)

and again:

"La terminaison -a, et les désinences verbales -a et -aka se disent pareillement -o, respectivement -oko ..." (page 21).

This is essentially a description of the difference between the Nkundo, his primary language of study (my “low-retention” type) and various other Mongo languages/dialects where there is suffixal low vowel assimilation (following the Babole pattern). However, the precise wording, “terminaison dérivative -a” with respect to the nominal forms in (5-11) suggests that he considers the nominals with final [a] to all be derived. If this is the case and, for some reason, there are no underived nominals of the form [e/ο…a], then the PARSE RT LO / PARSE AFF LO distinction would be sufficient to get the difference between Nkundo and Babole nominals. In fact the parallel between nominal and verbal forms is then perfect and the explanation for verbs covers the nouns automatically. However I think Hulstaert’s implied claim (that all nominals with final [a] are heteromorphemic) is too strong, and at any rate there is no way of verifying it. The fact that Babole and Nkundo (and all Bantu C languages, I will argue) do not underparse a stem-initial low can be handled by the shared ranking \{LICENSE >> ALIGN SL || PARSE$^{ST-IN}$ LO >> PARSE RTR RT ...\}. The difference in nominal forms is handled exactly as in the difference in verbal
forms from the previous chapter. These rankings for Babole and Nkundo are provided in (5-12).

The only difference between the grammars is how final low vowels are handled.

(5-12) Babole and Nkundo Ranking Differences

**Babole Type Ranking** : underparse non-initial [low] under harmony
{ LICENSE >> ALIGN SL || PARSE ST-IN LO >> PARSE RTR RT >> ALIGN SR >> PARSE LO || LEX PATH}

**Nkundo Type Ranking** : retain [low] everywhere under harmony
{ LICENSE >> ALIGN SL || PARSE ST-IN LO >> PARSE RTR RT >> PARSE LO >> ALIGN SR || LEX PATH}

In the tableau in (5-13), the optimal candidate is the one that accepts an ALIGN SR violation but satisfies the highly ranked PARSE RTR ROOT, as well as PARSE LO and LICENSE. This of course needs to be juxtaposed with the Babole ranking where generic PARSE LO is demoted one step, rendering it a less expensive violation than ALIGN SR. Since the low vowel is non-initial, it is not evaluated by the higher ranked positional parse constraint.

\[11\] For Nkundo type languages, one could also say that there is a single generic PARSE LO constraint and that it dominates PARSE RTR ROOT. Only the low-underparsing languages like Babole require the PARSE LO elaboration.
The tableau in (5-14) confirms that the analysis also works for the low-initial pattern for Nkundo.
Under this analysis, gaps of the type *[i...e] in a language like Likuba now have to have the same analysis as gaps of the type *[a...e]; [rtr] is underparsed under a consistent ALIGN SL dominance asymmetry. This necessity is clearly seen in a language like Babole that strictly disallows *[a...e], but allows some *[i/u...e]. Once the analysis with [rtr]-underparsing for *[a...e] is accepted (involving the ranking {ALIGN SL >> PARSE RTR}), we can no longer say that *[i/u...e] involves the contradictory ranking {PARSE RTR >> ALIGN SL} in the same language. We are forced to find another explanation for the existence of a class of marginal *[i/u...e] forms in the languages where they are allowed. I suggest, as noted earlier, that these forms involve the vestigial traces of a historical system where there were retracted verbal suffixes.
This raises an interesting point immediately. If we find vestigial \([i/u\ldots o/e]\), and \([a\ldots o/e]\), as we will see shortly, then why not \([o/e\ldots o/e]\) as well? We will see in fact that Tetela, which retains retracted suffixes\(^{12}\), has all these. Languages from the C-50 cluster, which will be examined shortly have \([i/u\ldots o/e]\) and \([a\ldots o/e]\), but not \([o/e\ldots o/e]\). Languages like Babole have vestigial \([i/u\ldots o/e]\) but not \([o/e\ldots o/e]\) or \([a\ldots o/e]\). Finally languages like Likuba and Bobangi have none of the marked sequences at all. Once a language lost its productive retracted verbal suffixes, I hypothesize that they were retained in nominals, where the sequences had been lexicalized. A clear markedness hierarchy can be seen in the above data corresponding to which of these nominals vowel sequences eliminated the vestigial retraction first.

\[\text{(5-15) Markedness Hierarchy for Suffixal [rtr] Elimination in Nouns.}\]

<table>
<thead>
<tr>
<th>Vowel Sequence</th>
<th>Markedness</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>([o/e\ldots o/e])</td>
<td>WORST</td>
<td>Tetela</td>
</tr>
<tr>
<td>([a\ldots o/e])</td>
<td>PRETTY BAD</td>
<td>Likile, Lokele</td>
</tr>
<tr>
<td>([i/u\ldots o/e])</td>
<td>NOT SO BAD</td>
<td>Babole, Nkundo</td>
</tr>
<tr>
<td>None of the above</td>
<td>BEST</td>
<td>Likuba, Bobangi</td>
</tr>
</tbody>
</table>

If a language allows an option higher on the “badness” scale it allows everything below. The “worst” forms are those with elements that are perceptually and phonetically “closer”. The most tolerated sequences are the \([i/u\ldots o/e]\) ones; these have the greatest phonetic and perceptual separation. I do not think that this kind of regularity needs to be handled by the constraint grammar but belongs to a subtheory of marginal forms. The constraint grammar does not in fact exclude these marginal marked forms. Rather they are stored by learners as exceptionally marked, and perhaps it is this markedness that results in their differential elimination over time.

\(^{12}\) Kikuyu, a 7-vowel Bantu language of Kenya also shows non-alternating retracted Final Vowel suffixes (Peng 1992).
To summarize the discussion to this point, in (5-16) I provide the constraint grammar fragment that corresponds to each of the language types considered so far. Note that (5-16) (iv) is a possible grammar, but one not yet encountered: it combines the low-retention quality of Nkundo with the “strict” high vowel pattern of Likuba.

(5-16) Grammar Fragments for Nominal Stem Distributional Gaps

(i) **Babole**: Parse hi||license» align sl >> Parse INT lo >> Parse rtr rt || align sr >> Parse lo

*{e...a}, {a...e} [e...i/u], */i/u...e]
*{e...a}, {a...e} [e...i/u], */i/u...e]

(ii) **Likuba**: Parse hi||license» align sl >> Parse INT lo >> Parse rtr rt || align sr >> Parse lo

*{e...a}, {a...e} [e...i/u], */i/u...e]
*{e...a}, {a...e} [e...i/u], */i/u...e]

The difference between Babole and Likuba is that Babole continues to allow a number of the marginal */i/u...e] and */i/u...e] sequences that have specially marked non-harmonic retraction while Likuba has eliminated all such.

(iii) **Nkundo**: Parse hi||license» align sl >> Parse INT lo >> Parse rtr rt >> Parse lo>> align sr

[{e...a}, {a...e} [{e...i/u}, */i/u...e] [{e...i/u}, */i/u...e] [{e...i/u}, */i/u...e]

Nkundo allows a small number of the marginal high vowel forms like Babole, but resolutely disallows low-underparsing to accomplish harmony.

(iv) **Lwankamba**: Parse hi||license» align sl >> Parse INT lo >> Parse rtr rt >> Parse lo>> align sr

[{e...a}, {a...e} [{e...i/u}, */i/u...e] [{e...i/u}, */i/u...e] [{e...i/u}, */i/u...e]

\[13\] I am using the “%” sign to indicate that the sequences are attested but marginal. The “*” starred forms are strictly impossible as in standard usage.
Lwankamba is exactly like Nkundo except that it has eliminated the marginal class of high vowel forms. I will now present data from the languages classified by Guthrie as C-50; these illustrate a group of languages where a class of [a...e/ɔ] forms are retained.

5.1.4 C-50 Languages: Nominals Where [a...e/ɔ] Are Good

So far, in all the languages I have considered, sequences like *[a...e/ɔ] have been strictly unattested. However, just as some languages allow a marginal class of *[^i/u...e/ɔ] forms, this subset of Bantu C languages allow a class of *[a...e/ɔ] forms, presumed to be the vestigial remains of a historical system where there were non-alternating retracted suffixes. The C-50 group of languages are found in the north and west of the Bantu zone C. In these languages we find nominals roots with both [a...e/ɔ] and [a...e/ɔ] sequences. The languages\(^{14}\) include Likile (Carrington 1977), Lokele (Carrington 1972a, b), Olombo (Carrington 1947), Mombesa (DeBoeck 1951), and Gesogo/Topoke (Harries 1955, Stoop 1989). Some of the languages (Likile, Olombo, Mombesa, and Gesogo/Poke\(^{15}\)) have the Nkundo-like property of retention of suffixal low vowels. Others, such as Lokele show suffixal underparsing of [low] after the Babole pattern. In the following subsection, I present the data from these languages to establish the generalizations and follow up with an analysis.

---

\(^{14}\) The studies from which these data are drawn are all short articles with small lexicons. Although the data from any one language is limited, the overall impression when viewed together is quite convincing.

\(^{15}\) Harries 1955 has Gesogo with no prefixal harmony. Stoop 1989 has Gesogo with prefixal harmony. It could be a matter of different dialects or the same dialect with a diachronic shift in the intervening 30 years. In neither case is the data ambiguous. The other languages all have some degree of prefixal harmony.
5.1.4.1 C-50 Languages: General Properties

I provide data below from Mombesa, Likile and Olombo to show some general properties of the C-50 group of languages. C-50 is a “mixed” group in terms of the basic typology proposed in this thesis for Bantu C. Some of the languages lack prefixal harmony and others have it. Some assimilate suffixal low vowels and some retain them. Some of the C-50 languages harmonize subjunctive final vowel -e and some don’t.

(5-17) Mombesa Prefixal Harmony (DeBoeck 1951)

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>NC</th>
<th>Dutch</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo-teto</td>
<td>n'teto</td>
<td>11</td>
<td>'lichaam'</td>
<td>'body'</td>
</tr>
<tr>
<td>mo-kongo</td>
<td>3</td>
<td></td>
<td>'rug'</td>
<td>'back'</td>
</tr>
<tr>
<td>mo-héhé</td>
<td>3</td>
<td></td>
<td>'strot'</td>
<td>'throat'</td>
</tr>
<tr>
<td>mo-sifé</td>
<td>3</td>
<td></td>
<td>'spier'</td>
<td>'stalk, shoot, blade'</td>
</tr>
</tbody>
</table>

The verb root [-foʃ]- in (5-18) is not assimilating the suffixal -a.

(5-18) Mombesa Suffixal [a] Retention

nɔli .... é-ka-[foʃ]-a  ‘die vogel ...is rot’  ‘the bird ... is decaying’

There is insufficient data in De Boeck 1951 to establish harmonic properties of subjunctive final -e. Likile shows clear prefixal harmony, (5-19), and suffixal low retention, (5-20).

(5-19) Likile Prefixal Harmony (Carrington 1977)

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>French</th>
</tr>
</thead>
<tbody>
<tr>
<td>i-kulu</td>
<td>to-kulu</td>
<td>'?/12  'corde'</td>
</tr>
<tr>
<td>i-tokô</td>
<td>to-tokô</td>
<td>'?/12  'natte'</td>
</tr>
<tr>
<td>lo-sifé</td>
<td>n-sifé</td>
<td>11/10 'tisserin'</td>
</tr>
</tbody>
</table>

16 Recall that the basic North Block / South Block split involves a characterization of North Block languages (Babole is an example) as lacking prefixal harmony and having low vowel assimilation. The South Block languages (Nkundo is an example) have prefixal harmony but retain suffixal low vowels. The C-50 languages are mixed in terms of this typology. This is not surprising since it is geographically between the two blocks. The reader is reminded that the C-10, C-20, etc. classification system is only a rough grouping of languages that awaits confirmation through further research.
(5.20) Likile Suffixal -a Retention

e-[kend-a]  ‘il voyage’
ba-[kend-ak-indéé]  ‘ils voyagaient’

In the two Likile subjunctive examples below it is clear that final subjunctive -e is harmonizing.

(5.21) Likile Subjunctive Final -e

bá-fót-e  ‘qu'ils extraien...’  text p. 81
á-ten-e  ‘qu'il coupe...’  text p. 81

5.1.4.2 Low Vowel Nominal Patterns

In the data provided for each of the four languages below, we see that in addition to [e...a] we find also [a...e]; in addition to [ɔ...a] we find also [a...ɔ]. It must be underlined how anomalous these [a...e]/[a...ɔ] sequences are in the perspective of the other Bantu C languages considered to this point. Not a single case has been seen.

5.1.4.2.1 Mombesa C-50 (De Boeck 1951)

The limited data from Mombesa in (5-22) and (5-23) shows that both [a...e], [a...o] and [a...e], [a...ɔ] are possible.

(5-22) Mombesa [a...e], [a...ɔ]

lo-láme  ndáme  ‘tong’  ‘tongue’  [a...e]
nkango  ‘palmnootvlees’  ‘palm nut’  [a...ɔ]

(5-23) Mombesa [a...e], [a...o]

lo-fáté  fáté  ‘mais’  ‘corn’  [a...e]
ye-táhe  bi-táhe  ‘tak’  ‘branch’  [a...e]
mo-kaló  me-kaló  ‘pad’  ‘path’  [a...o]
li-mbando  ba-mbando  ‘hagedis’  ‘lizard’  [a...ɔ]
Likile C-50 (Carrington 1977)

Likile and the other C-50 languages have a vowel harmony system that is highly similar to the other Bantu C languages seen so far. Carrington notes the (idiosyncratic) relationship between initial low vowels and retraction, commenting that sometimes initial low vowels are followed by retracted vowels, and sometimes not.

Carrington 1977 says:


This would be striking because several of the forms in Likile are common lexical roots across Bantu C. This can be seen in the Babole-Likile correspondences in (5-24). Some Babole forms have an advanced vowel to the right of an initial low vowel where Likile has a retracted vowel.

(5-24) Babole - Likile Correspondences

<table>
<thead>
<tr>
<th>Babole</th>
<th>gloss</th>
<th>Likile</th>
</tr>
</thead>
<tbody>
<tr>
<td>-sáto</td>
<td>'three'</td>
<td>-sáto</td>
</tr>
<tr>
<td>-táno</td>
<td>'five'</td>
<td>-taáno</td>
</tr>
<tr>
<td>bwáto</td>
<td>'pirogue'</td>
<td>bwáto</td>
</tr>
<tr>
<td>di-ale</td>
<td>'foie'</td>
<td>li-fale</td>
</tr>
</tbody>
</table>

A complete list of the [a...e] [a...o] forms in Carrington 1977 are given in (5-25).

(5-25) Likile Forms with [a...e] [a...o]

<table>
<thead>
<tr>
<th>likile</th>
<th>gloss</th>
<th>[a...e]</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo-lame</td>
<td>'langue'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>li-fale</td>
<td>ma-fale</td>
<td>'foie' [a...e]</td>
</tr>
<tr>
<td>bwáto</td>
<td>máto</td>
<td>'pirogue' [a...o]</td>
</tr>
<tr>
<td>ngando</td>
<td>'hutte'</td>
<td>[a...o]</td>
</tr>
</tbody>
</table>

17 The Babole cognate for this form is [nganda]. So not all the cognates show the final o/o correspondence.
On the other hand, Likile also has forms, (5-26), with sequences [a...e], [a...o], showing that the low vowel is not simply conditioning obligatory retraction to the right (via the influence of a highly ranked LO/RTR).

(5-26) Likile Forms with [a...e] [a...o]

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
<th>Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>mo-káke</td>
<td>'foudre'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>má-nale</td>
<td>'frère de l'épouse'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>li-kalo</td>
<td>'main'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>mbángó</td>
<td>'vitesse'</td>
<td>[a...o]</td>
</tr>
</tbody>
</table>

Moreover, I will maintain that there is no conditioning environment for the differences between the forms in (5-25) and (5-26); the difference will be attributed to the presence of a moribund historical retracted suffix for the retracted forms\(^\text{19}\).  

5.1.4.2.3 **Olombo C-50 Carrington 1947**

The data for Olombo from *Carrington 1947* shows the same basic pattern as Likile.

(5-27) Olombo Mid-Low Vowel Forms

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
<th>Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>bo-tae</td>
<td>'branche'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>bo-tema</td>
<td>'coeur'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>lo-lame</td>
<td>'langue'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>li-tale</td>
<td>'pierre'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>li-ambe</td>
<td>'six'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>bo-enda</td>
<td>'visiteur'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>nangó</td>
<td>'mère'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>lo-konda</td>
<td>'fôret'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>wáto</td>
<td>'pirogue'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>-sáso</td>
<td>'trois'</td>
<td>[a...o]</td>
</tr>
</tbody>
</table>

\(^{18}\) The Babole cognate for this form is [mbángó].

\(^{19}\) Again, the alternative to the "marginal-class" analysis is one that relies on reranking of the ALIGN STEM constraints.
Forms like bo-kota, 'chef' and bo-enda, 'visiteur', clearly show that there is low-retention on the right edge of stems, just as with Nkundo.

5.1.4.2.4 **Lokele C-50 (Carrington 1942)**

Finally, the data from Lokele shows the same nominal patterns as Mombesa, Likile and Olombo.

<table>
<thead>
<tr>
<th>Term</th>
<th>Origin</th>
<th>Type</th>
<th>Meaning</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>lyásásé</td>
<td>básásé</td>
<td>5/6</td>
<td>'yawn'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>bo-ándá</td>
<td>be-ándá</td>
<td>5/6</td>
<td>'fish snout'</td>
<td>[e...a]</td>
</tr>
<tr>
<td>lo-láme</td>
<td>ndáme</td>
<td>11/10</td>
<td>'tongue'</td>
<td>[a...e]</td>
</tr>
<tr>
<td>lw-enja</td>
<td>fenja</td>
<td>11/10</td>
<td>'palm-frond strip'</td>
<td>[e...a]</td>
</tr>
<tr>
<td>sy-áko</td>
<td>tw-áko</td>
<td>19/12</td>
<td>'water beetle'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>b-ósá</td>
<td>by-ósá</td>
<td>3/4</td>
<td>'fire'</td>
<td>[o...a]</td>
</tr>
<tr>
<td>li-álo</td>
<td>ba-álo</td>
<td>5/6</td>
<td>'blister'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>w-áto</td>
<td>by-áto</td>
<td>3/4</td>
<td>'pirogue'</td>
<td>[a...o]</td>
</tr>
<tr>
<td>lwásó</td>
<td>njásó</td>
<td>11/10</td>
<td>'palaver'</td>
<td>[a...o] der. -ásol-</td>
</tr>
<tr>
<td>lwambo</td>
<td>fambo</td>
<td>11/10</td>
<td>'petit ver'</td>
<td>[a...o] Bab. e-pambo</td>
</tr>
<tr>
<td>b-ówá</td>
<td>by-ówa</td>
<td>3/4</td>
<td>'fear'</td>
<td>[o...a]</td>
</tr>
</tbody>
</table>

5.1.4.3 **Analysis of C-50 Low Vowel Nominal Patterns**

One reaction to these data might be to suppose that the grounding constraint LO/RTR is playing a role, but in a highly conditioned environment. These data are reminiscent of Yoruba where

---

20 Relevant nominal data in *Harries 1955* Gesogo, is scant. I did find:

bw-átó | be-átó | 3/4  | 'pirogue'        | [a...o] |

This is parallel to the other C-50 languages. Instead of the [a...e] sequence in the C-50 common form lo-láme, 'tongue', we find in Gesogo, lo-gámi. In addition, the common C-50 numerals -sásó, 'three', and -tánó 'five' are respectively -sásó and -tánó in Gesogo. Additional data would be required to unambiguously determine the status of Gesogo with respect to this variation feature. For the moment I will assume that Gesogo does share the C-50 [a...e] pattern (with the exception of prefixal harmony, which the *Harries 1955* data definitely lacks).
retraction of a mid vowel to the left of a low vowel is obligatory (i.e. *[e...a]); However for C-50, note that besides [a...e] and [a...o], we also find [a...e], and [a...o]. Neither is there an obvious conditioning environment for a “final-lowering” or “final retraction” rule somehow tied to the presence of low vowel in stem-initial position. For example, if all the [a...e/o] sequences had the tonal melody H-L or L-L while all the [a...e/o] sequences had either H-H or L-H, we could say that LO/RTTR was having an effect but only when the right edge was prosodically weak (not having a high tone). I invoke this particular alternative because there are a majority of forms that obey the generalization and it would be the best candidate for a conditioning environment approach. However, the data in (5-28) shows that in fact this cannot be correct; both [a...o] and [a...o] exist with H-L melody.

(5-28) H-L Melody Forms with and without Final Retraction.

<table>
<thead>
<tr>
<th>Lokele</th>
<th>Sy-ako</th>
<th>Tw-ako</th>
<th>19/12</th>
<th>'water beetle' [a...o]</th>
<th>H-L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Li-ako</td>
<td>Ba-ako</td>
<td>5/6</td>
<td>'blist' [a...e]</td>
<td>H-L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Olombo</th>
<th>Bo-tae</th>
<th>Be-tae</th>
<th>3/4</th>
<th>'branche' [a...e]</th>
<th>H-L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lo-lame</td>
<td>Ndame</td>
<td>11/10</td>
<td>'langue' [a...e]</td>
<td>H-L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Likile</th>
<th>Mbango</th>
<th>Mata</th>
<th>3/4</th>
<th>'vitesse' [a...o]</th>
<th>H-L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bwato</td>
<td>Mafo</td>
<td></td>
<td>'pirogue' [a...o]</td>
<td>H-L</td>
</tr>
</tbody>
</table>

Having established that the C-50 [a...e/ε] patterns in stems are not due to the retraction inducing presence of a low vowel, it might be prudent to consider another way of deriving these forms, especially since the analysis based on a vestigial retracted suffix cannot be established uncontroversially. Assume for argument’s sake that a learner hypothesizes that forms like [a...ε] are due to the presence of underlying harmonic [rtr]. The ranking proposal developed
to this point will mean that [rtr] is underparsed, rather than violate ALIGN SL. But what could prevent the learner from concluding that the [rtr] is harmonic but simply not left-aligned? Note that this would be a dramatic departure from my current analysis of the rest of Bantu C where I maintain that ALIGN SL is never violated. The ranking \{...PARSE RTR RT \parallel PARSE^{ST-INiT} LO \gg ALIGN SL...\} also allows the array of low vowel forms seen in the C-50 languages to be generated. An input form [A...E/O] with [rtr] will have as an output the misaligned [a...e/o]. If an underlying form has [A...E/O] without [rtr], then [a...e/o] will result. First consider the tableau in (5-29) with an input [E...A] sequence and [rtr].

*(5-29) Mid-Lo Pattern in C-50 ([e...a] Output: Retain Final [a]):*

<table>
<thead>
<tr>
<th></th>
<th>[lo]</th>
<th>LICENSE</th>
<th>PARSE RTR</th>
<th>PARSE ST-INiT LO</th>
<th>ALIGN SL</th>
<th>PARSE LO</th>
<th>ALIGN SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>[lo]</td>
<td>E...A</td>
<td>[rtr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that this depicts a low-retention case, and is identical in this respect to Nkundo. The best candidate, #4 in (5-29) is one where the final low is retained and an ALIGN SR violation is
accepted. Parallel to this is the case shown in the tableau in (5-30). Here an [A...E] input with [rtr] is pictured. Under the proposed ranking revision, however, ALIGN SL is violated in the best candidate, #3.

(5-30) Lo-Mid Patterns in C-50 ([a...e] Output: Retain Initial [a])

<table>
<thead>
<tr>
<th></th>
<th>[lo]</th>
<th>LICENSE</th>
<th>PARSE \text{init} \text{LO}</th>
<th>PARSE \text{RTR} Root</th>
<th>ALIGN SL</th>
<th>PARSE LO</th>
<th>ALIGN SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>[lo]</td>
<td>A ... E</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The best candidate is #3, where an ALIGN SL violation is accepted. Note that even if a language had the low assimilation pattern (as indeed some C-50 languages do), then simply demoting generic PARSE LO below ALIGN SR would give final low underparsing without perturbing the rest of the analysis. So an analysis of the [a...o/e] pattern in C-50 languages is possible along these lines (both for the low-underparsing ones like Lokele and the low-retaining ones like Likile) even if the moribund historical retracted suffixal story turns out to be untenable. Overall though, the analysis that attributes a marginal status to forms like [i/u...e/ɔ] and [a....e/ɔ] is to be preferred. That is, deriving them via the phonological grammar predicts that they should
have a fairly robust presence in a language where they exist. This is contrary to fact however. In many Bantu C languages they are not found at all and when they are found, they appear not to be robustly distributed. This marginality seems to fit better with the hypothesis that such forms are marked, having a non-root [rtr] specification historically related to a productive retracted suffix. Languages like Babole and Nkundo that disallow [a...ə/e] entirely are only consistent with the ranking (5-31): [rtr] must be left-aligned. Languages like those in C-50 where [a...ə/e] is attested might be analyzed as having either ranking (5-31) or (5-32).

(5-31) Ranking for Non-Harmonic [rtr] Suffix Interpretation
{... ALIGN SL >> PARSE\textsuperscript{INT} LO >> PARSE RTR ROOT...}

(5-32) Ranking for Random Harmonic [rtr] Interpretation
{... PARSE\textsuperscript{INT} LO || PARSE RTR ROOT >> ALIGN SL ...}

Perhaps the misalignment analysis, (5-32) would be adopted first since it does not depend on the larger corpus required to establish statistical non-robustness. Whether (5-31) is eventually adopted or not might depend on the degree of robustness of [a...ə/e] forms and perhaps other factors pointing to a dominant ALIGN SL.

5.1.4.4 Summary

In this chapter, a consideration of low vowel / retracted vowel sequences has led to a rather different picture of the [i/u...e/ə] type sequences analyzed in Chapter 3. The overall marginality of both types of sequences suggests that the retraction in these sequences may not be of the harmonic type at all. A more coherent overall analysis of the Bantu C alignment system is then possible, an analysis which gives ALIGN SL its proper due. The evident left-
dominant properties of Bantu C stems in vowel harmony is then derivable transparently from the fixed ranking \{ALIGN SL >> PARSE RTR >> ALIGN SR\}. The parallel revision concerning stem-initial low vowels clarifies the metrical properties of the left stem edge; this metrical prominence effect was obscured and could not be directly correlated with ALIGN SL dominance in the early analysis where [low] was underparsed stem-initially, and left-alignment of [low] was sacrificed to allow [rtr] to be retained. The metrical prominence of the left-stem edge in Bantu C is well established by the stress / accent observations reported in the research cited; a consistent ALIGN SL dominant analysis of vowel harmony opens the way to clarifying the formal connection between metrical prominence and the special relationship between features like [rtr] and tone and the stem initial position. This theme will be taken up again and amplified in the last chapter. The final indeterminacy between two plausible analyses reflects perhaps what the learner himself experiences in analyzing a marginal class of forms; reorganizing the grammar is always a possibility, but then again so is simply noting that the forms are marked and treating them as lexically marked exceptions. This question, especially as it relates to Bantu C vowel harmony, will be an interesting direction for future research along these lines.
6. Coalescence and Non-Harmonic Retraction

Across the Bantu Zone C there are several languages where one finds “retracted” segments ([e] or [o]) that are not of the root/underlying type but rather arise from coalescence or merger of vowels in hiatus either (i) at morpheme boundaries or (ii) through consonant elision elsewhere (in particular elision of the ‘weak’ consonant [l]).

The coalescence that is of interest is of the type shown in (6-1).

(6-1) Retracted Vowels through Coalescence

\[
\begin{align*}
[a + o] & \rightarrow [oo] / [ɔ] \\
[a + e] & \rightarrow [ee] / [e]
\end{align*}
\]

I will first exemplify with coalescence data from three languages, showing the range of environments where vowel feature sharing (coalescence) occurs. In addition I will present a sketch of the harmony system of Tetela C-70 (Jacobs 1964), where there are non-alternating retracted suffixes. Although both (i), derived and (ii) underlying suffixal “retraction” are found in these languages, it is never of the harmonic sort; only the morpheme level [rtr] affiliated with roots is harmonic. I will present an analysis of how “retracted” segments arise through coalescence in these languages and conclude that it is necessary to segregate coalescence and harmony in distinct phonological components.

The constraints determining basic vowel harmony are in a word-formation or “lexical” component while the constraint interaction relevant to retraction-producing coalescence is in a “post-lexical” component. To some degree these notions correspond to the familiar labels “lexical” and “post-lexical”; this will be clarified as I develop the chapter.

---

1 The preservation / non-preservation of input timing units is taken to be due to factors independent of coalescence.
6.1 Case Studies of Coalescent Retraction

In this section, I consider three languages where assimilation involving a low and mid or high vowel under hiatus results in [ε] or [ɔ]. Although this derived retraction arises in a variety of morphological and phonological contexts, it is never harmonic.

6.1.1 Bolia

The harmony system of Bolia C-30 (Mamet 1960) was sketched in Chapter 2. It is a language, recall, which does not harmonize word level affixes at all (prefixes or the final vowel -e), but where all low vowel suffixes lose lowness and assimilate to the front /round (COLOR) value of the preceding vowel. In (6-2), we see Class 2 nominals having the prefix -ba and a stem-initial high vowel. There is an assimilatory process involving the adjacent high and low vowels in hiatus such that the initial low vowel becomes [ε], presumably involving the regressive transfer of frontness (or height) onto the low vowel.

(6-2) Regressive Frontness Assimilation, Mamet 1960 p. 15

/ba-ibi/  --->  [be-ibi]  'des voleurs'
/ba-inami/  --->  [be-inami]  'les miens'
/ba-ino/  --->  [be-ino]  'des dents'

Mamet points out that what would be [a-iko], 'alors' in the neighboring language Ntomba (Mamet 1955), becomes, in Bolia, [ε-iko], or even [e-eko], dialectically. In addition to this assimilation process involving high and low vowels, the examples in (6-3) show a similar process of feature merger between a low vowel prefix and an [ε]- or [o]-initial verb root. In particular note that the verbs in question are "advanced" roots;

\[\text{\footnotesize 2 Ntomba completely lacks vowel coalescence or other assimilatory processes under hiatus.}\]
they do not have an underlying retraction feature cross-linguistically and do not provoke harmony in suffixes. In both (6-2) and (6-3) the assimilation / coalescence is happening across a prefix-stem boundary.

(6-3) Coalescence in Verbal Morphology

\[ [a] + [e] \rightarrow [ee] \]

\[ /ntá-émalá pô/ \rightarrow [ntéémalá pô] \quad \text{'il ne s'arrête pas'} \]
\[ /á-éb-a/ \rightarrow [ééba] \quad \text{'il connait'} \]

\[ [a] + [o] \rightarrow [oo] \]

\[ /ń-ka-ok-a/ \rightarrow [ńkośka] \quad \text{'il sait'} \]

The data in (6-4) from the present indicative shows that when the verb root is retracted, as in the case of -en\(^*-\) , 'see', the low vowel suffix has assimilated to the root vowel, the familiar low-assimilation pattern of the "Northern Block". On the other hand, while a typically advanced root like -eb- , 'know', can "look" retracted because of coalescence, it never provokes harmony of the final vowel, creating the crucial contrast between [ééba] from underlying /a-éb-a/ , 'il connaît ...' and [ééne], from underlying /a-én-a/ 'il voit ...'.

(6-4) Final Low Vowel Harmony (assimilation) and Coalescence don't Interact

Present Indicative
- kel-a 'faire'
- két-e 'tailler'
- éb-a 'connaître'
- én-e 'voir'

(I) NO UNDERLYING RETRACTION, NO SUFFIXAL HARMONY:
\[ /á-kel-a/ \quad [ákela] \quad \text{'il fait ...'} \]

(II) UNDERLYING RETRACTION, SUFFIXAL HARMONY:
\[ /-két-a/ \quad [kéte] \quad \text{'tailler ...'} \]

\(^3\) The verbal root for 'see' is commonly -én-, across the Bantu C zone. It is always a harmonic root.
Bolia has this kind of derived “retraction” only in vowel hiatus contexts in the prefix-stem environment noted above. I will now present languages where non-harmonic retraction arises through the loss of the consonant [l] (a lateral approximant).

### 6.1.2 Nkengo

First of all, the data in (6-5) confirm that prefixes in Nkengo (*Hulstaert 1970*) do harmonize if there is underlying retraction in the nominal stem; this is the familiar prefixal harmony pattern documented in Chapter 2.

#### (6-5) Nkengo Prefixal Harmony

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Advanced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bo-sai</td>
<td>be-sai</td>
<td>3/4</td>
<td>‘doigt’</td>
</tr>
<tr>
<td>bo-lwe</td>
<td>be-lwe</td>
<td>3/4</td>
<td>‘racine’</td>
</tr>
<tr>
<td>bo-lungu</td>
<td>be-lungu</td>
<td>3/4</td>
<td>‘bouche’</td>
</tr>
<tr>
<td>bo-tá</td>
<td>be-tá</td>
<td>3/4</td>
<td>‘doigt’</td>
</tr>
<tr>
<td>lo-foso</td>
<td>m-poso</td>
<td>11/10</td>
<td>‘peau’</td>
</tr>
<tr>
<td>b. Retracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bo-tó</td>
<td>be-tó</td>
<td>3/4</td>
<td>‘chenille’</td>
</tr>
<tr>
<td>bo-kongo</td>
<td>be-kongo</td>
<td>3/4</td>
<td>‘dos’</td>
</tr>
<tr>
<td>lo-sofó</td>
<td>ns sofó</td>
<td>11/10</td>
<td>‘boyau’</td>
</tr>
</tbody>
</table>
The result of loss of the consonant [l] can be seen clearly by comparing Nkengo (Hulstaert 1970) with Nkundo (Hulstaert 1963) in (6-6). Where Nkundo has retained [l] between [a] and [e/o], Nkengo has lost it, resulting in hiatus and coalescence, but maintaining the two original vocalic timing units. It is particularly clear in many of the forms in (6-6) that the coalescence-produced retraction is not harmonic, since the prefixes in (i), (ii) and (iv) are not harmonizing. They should though, since ordinarily prefixes harmonize if there is retraction in the stem (review the data in (6-5b) above for the crucial contrast).

(6-6) [l]-Loss in Nkengo Leads to Coalescence in Nominal Stems

<table>
<thead>
<tr>
<th>Nkundo</th>
<th>Nkengo</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) bo-tálé</td>
<td>bo-téé</td>
<td>'longeur'</td>
</tr>
<tr>
<td>(ii) lo-sálé</td>
<td>bo-seé</td>
<td>'filet pour cheveux'</td>
</tr>
<tr>
<td>(iii) njálé</td>
<td>nyéé</td>
<td>'rivière'</td>
</tr>
<tr>
<td>(iv) bo-kálé</td>
<td>bo-keé</td>
<td>'co-épouse'</td>
</tr>
<tr>
<td>(iv) -samalo</td>
<td>-samó</td>
<td>'six'</td>
</tr>
</tbody>
</table>

Commenting on the data in examples (i) and (ii) in (6-6), Hulstaert says

"Remarquez que l'harmonie vocalique ne joue pas dans ce cas; ce fait atteste les voyelles originales" (Hulstaert 1970, p. 6)

His view is clearly that the conservative [l]-retaining Nkundo pattern was shared historically and that retracted segments derived via vowel merger do not trigger vowel harmony. Parallel to these nominal forms, the data in (6-7) show that Nkengo has derived retraction with [ae] hiatus sequences following the loss of [l] in verbal forms as well.
(6-7) [l]-Loss in Nkengo Leads to Coalescence in Verbal Suffixes

<table>
<thead>
<tr>
<th></th>
<th>Lonkundo</th>
<th>Nkengo</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>a-tsikale</td>
<td>átsikee</td>
<td>'qu'il reste'</td>
</tr>
<tr>
<td>(ii)</td>
<td>lêmale</td>
<td>lêmee</td>
<td>'arretez-vous'</td>
</tr>
<tr>
<td>(iii)</td>
<td>lônale</td>
<td>lônee</td>
<td>'levez-vous'</td>
</tr>
</tbody>
</table>

How do we account for the difference between the disharmonic forms in (6-6) and the fully harmonic forms in (6-5)b.? Before attempting to answer this question, we will consider additional data from a closely related language to broaden the empirical base.

6.1.3 Lwankamba

Lwankamba (C-60) (Hulstaert 1977), like Nkengo, has an extremely productive process of [l]-drop\(^4\), creating vowel hiatus. The chart in(6-8) contrasts Nkengo and Nkundo with Lwankamba. Although Lwankamba maintains hiatus without any assimilation for [ae] sequences\(^5\) as in (i) and (ii), it shows assimilation for [ea] and [oa]) sequences. Nkengo, as seen in(6-6) and(6-7), has the mirror image pattern, retaining [ea], [oa], but coalescing [ae]. These directional asymmetries must be explained by a fully articulated theory of vocalic elision and coalescence such as in Casali 1996. It is not my goal to elaborate such a theory here\(^6\); the question in focus is how retraction arising from coalescence systematically fails to be harmonic, as in the coalesced forms in (6-8) i, iii, and vii. where the prefixes, contrary to expectation, do not harmonize.

---

\(^4\) This process is attested all over the Bantu family and is evidence to varying degrees throughout the Bantu C zone.

\(^5\) No forms with [a...o] sequence are available, but this is probably an accidental gap.

\(^6\) I will present a schematic account of coalescence in a following section.
In addition, in Lwankamba a rather complete paradigm of verbal forms is attested where either (i), root-final [1] or (ii), [1] in the applicative suffix -el- or reversion suffix -ol- has dropped out before the final vowel -a or pre-final -ak-. In these cases, the coalesced output [ee] or [oo] is seen. In (6-9), these Lwankamba forms are give beside their Nkundo counterparts to facilitate comparison with forms that preserve the historical [1].

Hulstaert 1977 (p. 212) again provides an explicit commentary on the non-harmonic quality of the retraction produced through coalescence in Lwankamba:

---

7 A kind of traditional beauty cream used by Bantu groups in the rainforest area.

8 Accepting Hulstaert’s hypothesis, it is reasonable to suppose that the [1]-retaining languages are conservative, reflecting a common ancestor language.

9 Compare the subjunctive form [wō-sanggéé] /ō-o-sangél-é/, where [1] has dropped out between two [e]s. The underlying advanced status of the applicative suffix is thus preserved in some alternations.
La nature purement phonétique de ce phénomène est confirmé par le fait qu’il ne donne pas lieu à l’harmonie vocalique:  
(citing the following data MFL)

(6-10) Disharmonic Sequences in Lwankamba

(i) amoumɔ̃̃ké bolumu ‘elle ouvrit la bouche’ /-úm-ol-ak-e/
(ii) bameyengééké ‘ils vous regardent’ /-ėng-ol-ak-e/
(iii) múla émokungɔ̃̃ké ‘il tonnait’ /-kung-ol-ak-e/

In the data cited in (6-10)(i) and (iii), Hulstaert’s point is that if coalescent retraction had not been “purely phonetic” we would expect the final vowel -e to harmonize as it does elsewhere in the language if there is retraction to the left. Note moreover that the form (6-10)(ii) above, involving the root -ęng-, ‘regarder’, is a root with a lexical-harmonic [rtr] value. Lwankamba, like Nkundo, is squarely in the low-retention / opacity group, so even without coalescence we wouldn’t expect the final -e to harmonize since [a] in the underlying suffix -ak- is opaque to [rtr] harmony. However it is somewhat surprising that harmony is blocked even when the low vowel is lost in coalescence. Taking a cue from Hulstaert’s own view on the segregation of harmony (as phonological) and coalescence (as phonetic), this might be taken to suggest an analysis where HARMONY happens at a level prior to the elision of the low vowel in the pre-final suffix -ak-. This could be implemented as follows:

Level X: Vowel Harmony constraint interaction (opacity enforced)
Level X + 1 /a+e //e+a/ coalescence

Hulstaert notes (Hulstaert 1977, p. 212) that in all of the Mongo (C-60) zone only Lwankamba and Yenge (a related language) have productive vowel coalescence of this kind.

Here I am translating from French Hulstaert’s quote above, “purement phonétique”. His insight is that harmonic and coalescent retraction must somehow be formally segregated in the phonology. My proposal will extend this basic insight.
This would explain why real [rtr] harmony is blocked even when the low vowel is coalesced / elided: HARMONY was determined prior to coalescence, when the low vowel was present\textsuperscript{12}. At the same time this view also provides a possible explanation for the failure of coalescent retraction to be harmonic. The relevant HARMONY constraints, on this view, would be active at level X but inactive at level X+1; so even if [rtr] was derived at a subsequent level, we would not expect harmonic behavior. After we consider Tetela in the next section we will come back to this idea of levels and propose that the lexical / post-lexical distinction is the crucial one for a coherent analysis of coalescence, non-harmonic coalescent retraction, and related phenomena.

6.1.4 Tetela

Tetela presents unusual complexity in its vowel harmony system and this complexity can best be understood now that the basic properties of the Bantu C vowel harmony paradigm have been introduced and discussed. Like all of the other languages seen in this study, it has a vowel harmony system based on a root-affiliated harmonic [rtr] value. In Tetela, the same basic stock of lexical verb roots are retracted as in the other languages seen\textsuperscript{13}. Tetela shares in the low-retention / opacity paradigm where the low vowel is retained under harmony in suffixes and is opaque to harmony. Tetela mid vowel suffixes and prefixes harmonize as we have come to expect in the low-retention group. In addition to these characteristics, however, Tetela has coalescent retraction in a variety of non-root

\textsuperscript{12} We have seen similar cases in this thesis. Recall that Nkundo prefixal harmony (one-syllable-to-the-left genre) did not hold where the vowel to left of the root was glided. In the form /á-fő-loom-[es]-any-e/ , [áfójwésanye], one-over harmony fails : *áfójwésanye. It seems that HARMONY must precede prosodically driven vowel elision.

\textsuperscript{13} In 7-vowel Bantu languages with which I am familiar, verb roots rarely change their Tongue Root class from language to language.
contexts. It has in addition non-alternating retracted verbal suffixes that also show up in
nominal forms. As well, a class of fortis or geminate consonants blocks normal vowel
harmony (Jacobs 1964, p. 11). The overall result is somewhat chaotic in that there are
many apparently disharmonic forms. In addition to all this, non-root non-lexical
retraction is simply never harmonic, underlining that Tetela dramatically distinguishes
between root-affiliated harmonic retraction and all other kinds. Apparently disharmonic
nominal stem sequences among mid vowels, (6-11), are always of the type [o/e...e/o],
where the first element is “advanced” and the final one is “retracted”. This in itself is
compelling evidence that the retraction is suffixal.

(6-11) Tetela Disharmonic Forms

Nominals

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Number</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-wótsó</td>
<td>3/4</td>
<td>‘verwantschap’</td>
</tr>
<tr>
<td>e-wótsó</td>
<td>9/10</td>
<td>‘family likeness’</td>
</tr>
<tr>
<td>héémó</td>
<td></td>
<td>‘ziekte’</td>
</tr>
<tr>
<td>to-yongó</td>
<td>7/12</td>
<td>‘zeef’</td>
</tr>
<tr>
<td>e-onóóne</td>
<td>7/8</td>
<td>‘plant’</td>
</tr>
</tbody>
</table>

Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Translation</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>kélé njó-kó-fú-féek-e</td>
<td>‘dat ik je helpe bij het smeedwerk’</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>‘that I would help you with the forging’</td>
<td></td>
</tr>
<tr>
<td>lá-má-mbó-wó-hék-ó</td>
<td>‘daar waare zij genoed hadden’</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>‘there, where they had been invited’</td>
<td></td>
</tr>
<tr>
<td>[láyalómbeé] /l-á-yá-lomb-éé/</td>
<td>‘ik overvoog’</td>
<td>143</td>
</tr>
<tr>
<td></td>
<td>‘I flew over...’</td>
<td></td>
</tr>
</tbody>
</table>

14 That is, they are disharmonic from the perspective of the other languages seen in this study. Babole for example has no
disharmonic sequences at all in harmonic domains, except where harmony is broken by an intervening high vowel or
affricate derived from a high vowel.

15 As pointed out in the last chapter, the only language that allows nominal sequence like [o...e], [e...e], [o...e], etc. is
Tetela, where there are non-alternating retracted suffixes in verbs.
Despite the superficial chaos of the Tetela vowel harmony system, we shall see that it can be understood as simply involving either: (i) lexicalization of coalescent retraction of exactly the sort we have seen, or (ii) overt non-alternating retracted suffixes. This overlay of non-harmonic retraction co-exists with the familiar vowel harmony system, but does not interact with it. The crucial difference between Tetela and the other languages viewed in this chapter is that in addition to derived coalescent retraction, there are retracted suffixes that do not alternate.\(^{16}\)

6.1.4.1 A Sketch of Tetela C-70

There are several dialects of Tetela (Labaere and Shango 1989). The data for this sketch is drawn from the detailed description in Jacobs 1964, (Morphologie van het Tetela) and from the smaller database in the introduction in Jacobs 1957 (Tetela Texten). My goal in this section is to present the essential characteristics of the Tetela system. In (6-12) below, I provide forms which establish the basically canonical properties of Tetela vowel harmony: stem mid vowels and prefixes harmonize with a root retraction value, if present.

\(^{16}\) This will oblige me to admit that non-root but still underlying [rtr] can exist. I will not therefore be able to claim that the crucial distinction for harmony is between underlying harmonic [rtr] and derived non-harmonic [rtr]; Tetela suffixal retraction is both underlying (lexical) and non-harmonic (inert). The correct distinction will have to be that harmonic [rtr] is both underlying and root-affiliated. These distinctions will have to be implemented via indices on features within OT.
Basic Mid Vowel Harmony in Tetela

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>NC</th>
<th>Dutch</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-heké</td>
<td>di-heké</td>
<td>7/8</td>
<td>'paan'</td>
<td>??</td>
</tr>
<tr>
<td>e-soko</td>
<td>soko</td>
<td>7/8</td>
<td>'kuif'</td>
<td>'tuft, forelock'</td>
</tr>
<tr>
<td>e-mondé</td>
<td>di-mondé</td>
<td>7/8</td>
<td>'boomsoort'</td>
<td>'type of tree'</td>
</tr>
<tr>
<td>e-pété</td>
<td>di-pété</td>
<td>7/8</td>
<td>'vissoort'</td>
<td>'type of fish'</td>
</tr>
<tr>
<td>e-mósó</td>
<td>móso</td>
<td>7/8</td>
<td>'onhandigheid'</td>
<td>'clumsiness'</td>
</tr>
<tr>
<td>e-sólé</td>
<td>sólé</td>
<td>7/8</td>
<td>'mus'</td>
<td>'sparrow'</td>
</tr>
<tr>
<td>e-selo</td>
<td>selo</td>
<td>7/8</td>
<td>'afdak'</td>
<td>'shed, shack'</td>
</tr>
<tr>
<td>e-helohelo</td>
<td>di-helohelo</td>
<td>7/8</td>
<td>'dij'</td>
<td>'thigh'</td>
</tr>
</tbody>
</table>

Just as the preceding data shows that mid vowels harmonize in nominal stems and prefixes, the data in (6-13) shows that the mid vowel past tense suffix -e harmonizes with an [rtr] value in the verb root, (ii).

Mid Vowel Suffixes Harmonize In Tetela (Jacobs 1964 p.142)

(i) átalélé     á-tá- [lel-É]    'al wenende'  'he wept'
       3s-Tns-[WEEP-FV]

(ii) átšámbe    á-tá- [óm-É]     'al vegen'    'he swept'
       3s-Tns-[SWEEP-FV]

Low vowel suffixes follow the pattern seen in Nkundo, C-60. A suffixal low vowel on the right of the retracted verb roots in (6-14) (ii) and (iii) is not assimilated but is retained.

Tetela Low Vowel Retention (Jacobs 1964 p. 113)

(i) ambónciká    á-mbó-N-[cik-á]  'he deceived me'
       3s-tns-OBJ:1s-[DECEIVE-FV]

(ii) ambómená    á-mbó-N-[én-á]  'he saw me'
       3s-tns-OBJ:1s-[SEE-FV]

---

17 Jacobs 1964 (p. 11) notes two cases that fail to conform to the prefixal harmony generalization:

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>NC</th>
<th>Dutch</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-nyo</td>
<td>e-nyo</td>
<td>3/4</td>
<td>'mond'</td>
<td></td>
</tr>
<tr>
<td>o-vó</td>
<td>e-vó</td>
<td>3/4</td>
<td>'lever'</td>
<td></td>
</tr>
</tbody>
</table>

Jacobs offers no explanation for these disharmonic sequences, merely noting that they are exceptions.
Such suffixal low vowels are not merely retained, but are opaque to [rtr] harmony, just as Nkundo and the other Southern Block languages are. Some examples are provided in (6-15). In (i) the low vowel in the prefinal aspectual suffix -ak- is elided but harmony is still blocked. The form in (ii) is a variant where the prefinal -ak- is doubled. The advanced verb root form in (iii) is provided for contrast.

(6-15) Tetela Low Vowel Retention and Opacity

(i) kēlé ncoōke /n-cō-ak-e/ 'dat ik ga’ p. 139
(ii) kēlé ncoōkake /n-cō-ak-ak-e/ 'dat ik ga’ p. 139
(iii)(kēlē) nyōhembolake /nyō-hembol-ak-e/ 'dat wij snijden’ p. 138

Similarly, non-derived nominal stems with [o...a] and [e...a] are fine just as they were in Nkundo. Final low vowels do not assimilate. Several examples are given in (6-16).

(6-16) Nominal Stems with [o...a]/ [e...a]

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>wo-osa</td>
<td>wo-emə</td>
<td>w.o-emə</td>
<td>3/4</td>
<td>‘haar’</td>
</tr>
<tr>
<td>we-osa</td>
<td>we-emə</td>
<td>w.e-emə</td>
<td>3/4</td>
<td>‘witheid’</td>
</tr>
<tr>
<td>o-tetela</td>
<td>a-tetela</td>
<td>1/2</td>
<td>‘Tetela-mens’</td>
<td>‘Tetela person’</td>
</tr>
<tr>
<td>donga</td>
<td>5</td>
<td>‘schotel’</td>
<td>‘dish’</td>
<td></td>
</tr>
<tr>
<td>mbōsa</td>
<td>10</td>
<td>‘nemen’ (1957, p.12)</td>
<td>‘taking, receiving’</td>
<td></td>
</tr>
<tr>
<td>ki-ngoma</td>
<td>di-ngoma</td>
<td>7/8</td>
<td>‘geweer’</td>
<td>‘gun, rifle’</td>
</tr>
<tr>
<td>lo-besha</td>
<td>mbesha</td>
<td>11/10</td>
<td>‘kansspel’</td>
<td>‘game of chance’</td>
</tr>
<tr>
<td>lo-noná</td>
<td>noná</td>
<td>11/10</td>
<td>‘zwarte mier’</td>
<td>‘black ant’</td>
</tr>
<tr>
<td>lo-men-a</td>
<td>mena</td>
<td>11/10</td>
<td>‘soorte slang’</td>
<td>‘type of snake’</td>
</tr>
<tr>
<td>lo-lang-a</td>
<td>nonga</td>
<td>11/10</td>
<td>‘categorie’</td>
<td>‘category’</td>
</tr>
<tr>
<td>lo-oka</td>
<td>njoka</td>
<td>11/10</td>
<td>‘roep’</td>
<td>‘call, cry’</td>
</tr>
</tbody>
</table>

18 In Jacobs 1964, I could find no additional subjunctive examples of the kind that would be most illustrative in this context. The clearest examples would be -CV C verb roots where V is [e] or [o], followed by -ak-, with a final vowel -e. In other words the desired examples would be like (6-15) (iii) above except with an underlyingly retracted verb root. It seems clear that the absence of such forms in Jacobs 1964 is strictly accidental, and I will assume that they would confirm the opacity of the low vowel to [rtr] spread as in the other Southern Block languages.
Since we have already provided an alignment account of these sequences for the low-retention group, I will say nothing further about them for the moment. Although Tetela does have [a...e] sequences, (6-17), we will see shortly that these are most likely the result of suffixation with a non-alternating underlyingly retracted suffix.  

(6-17) Nominal Stems with [a...o]/[a...e]

<table>
<thead>
<tr>
<th>Stem</th>
<th>Contrast</th>
<th>Tone</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-kambó</td>
<td>di-kambó</td>
<td>7/8</td>
<td>'veld' 'field'</td>
</tr>
<tr>
<td>engó</td>
<td>dyaangó</td>
<td>7/8</td>
<td>'ding' 'thing'</td>
</tr>
<tr>
<td>lo-nganjó</td>
<td>nganjó</td>
<td>11/10</td>
<td>'staak' 'pole'</td>
</tr>
<tr>
<td>o-hano</td>
<td>e-hano</td>
<td>3/4</td>
<td>'haak' 'hook'</td>
</tr>
</tbody>
</table>

In (6-18) below though, note that the form bwáto, 'pirogue', in the C-50 group, uniformly showed retraction of the final mid vowel. In Tetela 'pirogue' is bwáto as elsewhere in Bantu C. This shows that the suffixal source for final retraction in stems may not be the whole story for all of Bantu C..

(6-18) Tetela and C-50 Compared

<table>
<thead>
<tr>
<th>Tetela</th>
<th>Lokele C-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>wááto</td>
<td>w-ááto 'pirogue'</td>
</tr>
<tr>
<td>la-alo</td>
<td>li-áló 'blistet'</td>
</tr>
</tbody>
</table>

The list of nominal forms in (6-19) all have a final retracted vowel. Since many of them are de-verbal nouns, having a clearly identified verb root (underlined), the stem final vowel must be a suffix. We will see shortly that Tetela has a number of non-alternating

---

19 Just as hypothesized for the C-50 languages in the previous chapter.

20 This form shows that Tetela also has coalescent retraction of the ordinary kind where e+a -> [e].

21 Despite the tonal difference, these forms seem to be cognate. The Dutch gloss means "scab" or "crust". Although the Tetela grammar is in some ways comprehensive, the database of nominals provided is not systematic or complete. This prevents me from searching systematically for Tetela cognates of the C-50 forms having [a...e/o].
retracted verbal suffixes, so it is not surprising that non-alternating retracted suffixes show up in derived nouns as well.

(6-19) Tetela De-Verbal Nouns with Initial High Vowel and Retracted Stem-Final Vowel

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>o-dihé</td>
<td>e-dihé</td>
<td>3/4</td>
<td>'deksel'</td>
<td>'opening'</td>
</tr>
<tr>
<td>o-dihelo</td>
<td>e-dihelo</td>
<td>3/4</td>
<td>'sluiting'</td>
<td>'fastening'</td>
</tr>
<tr>
<td>o-kité</td>
<td>e-kité</td>
<td>3/4</td>
<td>'erfgenaam'</td>
<td></td>
</tr>
<tr>
<td>e-kité</td>
<td>kité</td>
<td>7/8</td>
<td>'geneesmiddel'</td>
<td></td>
</tr>
<tr>
<td>e-dímé</td>
<td>dímé</td>
<td>7/8</td>
<td>'geest'</td>
<td>'spirit'</td>
</tr>
<tr>
<td>e-dihé</td>
<td>dihé</td>
<td>7/8</td>
<td>'grendel'</td>
<td>'bolt'</td>
</tr>
<tr>
<td>ki-dunde</td>
<td>dunde</td>
<td>7/8</td>
<td>'mand'</td>
<td>'basket'</td>
</tr>
<tr>
<td>di-kumbe</td>
<td>a-kumbe</td>
<td>5/6</td>
<td>'mandje'</td>
<td></td>
</tr>
</tbody>
</table>

The Tetela verbal suffixes are given in (6-20). I will assume, as seems reasonable, that all Tetela derived nominals having final retraction are incorporating these suffixes. Note that this has the consequence of requiring me, for the first time, to admit lexical retraction for a class of morphemes other than roots. In addition to the applicative -éé, which we have already seen in Lwankamba, Tetela has the neutral intransitive suffix -é and the reversive intransitive -é. These suffixes are non-alternating and do not provoke retraction harmony on adjacent mid vowels either to the right or left.

(6-20) Verbal Suffixes (Jacobs 1964 p. 109)

→ -é neutral intransitief
   -y- causatief
   -ól- reversief
→ -é reversief intransitief
→ -éé applicatief
   -án- wederzijds (reciprocal)
   -ám- passief
   -át- contactief
Alternations between the final vowel -a, and various retracted suffixes like the "neutral intransitive", -ɛ, reversive intransitive -ɛ́, and applicative -ɛ́ɛ́, create pairs like the following:

(6-21) Infinitive Verbal Forms (Jacobs 1964, p.109)

mbát-a 'splitjen' 'to split (transitive)'
mbát-ɛ₂²² 'splitjen' 'to split (middle intransitive)'
ndih-á 'sluiten' 'to close, to fasten (transitive)'
ndih-ɛ́ 'open zijn' 'to open (middle intransitive rensive)'
ntóm-á 'senden' 'to send (transitive)'
ntóm-ɛ́ɛ́ 'senden voor' 'to send for (applicative)' (note lack of harmony)

Jacobs 1964 (p. 171) explicitly compares the retracted suffixes found in Tetela with parallel suffixes from Nkundo. He also proposes a correspondence for each of these with Proto-Bantu re-constructions. This is shown in (6-22).

(6-22) Correspondences for Tetela Retracted Suffixes (Jacobs 1964 p. 171)

<table>
<thead>
<tr>
<th>Tetela</th>
<th>Mongo (Nkundo)</th>
<th>Proto-Bantu</th>
</tr>
</thead>
<tbody>
<tr>
<td>neut.</td>
<td>-ɛ</td>
<td>-u-a</td>
</tr>
<tr>
<td>rev. intr.</td>
<td>-ɛ́</td>
<td>-ɛ́y-a</td>
</tr>
<tr>
<td>appl.</td>
<td>-ɛ́ɛ́</td>
<td>-ɛ́l-a</td>
</tr>
</tbody>
</table>

Although the Proto-Bantu and Nkundo correspondences for the neutral and reversive intransitives are not very helpful with respect to tracing the development of the Tetela forms, the applicative development is quite transparent. It is still possible that in every case the retracted suffixes arose through coalescence or some parallel assimilatory process under VV adjacency at an earlier stage, but the non-alternating retracted suffixes

²² Although Jacobs does not provide examples of verb roots with an "advanced" mid vowel and intransitive suffix, -ɛ, it seems clear that it is an accidental gap in his presentation and that such forms should indeed be possible.
may just be inherited from the historical system as such. The data in (6-23) confirms that
at least the reversive neutral suffix -5 did not simply arise via coalescence from the
reversive sequence -ol-a, but rather had another source, since both are attested in the
current language.

(6-23) Reversives and Reversive Middle Suffixes

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>-bik-a</td>
<td>‘planten’</td>
<td>‘to plant’</td>
</tr>
<tr>
<td>-bik-ol-a</td>
<td>‘uitrukken’</td>
<td>‘to uproot’</td>
</tr>
<tr>
<td>-bik-o</td>
<td>‘uitgerukt zijn’</td>
<td>‘be uprooted’</td>
</tr>
</tbody>
</table>

I will not delve further into the origin of the non-alternating retracted suffixes, but just
summarize by noting that, as with Bolia, Nkengo and Lwankamba, coalescent and/or
non-root retraction consistently fail to be harmonic. I will now turn to an analysis of
coalescent retraction and to the question of how the non-harmonicity of derived and non-
root retraction is to be accounted for within the framework developed in this thesis.

6.1.5 The Coalescent Retraction Problem

In the featural system assumed in this study, ‘retracted’ mid vowels [e] and [o] are
crucially distinguished from the ‘advanced’ mid vowels [e] and [o], respectively, by the
presence or absence of the feature [rtr]\(^{23}\). To facilitate the discussion to follow, I make
the relevant specifications explicit in (6-24), abstracting away from details of feature
geometry not in focus.

\(^{23}\) And of course by the dominance of the [rtr] constraint set over the [atr] constraint set.
A key element of the specification schema concerns the low vowel. Assume for the moment a low vowel input as in (6-24), having both [rtr] and [lo]. Abstracting away from some details of the coalescence analysis, the process in (6-25) would give the correct output given a certain constraint ranking to be discussed.

(6-25) Simplified Coalescence Analysis

\[
\begin{array}{c}
[a] + [e] \rightarrow [e] \\
\mu + \mu \rightarrow \mu \\
[lo] [rtr] [fr] [rtr] [fr] [<lo>] \\
\end{array}
\]

INPUT \rightarrow OUTPUT

Given [rtr] in the input, such an outcome could be implemented, following the general approach of “parse-interleaving” in Casali 1996, by positing the ranking \{*FR/LO \parallel PARSE RTR \parallel PARSE FR >> PARSE LO\}. The optimal output would be the one that preserves (parses) as much of the underlying featural material as possible while still respecting a dominant *FR/LO cooccurrence constraint. Because PARSE LO is ranked low, it is violated as the least costly way of resolving the constraint conflict. Clearly there are

---

24 A Grounded cooccurrence constraint \{If Low then Not Front\} prohibiting [æ].

219
additional questions to be answered concerning why languages differ as to whether [ae] (i.e. *Nkengo*) or [ea] (i.e. *Lwankamba, Tetela*) sequences coalesce (see (6-8) for example). Any fully articulated theory of coalescence will have to address this directionality question. In addition it will have to say many things about which features survive in the merging of featural specifications, and indeed why elision and coalescence happen at all since vowel hiatus is tolerated in some languages but not in others. *Casali 1996* explores these issues in great detail, providing a robust cross-linguistic Optimality Theory account of vowel elision and coalescence patterns. However in the framework adopted in this study, even the simplified account of coalescence pictured in (6-25) runs into difficulty. Under normal OT assumptions, one cannot guarantee that an input representation for a low vowel will have the feature [rtr]. Constraints (i.e. LO/RTR) may require the presence of [rtr] on a low vowel or prohibit [rtr] linked to [low] (i.e. LICENSING) in the output, but we may not so constrain inputs. For example, we might equally expect that the representation in (6-26) be posited for a low vowel. The problem is that if such an [rtr]-less input is posited, we cannot straightforwardly explain how retracted outputs consistently arise when low and mid vowels coalesce.

---

25 Although I follow *Casali 1995*'s general parse-interleaving approach to vowel elision and coalescence, I will not adopt the "pure acoustics" approach to vowel height features that he proposes.

26 This follows from the hypothesis that the relationship between [lo] and [rtr] is constraint governed. One might get around the problem by structurally encoding the relationship between [rtr] and [lo] in the representation itself, perhaps as a structural dependency. Note, however that this would be quite a different approach, shifting the burden of explanation away from constraint interaction to representational subtlety. *Padgett 1995* contains an illuminating discussion of the move within OT to reduce the representational emphasis in phonology.

27 Maintaining the additional assumption that coalescent [e] and [o] involve the same feature as other instances of [e] and [o], that is, some kind of [rtr] and not an entirely different feature. One conceivable possibility would be that coalescent [e] is simply [front] and [low] but homophonic to [e] [front] and [rtr]. I will not pursue this possibility further here.
This is the basic problem of characterizing coalescent retraction in an Optimality Theory account given the featural framework and constraint scenario I have adopted. Formally independent yet related is the fact that coalescent retraction is never harmonic and must be differentiated from the underlying root harmonic kind. In the following sections, I will present one approach to providing an overall solution to the basic coalescence problem, on the one hand, and the harmonic / non-harmonic retraction issue on the other hand.

6.1.5.1 Coalescence is on a different ‘level’

Let’s now return to the idea of levels that was raised earlier in the chapter. There can be little doubt that the STEM HARMONY processes analyzed in this study can be characterized as “lexical” in the sense of Lexical Phonology (Kiparsky 1982, Mohanan 1986, Kaisse and Shaw 1985, Lombardi 1996, etc.). The constraint interactions explored are inextricably tied up with the morpheme by morpheme construction of stems from the root up. Extending the one view within OT (McCarthy and Prince 1993b), that lexical and post-lexical levels are still significant in constraint-driven phonology, I will adopt the position that there are (at least) two blocks of phonological constraints. The first is a word-formation or lexical component which includes the lexicon proper plus a
A subcomponent where the syntactically-oriented inflectional affixes are added. The second level corresponds to the traditional post-lexical or syntactic phonology.

(6-27) Lexical and Post-Lexical Components

What is important is that each level, Lexical and Post-Lexical, be regulated by a different constraint grammar (same "universal" constraints but with a different ranking). I will argue that normally HARMONY is in the lexical (word-formation) component while coalescence is post-lexical, that is, insensitive to any cyclic type phenomena, morpheme boundaries, or internal brackets. Recall that my account of harmony via LICENSING involved the eventual reassertion of the LO/RTR constraint at some other level (I speculated at that point that this might be the level of phonetic implementation), since low vowels are indeed retracted in the output. An account segregating harmony and coalescence along these lines does provide a ready account of why coalescent-produced retraction uniformly fails to be harmonic, but it turns out to require a fairly strong
stipulation to explain why coalescent retraction is possible in the first place. To see why this is so, consider a case where an input low vowel has the configuration in (6-26), just the feature \([lo]\), without \([\text{rtr}]\). With such an input to the morpho-phonological constraint block, given \textsc{licensing} and the constraint interactions assumed to this point, a low vowel could not possibly acquire \([\text{rtr}]\) in the output of that component. According to the analysis developed so far, if \([\text{rtr}]\) \textit{were} stipulatively posited in the input representation of every low vowel, \([lo]\) or \([\text{rtr}]\) might be underparsed or retained depending on the constraint grammar. Given this background, the optimal output representation for any low vowel in the lexical component can only be \([lo]\) without \([\text{rtr}]\); because of \textsc{license}, one or the other feature has to go. Therefore the input representation of a low vowel for the post-lexical level could not, without some adjustment, have \([\text{rtr}]\) present either. The hypothetical post-lexical constraint interaction that produces coalescence is still starved for any consistent input \([\text{rtr}]\) to work with. What about just re-ranking constraints post-lexically such that \{\([lo]/\text{rtr} \gg \text{licensing}\)\}? Would this provide a solution? The answer is “no”. Because the output of coalescence is non-low \([\text{ee}]\) or \([\text{oo}]\), we simply cannot force the presence of \([\text{rtr}]\) from \([lo]\) via output constraints under any ranking; there is no \([\text{low}]\) in the output. In the lexical component, \textsc{licensing} (together with the proposed constraint rankings) means that \([lo]\) will either be lost (underparsed) in the presence of underlying \([\text{rtr}]\) or retained. In the post-lexical component, we have just shown that lack

\footnote{That is, I must say that phonetic or “redundant” \([\text{rtr}]\) is implemented on all low vowels at the output of the lexical component. While reasonable, this does not follow from anything in the structure of OT as a theory and must be stated as a stipulation.}

\footnote{Just to stress this perhaps murky point: since lowness in my analysis is underparsed in the output of coalescence, one cannot require \([\text{rtr}]\) based on the presence of \([lo]\), unless it is keyed to the presence of underparsed \([lo]\) which seems dubious at best.}
of [rtr] in the input should make consistent coalescent retraction impossible. There is simply no [rtr] available on low vowels anywhere in the system as it is set up, yet input [rtr] is needed to derive retracted output. What is required is that [rtr] be implemented on low vowels at the output of the lexical component. Together with the post-ranking ranking \{LO/RTR >> LICENSING\}, this move would ensure that every low vowel has [rtr] as it enters into the post-lexical constraint grammar. Then the simple mechanics of coalescence as outlined earlier could work.

Let us assume that redundant [rtr] is implemented on all low vowels at the output of the lexical phonology. Now since HARMONY (so far) is happening within the lexical component, we would not expect post-lexically implemented [rtr] to be harmonic, which is the correct result. Taking our cue from the characterization in Hulstaert 1977, is it in fact possible in this way to construe the retraction arising from coalescence as “purely phonetic”, or at least formally distinct from the level at which harmony occurs? In this approach outlined above, harmony and coalescence are segregated to explain, (i) why “derived” phonetic retraction is not harmonic, (ii) why coalescent retraction is possible.

---

30 A doctrine of “full” specification of underlying forms would also be a way out of this dilemma. However, it is difficult to see how one could demand full specification of UFs (inputs) any more than one could demand radical underspecification of UFs within OT. I do point out though that this idea has appeared in the literature recently. See Mohanan 1991 and Calabrese 1995 for frameworks espousing full specification, but not within OT.

31 This is necessary to ensure that [rtr] is consistently present in the input to the post-lexical constraint interaction. I recognize that this amount to a claim that the input to the post-lexical level is constrained in a very specific fashion, namely that GROUNDED type constraints like LO/RTR must be honored. This makes some sense, since constraints like LICENSING in effect suppresses the innate retraction of low vowels for the purpose of maintaining lexical contrast in this kind of system. Once the output of the lexical component is reached, such constraints serve no more purpose. In my analysis in this thesis LICENSE rigorously prevents [rtr] from linking to any low vowel. However once a form escapes from the lexical phonology, I want the presence of [rtr] to be required, otherwise the post-lexical coalescence analysis can not go through. This idea gets very close to Kiparsky 1985’s claim that redundant features are automatically implemented post-lexically. See also Lombardi 1996 for a related proposal within a rule-based autosegmental framework.

32 Something special will still need to be said about the Tetela retracted suffixes. It seems plausible that a learner would simply conclude that both lexicality and root-affiliation were pertinent for harmony.
post-lexically. Note that this does not exclude the possibility of post-lexical harmonies that target any kind of [rtr]. Neither do we want to completely segregate morphologically and phonetically driven phonological processes, since it is precisely the interaction of various classes of constraints in a block, such as PROSODY, FAITHFULNESS, ALIGNMENT, that gives interesting and subtle results in some cases. The claim rather is that the constraint interaction that drives retraction-producing coalescence of adjacent vowels is in the post-lexical constraint block. One kind of independent supporting evidence for this claim comes from the lack of morphological conditioning on coalescence. If a Bantu C language has retraction coalescence, it is completely across-the-board and happens without regard to conditioning environment; it is exceptionless. The picture that emerges in this view could be represented as in (6-28), with both a lexical and post-lexical constraint interaction block.

(6-28) Lexical and Post-Lexical Constraint Domains

```
PHONETIC OUTPUT
  ↑
( PHONETIC COMPONENT )
  ↑
Post-Lexical CONSTRAINT GRAMMAR
  ↑
   
Adjust Output of Lexical Component
   ↑
Lexical CONSTRAINT GRAMMAR
   ↑
  INPUT (LEXICON)
```

Filling out the picture somewhat, (6-29) shows what would happen at each level.

---

33 This may not be true of every kind of coalescence, but I claim it is true in the case of [ae] & [ea] → [ee]
6.1.5.2 Coalescence and Harmony: Is [rtr] Indexing Needed Too?

Assuming that the proposed “adjustment” of the lexical output is defensible, something may still have to be said about forms like those in (6-6) and (6-8). In an Nkengo nominal form like bo-téé, 'longeur' (corresponding to Nkundo bo-tálé), there is no synchronic alternation signaling the derived status of the retracted stem vowel(s), yet there is no harmony. A learner would just have to learn them as exceptions to the harmony process.

There is a sufficiently small number of such forms to make this exception-marking approach plausible. Where retraction arises in the verbal morphology, there is usually an alternation and the learner can be presumed to be able to posit the pre-coalescent input sequence based on the alternations. Since the coalescent output is general prosodically long in all contexts, this would tend to facilitate his or her identification of the non-harmonic nominal stem retraction as derived also. All of this means that the learner will

---

34 The longness of the derived retraction could be construed as a clue to the exceptionality of these forms. There is no reason however to suppose that a form like /bo-keɛ/ (hypothetical), is impossible (where [l] has been lost between identical underlying retracted vowels). Although no forms are provided in the sources available (hinting perhaps at the their rareness), it is clear that [l] drops out between identical vowels of all sorts.
essentially be forced to recognize two kinds of [rtr] in the lexical component, even with the segregation afforded by the post-lexical analysis of coalescence. One kind of [rtr] is affiliated with lexical roots and provokes harmony. Any other kind, whatever the source, is not harmonic.  

Even though coalescence arises post-lexically (that is the hypothesis we are exploring in this section), it is marginally lexicalized to some degree in exceptional forms like bo-téé, 'longeur', where there is no synchronic alternation. The non-harmonicity of such forms could be formalized in the harmonic grammar by further differentiating between (i) harmonic [rtr] which is both lexical (non-derived, underlying), and root affiliated and (ii) all other kinds. The resulting typology of retraction types is pictured in (6-30), where only the shaded box is harmonic [rtr].

(6-30) Descriptive Typology of Retraction Types

<table>
<thead>
<tr>
<th>Root</th>
<th>Non-Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying</td>
<td></td>
</tr>
<tr>
<td>Derived</td>
<td></td>
</tr>
<tr>
<td>e-pété (Tetela)</td>
<td>ntóm-ée (Tetela)</td>
</tr>
<tr>
<td>bo-téé (Nkengo)</td>
<td>é-mo-kung-sok-é (Lwankamba)</td>
</tr>
</tbody>
</table>

In the account developed here, the harmony-inducing ALIGN constraints in the lexical component target only lexical-root [rtr], which I will continue to identify as [rtr]1. It may be true that with different assumptions about the set of phonological features involved (or perhaps with the same features, but a different analysis), a solution that keeps

---

35 Including both coalescence-derived retraction and non-root lexical retraction as in Tetela suffixes.

36 There could easily be dialectical alternations however, as we have seen that l-retaining and l-drop languages, coalescing and non-coalescing languages are in close proximity and otherwise closely related.
coalescence and harmony in the same component would be possible. Both Goad 1993’s and Casali 1996’s approach in fact allow a single component approach, but run into difficulties as I have suggested. However, neither of these alternatives avoid the necessity of differentiating between the harmonic “version” of the feature (underlying in lexical roots) and all other instances of it, including those that arise via coalescence, which are not harmonic. This can be seen by considering the account of coalescence proposed by Casali 1996. In Casali’s view, vowel features are organized into two acoustic zones \( H(igh) \) and \( L(ow) \). These upper and lower registers are then further differentiated by secondary features that designate the upper “h”, and lower “I” areas of the basic zones. Seven vowel systems like those we have been examining would have the feature analysis in (6-31).  

(6-31) Feature Specification for Yoruba 7-vowel System from Casali 1996

\[
\begin{array}{c|cc}
H(igh) \text{ Region} & i & u \\
\hline
L(ow) \text{ Region} & e & o \\
& l & e & a & o \\
\end{array}
\]

Expressed in a chart, the vowel specification of the distinct heights would be as in (6-32). 

(6-32) Vowel Features of Casali 1996 for 7-Vowel System

\[
\begin{array}{c|cc}
[i] & H, Fr \\
[u] & H, Rd \\
[e] & L, Fr \\
[o] & L, Rd \\
\rightarrow [e] & L,l, Fr \\
\end{array}
\]

\[37 \] I encourage the reader to consult Casali 1996, where the difference between 5 and 9 vowel systems on the one hand and 7-vowel systems on the other hand is captured in a novel and revealing way. In particular, Casali’s system derives the claimed generalization (also noted in Goad 1993) that \([e+a]\) coalescence in 5 and 9 vowel systems yields \([e]\) while \([e+a]\) coalescence gives \([e]\) in seven vowel systems.
In Casali’s OT system various constraints control possible feature combinations in inventories; the actual details of the analysis are not important for this discussion. What is to be noted is that his schema for retraction-type coalescence, which I represent schematically in (6-33), has the same output representation for coalescent-derived [e] / [ɔ] as for underlying [e] / [ɔ], (6-32).

(6-33) a+e Coalescent Output in Casali 1996

For the Bantu C harmony paradigm, even in a system like Casali’s where both coalescence and harmony can be handled in a single level of the phonology\(^{38}\), coalescent output and root-underlying [rtr] will still need to be distinguished by some additional mechanism\(^{39}\). Such a distinction will have to be stipulatively captured in any system that does not have different representations for coalescence output and the underlying harmony-inducing segments/features. This is just to say that the need to crucially distinguish between underlying root [rtr] and other kinds is not a peculiarity of my analysis.

---

\(^{38}\) Presumably the relation between [L] and [l] for the low vowel is structurally required in Casali’s system; that is, it is stipulated to be a property of the basic representational system (GEN), rather than determined by constraint. If the relationship between [L] and [l] were governed by constraints in the same way that [lo] and [rtr] are in the present OT analysis, the Casali would have the same problem that I do: namely that OT forbids constraining UF’s and therefore a learner might posit just [L] as the representation for a low vowel.

\(^{39}\) Casali (personal communication) would analyze [rtr]-type harmony via alignment of the feature [l]. Casali 1996 however does not propose an explicit account of the kind of harmony system documented in this thesis, so the approaches cannot for the moment be compared on that score.
6.1.5.3 Lexical and Post-Lexical Harmonies: Revision

Phonological theory must have some way of distinguishing phenomena which are the result of relatively recent historical change (i.e. [l]-drop and vowel-coalescence) and phenomena which are deeply characteristic of the historical system (root-controlled vowel harmony). In terms of a core / periphery model, robustly attested patterns like root-controlled vowel harmony might be thought of as governed by "core" constraint interaction, whose function is the maintenance of contrast in a large stock of lexical items. Such processes, especially those keyed to morphological categories could conceivably involve the high ranking of constraints like LICENSING whose effect is to suppress the phonological retraction of low vowels. Corresponding somewhat to post-lexical phonology, periphery-type processes would by contrast be very "phonetic / grounded" in character, being related as they are to prosodic re-organization and other across-the-board processes driven by the articulatory/acoustic dynamics of actual speech production and perception. Again, if something like this is true, then it would not be surprising that a constraint like LICENSE might be automatically rendered impotent post-lexically because it is overwhelmed at that level by a phonetic requirement like LO/RTR.

To sum up, my view is that [a]+[e]->[e] coalescence is a post-lexical process which exploits the presence of redundant [rtr] on the low vowel.

One small class of marked exceptions have coalescent retraction lexicalized (forms like Nkengo bo-te'e, 'longeur'), where no synchronic alternation preserves the historical [a] + [e] sequence. Similarly some retracted suffixes, such as the Tetela applicative -ee- are probably encoded by learners as involving lexicalized [rtr] from
coalescence (reflecting what actually happened historically). HARMONY in general is a lexical component process whose output is computed prior to post-lexical coalescence. It is important to note one important prediction made by this move. Non-lexical [rtr] will be implemented on all low vowels at the output of the word-formation component. This means that if there were a phonologically keyed post-lexical [rtr] harmony process targeting a domain edge, it might be sensitive to both the retracting influence of low vowels and to derived coalescent retraction. I will discuss an example of this post-lexical harmony below. First though, it is necessary to think about the two classes of cases that have been analyzed in this thesis as crucially involving phonological domain edges rather than morphological domain edges. Do they exhibit the behavior predicted by the lexical / post-lexical proposal?

6.1.5.3.1 Ntomba Updated: Phonological Domain Harmony

The first case is the transparency of stem-initial high vowels to leftward harmony in Ntomba, as discussed in Chapter 3. To facilitate the discussion, sample forms are repeated in (6-34):

(6-34) Prefixal Harmony and Initial High Vowel Transparency

<table>
<thead>
<tr>
<th>Ntomba</th>
<th>Nkundo</th>
<th>Bolia</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo-hùnge</td>
<td>‘nectarin’</td>
<td>(Nkundo lo-sùnge)</td>
</tr>
<tr>
<td>lo-pumbe</td>
<td>‘petits poissons de toutes variétés’</td>
<td>(Bolia lo-pumbe, Nkundo lo-fumbe)</td>
</tr>
<tr>
<td>mo-lùmbe</td>
<td>‘autre nom donné aux negrilles’</td>
<td>(Nkundo bo-lùmbe)</td>
</tr>
<tr>
<td>bo-ndiko</td>
<td>‘d’une certaine profondeur’</td>
<td></td>
</tr>
<tr>
<td>bo-pimbo</td>
<td>‘arbre à briquet’</td>
<td></td>
</tr>
<tr>
<td>e-kiòc</td>
<td>‘ver de Cayor sous la peau’</td>
<td>(Bolia bo-kiòc)</td>
</tr>
<tr>
<td>e-hiyò</td>
<td>‘grande saison sèche’</td>
<td></td>
</tr>
<tr>
<td>mo-kieteno</td>
<td>‘peine, souffrance’</td>
<td></td>
</tr>
<tr>
<td>mo-lièliè</td>
<td>‘une action faite vers soi-même’</td>
<td></td>
</tr>
<tr>
<td>mo-iyòc</td>
<td>‘sorte de petit poisson noir’</td>
<td></td>
</tr>
</tbody>
</table>
Recall that the analysis of Ntomba high vowel transparency involved the positing of [rtr] alignment to phonological domain edges and the insertion of non-lexical [rtr]\(^1\). However Ntomba definitely does not demonstrate harmonic sensitivity to low vowels in any domain\(^40\). At any rate, according to the alternative proposal in Chapter 5, forms like those in (6-34) might not even involve root-underlying [rtr]\(^3\) at all, but rather specially marked non-harmonic [rtr]. Since the harmony proposal for prefixal transparency involves phonological domain edge alignment (with respect to LEX RTR) no problem is created since any kind of [rtr] will do. As for harmonic insensitivity to low-vowels, this is not a problem either. Although Ntomba is targeting phonological domain edges, the harmony-producing constraint interaction is still within the word lexical component\(^41\).

Under the revised proposal any cases of harmonic sensitivity to low vowels would necessarily involve post-lexical harmony. One such case, Mbosi Olée (Fontaney 1988), will be discussed below.

### 6.1.5.3.2 One-Syllable-Over Harmony and Phonological Domains

The other instance where I appeal to a phonological domain is for the one-syllable-to-the-left harmony of Nkundo (§§ 2.2.7), Nkengo (§§6.1.2), Lwankamba (§§6.1.3), Tetela (§§6.1.4), etc., claiming that a phonological domain analogous to the lexical\(^42\) word is crucial. Again these cases are considered to target a phonological domain edge, but still

\(^{40}\) Ntomba (Mamet 1955) did not have any coalescent retraction at all and cannot be evaluated on this count.

\(^{41}\) Within the Lexical Component, either phonological or morphological domains might be pertinent, but low vowels may not host [rtr] in any case because of dominant LICENSE. If post-lexical harmony is present, only phonological domain edges are relevant and any kind of [rtr] will be targeted, including “redundant” [rtr] on low vowels, and coalescent retraction.

\(^{42}\) Recall that in this context, lexical has a sense which is different from that used in the lexical / post-lexical distinction. Lexical mean root
within the lexical component. None of these cases shows any harmonic sensitivity to low
vowels, but rather each has the same inert and opaque low vowels as we have seen
elsewhere in the paradigm. Even though phonological edges rather than morphological
dges figure in the analysis of these cases, the harmony is still in the lexical component
and does not have access to post-lexical coalescent retraction ("redundant" low vowel
\[rtr\]).

Two of the single-syllable harmony languages, Tetela and Nkengo, still present a
problem for this approach. Tetela (see (6-11)) has non-alternating retracted verbal
suffixes which must be considered "underlying", yet these do not provoke harmony.
Nkengo, (see(6-8)) has non-harmonic retraction in nominal stems. The problem is that a
learner might not ascribe derived status to retraction in cases like Nkengo bo-tÉÉÉ,
'longeur'. If the domain edges in question are phonological for these cases (as I proposed
in Chapter 2.), then any \([rtr]\) should be relevant to harmony, not just root-underlying
harmonic \([rtr]\). However, in all of the one-syllable-over cases seen so far, non-root
retraction uniformly fails to be harmonic. This obliges me to say that as long as the
harmony is within the word-formation component, only \([rtr]\) is relevant, whether
phonological or morphological edges are involved. This amounts to saying that when
phonological domains are set up within the lexical component then those domains are of
a hybrid nature, involving edges that are not morphological, but still insist on the root-
controlled character of Harmony and thus require \([rtr]\). I do not see at present how this
can be made to follow from any existing principles of OT or of Generalized Alignment.
Alternatively the morphemes in question may just be exceptionally marked as \([\text{NOT}}

233
HARMONIC]. This is plausible when there is an extremely small number of words as in the case of Nkengo where the only relevant forms are the three examples in (6-6). In this way, truly exceptional cases would be given an exceptional treatment. When a learner hears a form like Nkengo, bo-tee, 'longeur', he or she would simply note that it an exception to harmony; the corollary of this is that one expects such “marked” forms to be reanalyzed as harmonic or otherwise regularized by subsequent generations of learners.

For Tetela the situation is slightly more complex since closed-class inflectional morphemes are lexically retracted. The three verbal suffixes in (6-20) marked with arrows are the relevant retracted ones. The learner could encode the exceptional non-harmonicity of these morphemes in their lexical entry. Although the grammar itself seeks to align [rtr] of any persuasion, these morphemes are excluded because of the exception feature. Thus in the case of Tetela a small number of exceptional morphemes leads to a large number of disharmonic forms. While neither the concept of special domains nor exceptional marking seem entirely satisfactory, they allow me to maintain the phonological domain analysis of Nkundo-type one syllable harmony, which I take to be correct. Further research is required to decide on the best analysis of these recalcitrant cases.

6.1.5.3.3 C-20 Mbosi Oléé: A Case Study of Harmonic Sensitivity to Low Vowels

Since the present analysis predicts a possible class of post-lexical harmonies with special properties I will briefly discuss the one case that is known to me. These are perhaps the most striking data in my whole corpus since stem initial low vowels are unarguably inducing retraction in the prefixal domain to the left but fail to do so in stem vowels and
suffixes to the right. Rather, in stems and suffixes the familiar Bantu C pattern of root
controlled [rtr] harmony is attested. Moreover, Mbosi Oléé belongs to the subset of Bantu
C languages that underparse [lo] suffixally, so the difference in domain effects is quite
dramatic. The data in (6-35) and (6-36) show that while advanced-initial forms, (i) fail to
induce harmony in prefixes (as expected) and retracted-initial forms, (ii) induce harmony
(as expected), low vowel initial forms also induce harmony. I have included Babole
cognates where possible for comparison.

(6-35) Class 7 Nominals Showing Prefixal Harmony Effects

<table>
<thead>
<tr>
<th>Mboshi Oléé</th>
<th>Babole</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) ADVANCED-INITIAL STEMS</td>
<td></td>
</tr>
<tr>
<td>e-kwè 'leg'</td>
<td>e-kólò</td>
</tr>
<tr>
<td>e-kóró 'skin'</td>
<td>e-kótó</td>
</tr>
<tr>
<td>e-kiβà 'consternation'</td>
<td></td>
</tr>
<tr>
<td>e-duŋá 'iron'</td>
<td></td>
</tr>
<tr>
<td>(ii) RETRACTED-INITIAL STEMS</td>
<td></td>
</tr>
<tr>
<td>e-kɔɔ 'evening'</td>
<td></td>
</tr>
<tr>
<td>e-seé 'hoe'</td>
<td></td>
</tr>
<tr>
<td>(iii) [a]-INITIAL STEMS</td>
<td></td>
</tr>
<tr>
<td>e-bålè 'river' *[e-bålè]</td>
<td>e-åle</td>
</tr>
</tbody>
</table>

(6-36) Class 3 Nominals Showing Prefixal Harmony Effects

| (i) ADVANCED-INITIAL STEMS   |                         |
| d-lómì 'husband'             | mò-lómì                 |
| d-βé 'evil'                  | mò-βé                   |
| d-túfà 'well/ hole'          |                         |
| (ii) RETRACTED-INITIAL STEMS |                         |
| d-nɔɔ 'mouth'                |                         |
| d-pɔmì 'sweat'               |                         |
| d-ñèφì 'older sibling'       | mu-ñèbì                 |

235
(iii) LOW-INITIAL STEMS

\[ \delta \text{-långè} \quad 'bottle' \quad \text{mo-långī} \\
\delta \text{-kålè} \quad 'devil' \\
\delta \text{-bångà} \quad 'cheek' \\
\delta \text{-kándé} \quad 'garment' \]

Note in particular that the forms in (6-35)(iii) and (6-36)(iii) induce retraction in prefixes on the left but not in the stem sister mid vowel on the right. Exactly the same prefixal harmony effects are found in the verbal infinitives in (6-37).

(6-37) Verbal Infinitives

\[ \text{o-sìng-á} \quad 'wash' \\
\text{o-kír-á} \quad 'sell' \\
\text{o-tò-á} \quad 'draw water' \\
\text{o-tí-á} \quad 'say' \\
\text{ɔ-pé} \quad 'give' \\
\text{ɔ-mɔ-ð} \quad 'chat' \\
\text{ɔ-sál-á} \quad 'do' \\
\text{ɔ-t-á} \quad 'see' \\
\text{ɔ-yá-á} \quad 'come' \\
\text{ɔ-dzá-á} \quad 'eat' \\
\text{ɔ-bál-á} \quad 'cut' \]

Clearly, low vowels in the stem-initial position are inducing retraction in prefixes to the left. Now Mbosi Oléé underparses [lo] on the right like Babole so the pattern [e/ɔ...a] is unattested for stems. Equally [a...e/ɔ] is bad with exactly the same analysis as Babole. Mbosi Oléé therefore can be assumed to have the same stem-harmony grammar as Babole. In addition, prefixes harmonize. The difference is, I claim, that Mbosi Oléé has a post-lexical component harmony that is aligning the “redundant” [rtr] of low vowels to a left domain edge, but not to the right. It can be shown that the same process of retraction
to the left from low vowels operates phrasally in the following example from Fontaney 1989, p. 121.

(6-38) Post-Lexical Harmony to the Left from a Low Vowel.

\[
\text{mbósànáàdè} \\
\text{mbósi ya nò à dè} \\
\text{[goat of you] he which} \\
\text{\'which (one) is your goat?\'}
\]

The first line of the example is the actual utterance. The slow speech version is provided in the second line. In the post-lexical prosodic reorganization, the final high vowel of \( 	ext{mbósi, \text{\textquoteleft goat\textquoteright}} \) and the initial \( [y] \) of the associative particle \( 	ext{ya} \) both elide creating the environment where \( [o] \) and \( [a] \) are syllable-adjacent in the output. The low vowel is inducing retraction to the left but not to the right exactly as predicted by the proposal. An additional supporting example from a phrasal context is given in (6-39).

(6-39) Phrasal Harmony to the Left of Low Vowels (Fontaney 1989)

\[
\text{ô swé, là swé ... ñàmà là ñàmà} \\
\text{for fish, fish ... [for meat], meat}
\]

This is a proverb about borrowing that says one should pay back in kind what is borrowed. Note that the prepositional particle glossed \text{\textquoteleft for\textquoteright} is showing retraction harmony only when it precedes the initial low vowel in \( [nàmà] \), and not when it precedes \( [swé] \). In a parallel phrasal context the particle \( 	ext{là} \) (no gloss provided\(^{43}\) in

\(^{43}\) From the context I would say that this particle is cognate with Babole \( ná \), meaning variously, \text{\textquoteleft some\textquoteright}, \text{\textquoteleft and\textquoteright} or \text{\textquoteleft any\textquoteright} depending on the syntactic context. See Leitch 1994 for a syntactic study of Babole \( ná \) within the Government and Binding framework.
Fontaney 1989) is not inducing retraction to the right. These examples show that the claimed post-lexical process is indeed acting as predicted.

An additional twist is provided by the fact that suffixal low vowels fail to induce harmony to the left. The forms in (6-40) are another kind of verbal infinitive.

(6-40) Verb Forms with Initial Mid Vowel and Final -a

\begin{center}
\begin{tabular}{ll}
\text{i-sem-à} & 'shout' \\
i-bôm-à & 'kill' \\
i-bé-à & 'call' \\
i-só-à & 'climb'
\end{tabular}
\end{center}

Nominal forms as well do not show retraction harmony from a final low vowel, (6-41).

(6-41) Nominal Stems with Initial Mid Vowel and Final -A

\begin{center}
\begin{tabular}{ll}
\text{à-kyémà} & 'monkeys' \\
ϕēà & 'slave' \\
bēà & 'food' \\
i-béá & 'well'
\end{tabular}
\end{center}

I suggest that the fact of retraction being induced only from stem-initial low vowels is related to an independently justified property, that of stem-initial prosodic prominence. Although the data in (6-40) might support a “root-versus-affix” variable specification approach, the data in (6-41) is harder to interpret unambiguously, since it is never clear whether such final vowels are suffixal or not in nominal forms. In fact, there is further data available in Fontaney 1989 that seems to settle the matter in favor of a prosodic interpretation. The verbal forms in (6-42) all have an alternating mid vowel prefix, either the second person singular or class 3 agreement prefix (the two are homophonous as in Babole and many other Bantu C languages). It is clear for both (i) and (ii) that the low
vowel is in fact a verbal suffix and not part of the root. The Babole cognate verbs\textsuperscript{44} show that historically and cross-linguistically these roots are not of the retracted class. What is significant is that when the suffixal low vowel is stem-initial prosodically, then it is able to induce harmony to the left.

\textit{(6-42) Mbosi Oléé C\textsuperscript{yw} Verb Roots}

(i) 3-[\textit{ky-à}] \textit{'you do'} Babole-\textit{kēl-à, kyākā}

(ii) o-lōmī 3-[\textit{pw-a kò} \textit{the husband did not come} Babole-\textit{pōl-à, pwākā cl:3-man agr:3-[come not}

This can be seen perhaps more clearly in the partial paradigm of infinitives in (6-43) (see complete paradigm in (6-37)). Low-initial CVC verb roots, (i) and (ii), induce retraction in the prefix. Similarly, low-initial CV roots, (iii) and (iv), induce harmony in the prefix. Finally, roots that consist of a bare consonant, (v), induce retraction when the final low vowel fills the “strong” stem-initial position.

\textit{(6-43) Verbal Infinitives with Suffixal -à}

(i) o-sāl-à \textit{‘do’} \\
(ii) o-bāl-à \textit{‘cut’} \\
(iii) o-dzā-à \textit{‘eat’} <tonal polarity of suffix related to bimoraicity. mfl> \\
(iv) o-yā-à \textit{‘come’} \\
\rightarrow (v) o-t-à \textit{‘see’}

A final bit of evidence is provided by the periphrastic negative paradigm in (6-44). Here the verbal form has a low toned suffixal -a. The verb glossed \textit{‘make’} (indicated by the

\textsuperscript{44} Babole shows the 1-dropping glided variant identical to Mbosi Oléé when the prefinal -ak- is added to an imperative form like [pōl-å], \textit{‘come!’}. Underlying /pōl-åk-å/ becomes [pwāk-å] in a process that is partly dialectal, partly rate-of-speech related. The crucial point here is that these Mbosi Oléé verb roots are clearly of the non-retracted class and have “advanced” mid vowels cross-linguistically. The low vowels in (6-42) are suffixal and yet are provoking retraction.

239
arrow) is inducing retraction because the suffixal low vowel is in the stem-initial position for this shape of verb root.

(6-44) Periphrastic Negative Construction

<table>
<thead>
<tr>
<th>leave</th>
<th>X</th>
<th>verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>yà</td>
<td></td>
<td>don't sing ....</td>
</tr>
<tr>
<td></td>
<td></td>
<td>don't put ....</td>
</tr>
<tr>
<td></td>
<td></td>
<td>don't breathe ....</td>
</tr>
<tr>
<td>ð-ky-à</td>
<td></td>
<td>don't make ....</td>
</tr>
<tr>
<td>ð-kàr-à</td>
<td></td>
<td>don't touch ....</td>
</tr>
<tr>
<td>ð-pé-è</td>
<td></td>
<td>don't give ....</td>
</tr>
</tbody>
</table>

These data persuade me that post-lexical [rtr] harmony in Mbosi Oléé can only be launched from low vowels that are in the prosodically prominent stem-initial position and then only to the left.

This situation is very reminiscent of Wolof (as analyzed in Pulleyblank 1994), where rightward [rtr] harmony is launched only from prosodically long [aa]. Because the triggering prosodic property in Wolof is prosodic length rather than a strong position, Pulleyblank 1994 is able to keep the low-vowel induced harmony segregated from the morphologically-keyed retraction harmony by introducing a special grounded condition "LO/ATR μu". When highly ranked, this condition forces the insertion of [rtr] on long low vowels, while short low vowels are exempted. However, in Mbosi Oléé, exactly the

---

45 Prosodic prominence could be encoded via the notion HEAD. However, the headedness would still have to be defined in terms of stem-initiality so no further insight is gained thereby. Note that the notion of strong position may provide a solution to problem of Tetela retracted suffixes. Perhaps the reason they are not harmonic is simply that harmony can only be triggered from the prosodically strong stem-initial position. This could be implemented through a highly ranked constraint to that effect.

46 Note that Wolof shows domain complementarity for these harmony types: root [rtr] harmony to the left, prosodic low vowel harmony to the right. Mbosi has root [rtr] harmony within stems and prosodic low vowel harmony in prefixes. It appears that the more phonetic harmony is not permitted to obscure the output of the more morphological harmony. I will leave the development of this idea for future work.
same low vowel segment must crucially induce retraction to the left and yet crucially fail to induce it to the right. Understanding that Mbosi Olélé partakes in the Bantu C system where [rtr] is not licensed on low vowels at all in the lexical phonology can help us. Systematic exclusion of [rtr] on low vowels via LICENSE on the one hand is characteristic of the lexical component. Systematic retraction of the very same low vowels is only possible if the low vowel retraction effect is based on a post-lexical harmony targeting [rtr] introduced after the lexical component.

6.1.5.4 Closing Remarks on Coalescent Retraction and Harmony

In this chapter I have tried to come to terms with the fact that although coalescent retraction is attested, it never induces harmony in any of the cases in my database. I have argued that phonetic or redundant [rtr] is inserted on low vowels late in the phonological system, after the word-formation component, making it available only in the phrasal phonology and rare\textsuperscript{47} post-lexical [rtr] harmony constraints (of which Mbosi Olélé is an example). The explanation of coalescent retraction involving component-ordering thus finds independent support in the low-vowel retraction harmony of Mbosi Olélé. The proposal makes the prediction that if a language did have coalescent retraction and a post-lexical harmony process, then that language would show harmonic sensitivity even to the coalescent retraction, perhaps with an additional prosodic requirement imposed (as with the low-vowel retraction harmony in Mbosi Olélé and Wolof). Segregating vowel harmony and coalescence by component also explains why generic vowel elision and

\textsuperscript{47} Rare in my database of Bantu C cases at least.
gliding appear to block harmony; lexical harmony is satisfied before elision takes place. Post-lexical elision may therefore obscure harmony that has been determined in the lexical component. The core of Bantu C vowel harmony is based on the lexical contrast system that uses [rtr] to distinguish two types of mid vowels. Since [rtr] is used in the lexicon (to create a basic stock of lexical contrasts) and morphology (vowel harmony), redundant [rtr] is suppressed in these same domains via the LICENSE constraint. Where the demands of contrast (LICENSE) and HARMONY are in conflict a range of phenomena result: [low] underparsing, [rtr] underparsing, or the failure to harmonize (opacity to low vowels) are all attested. It is not surprising that low vowel retraction effects and coalescent retraction are limited to post lexical and phrasal contexts where they minimally perturb the morpho-lexical system. Note that this proposal still makes room for systems like Yoruba and Wolof where LICENSING apparently plays no role whatsoever. In these systems, retraction from low vowels and underlying lexical retraction may interact in the lexical component. The difference between these systems falls out from the importance of LICENSE alone.

6.2 Summary and Conclusion

In this final section, I want to reflect back over the whole development of the thesis and consider several significant themes that emerged in the course of the study. Some of these I anticipated and others are new in the sense that they grew out of the research as it progressed.
6.2.1 Musing I. Empirical Breadth

The first point I would like to stress concerns the empirical breadth of the study. My aim was to try to uncover aspects of the phonological system underlying the Bantu C vowel harmony variation paradigm. The languages are all clearly closely related genetically, historically, and areally. An alignment approach to harmony within Optimality Theory was largely successful in terms of accounting for the rich and detailed variation. The idea that the present-day affixes were historically independent particles that were grammaticalized is quite appealing. It is not surprising, given the idiosyncratic nature of historical change, that the real variation in the system is in how harmony extends to prefixes and word level suffixes. In this sense the alignment analysis is really reflecting the historical reality, since STEM harmony is monolithic and likely inherited directly from the historical ancestor language.

6.2.2 Musing II: Distinguishing M-Domains and P-Domains.

A second issue that has emerged is the difficulty of distinguishing morphological and phonological domain effects. It is clear that morphological edges are not the only ones active in the system. Often though, as in the case of Ntomba, an unexpected phonological property like transparency of high vowels to [rtr] harmony points toward a non-morphological edge. Similarly, the nouns-only pattern of Bobangi and the one-syllable-over harmony pattern of Nkundo, force us to look beyond the morphology. It seems in all the cases where a prosodic domain edge is invoked that marked phonological behavior is involved. My intuition is that phonological domains are indeed more marked and
represent transitions between more stable morphologically oriented systems. This is clearly schematic and points to the need for much more work in this area. I hope that the cases presented here contribute to raising the curiosity of phonologists about these problems.

6.2.3 Musing III: Ambiguous Analyses and Marginal Classes

The possibility of having two completely different analyses of the [a...e/o] and [i/u...e/o] sequences is both unsettling and opportune. The (original) analysis in Chapter 3., based on the assumption that the retraction involved [rtr], the root-harmonic variety, is clearly a possible analysis. On the other hand, it does no justice to the marked status of such sequences statistically. This troubled me as the analysis developed and eventually led to the conceptual changes introduced in Chapter 5. The ambiguity is a liability, to be sure, but the chance to focus on the issue of marginality is an opportunity. I originally assumed that the learner would reorganize his ALIGN grammar to accommodate such forms. However this forced the analysis in a direction where the key role of ALIGN LS dominance was obscured. If the learner could easily abandon an analysis where the ranking \{ALIGN L $\gg$ PARSE RTR $\gg$ ALIGN R\} was a basic building block, then nothing can explain how sequences like [e/o...i/u] are universally accepted. Although the reanalysis in Chapter 5 still faces some difficulties, as outlined, it is overall stronger. Its strongest point perhaps is that it forced the analysis in the direction of recognizing the issue of stem-initial prosodic prominence and how it relates to feature alignment. This came up again in the discussion of Mbosi Olélé in the last chapter, where it was seen that
post-lexical [rtr] harmony can be launched from a low vowel, but only if the vowel is in the prosodically strong position. The possibility that some constraint configurations are “deeper” or more basic is an interesting one. It seems that an ALIGN dominance asymmetry is a good candidate for such status. If a child encodes the basic metrical prominence property of the language in terms of an ALIGN asymmetry, it may constitute a kind of parameter which, once set, determines aspects of featural alignment as well. Again this is speculative but should be mentioned as a promising direction for further inquiry.

6.2.4 Musing IV: [rtr] as a Vocalic Feature

The issue of the viability of [rtr] as a vocalic feature is likely to be a topic for active discussion for some time to come. One of my goals has been to widen the database for such discussions. It may be that the detailed and thoughtful proposals made in Goad 1993 or Casali 1996 can be extended to cover the Bantu C paradigm documented here. I have pointed out, however, that representationally encoding the relationship between the features defining [e/o] and [a] does lead to difficulties for these approaches, the question being: if [a] has the harmonic feature by virtue of the representation, then why does [a] never induce harmony? I think a constraint-based relationship between [rtr] and [low] within the OT framework does allow a robust analysis of Bantu C and a wide range of other cases. It also allows the generalization about [rtr] / [low] hostility to be formulated in terms of licensing failure, a key aspect of my proposal. I anticipate fruitful further discussion on these points as researchers with differing assumptions interact with the rich
variation paradigm brought to light here and provide competing solutions consistent with
their views.

6.2.5 Musing V: Level-ordering and Phonological "Components"

Finally, the necessity of appealing to level-ordering might be seen as a liability within an
OT approach. However, conceptually, it seems that the basic notion of distinct lexical
and post-lexical phonological components continues to thrive in modern phonology both
within and outside of OT (see Kenstowicz 1995 and Lombardi 1996, respectively). The
need to distinguish lexical and post-lexical levels in my proposal is in part driven by the
assumptions I adopt, in particular, that low vowel inputs cannot be constrained to have
both [low] and [rtr]. Since coalescent retraction in my account depends on the presence
of [rtr], it is necessary to have a point where "redundant" [rtr] is implemented; my
proposal is really just a refurbished version of the Kiparskyan (1982) idea that redundant
features be implemented post-lexically. How or whether this can be accommodated as a
special mechanism within OT is an open question. Quite apart from this though, the case
of Mbosi Oléé provides striking confirmation of the view I have taken. The fact that one
and the same stem-initial low vowel can crucially induce [rtr] harmony to the left in
prefixes and crucially fail to induce [rtr] harmony to the right in stems points toward the
kind of solution I have proposed.

6.2.6 Conclusion

My overarching goal was to provide a systematic account within Optimality Theory of
the fascinating variation in the Bantu zone C and to draw out some of the wider
implications for phonological theory. I have done this within the limitations imposed by a thesis that must be completed in space and time, and have raised, I think, some interesting questions. If the analyses presented do not prove to be the last word (and surely they won't), it is my hope that the collected data and generalizations regarding vowel harmony in a wide linguistic zone provides grist for ongoing research and contributes to our understanding of the nature and limits of linguistic variation.
References


Carrington, J., 1972b. *Esquisse de Grammaire Lokele.* Ms. Kisangani. (a copy is available at the Musée Royale Belge at Tervuren, Belgium)


Casali, R., 1994. ‘On some uses of ATR’. Ms. UCLA.


Kirchner, R., 1993. Turkish Vowel Disharmony in Optimality Theory. Paper presented at ROW-1, Rutgers University.


252


Leitch, M., 1992. ‘Babole Vowel Harmony’, Ms. UBC.


254


Pulleyblank, D., 1994 ‘Neutral Vowels in Optimality Theory: A Comparison of Yoruba and Wolof’. Ms. UBC.


257


Appendix A: 5 Maps

Geographical Distribution
of Variation Features
Map 2. Suffixal Low Vowel Behaviors

- **Low Assimilation** (plain text)
- **Low Retention / Opacity** (bold text)
- **Low Retention / Transparency** (bold / italic text)
Map 3. Harmony of Final -e

- e Harmonizes (plain text)
- e fails to Harmonize (bold text)
Bantu A.

Oubangian Languages

- Leke
- Babole
- Lobala
- Ngombe
- Doko
- Mbisi
- Likuba

Bantu B.

- Babole Pattern
  * [a...o/e], * [o/e...a]

- Nkundo Pattern
  * [a...o/e], [ o/e...a]

- Likile Pattern
  [a...o/e], [ o/e...a]

Bantu L.

- Gesogo
- Mbesa
- Olombo
- Likile
- Mituku
- Lwankamba
- Losikongo
- Ntomba
- Bolia
- Elembe

Bantu D.

Map 5. Distribution of *[a...o/e], *[o/e...a]}
Appendix B
Vowel Harmony Properties of Key Languages

In this appendix, I provide a summary sketch\(^1\) of the vowel harmony properties of the main languages examined in this study. I have only included languages here for which at least a tentative analysis was offered. By referring to the maps in Appendix A (and the maps on pages 6 and 8 of Chapter 1.), the reader can verify the key properties and location of each language. Below is list of the relevant languages followed by a one page summary of the vowel harmony properties of each one. The languages are listed below in the order they appear in the appendix.

Language Summary Index

<table>
<thead>
<tr>
<th>ZONE ID</th>
<th>LANGUAGE NAME</th>
<th># IN APPENDIX</th>
<th>PAGE IN APPENDIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-10</td>
<td>Babole</td>
<td>B.1</td>
<td>266</td>
</tr>
<tr>
<td>C-20</td>
<td>Mbosi Olée</td>
<td>B.2</td>
<td>267</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.3</td>
<td>268</td>
</tr>
<tr>
<td>C-30</td>
<td>Bobangi</td>
<td>B.4</td>
<td>269</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.5</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.6</td>
<td>271</td>
</tr>
<tr>
<td>C-40</td>
<td>Ngombe</td>
<td>B.7</td>
<td>272</td>
</tr>
<tr>
<td>C-50</td>
<td>Likile</td>
<td>B.8</td>
<td>273</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.9</td>
<td>274</td>
</tr>
<tr>
<td>C-60</td>
<td>Nkundo</td>
<td>B.10</td>
<td>275</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.11</td>
<td>276</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.12</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.13</td>
<td>278</td>
</tr>
<tr>
<td>C-70</td>
<td>Tetela</td>
<td>B.14</td>
<td>279</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.15</td>
<td>280</td>
</tr>
<tr>
<td>C-80</td>
<td>Ndengese</td>
<td>B.16</td>
<td>281</td>
</tr>
<tr>
<td>D-13</td>
<td>Mituku</td>
<td>B.17</td>
<td>282</td>
</tr>
</tbody>
</table>

\(^{1}\) I have not verified for every language the vowel sequences that do not involve retracted vowels. I am assuming, according to the detailed data available for Babole and Nkundo, that these sequences are fine in the other languages as well.
## B.1 Babole

### (I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>$v_2=[i]$</th>
<th>$v_2=[u]$</th>
<th>$v_2=[e]$</th>
<th>$v_2=[o]$</th>
<th>$v_2=[e]$</th>
<th>$v_2=[o]$</th>
<th>$v_2=[a]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1=[i]$</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
<td>i..o</td>
<td>i..a</td>
</tr>
<tr>
<td>$v_1=[u]$</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..e</td>
<td>u..o</td>
<td>*u..o</td>
</tr>
<tr>
<td>$v_1=[e]$</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..e</td>
<td>*e..e</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1=[o]$</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..e</td>
<td>*o..e</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1=[e]$</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1=[o]$</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..e</td>
<td>*o..o</td>
<td>o..e</td>
<td>o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1=[a]$</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..e</td>
<td>*a..e</td>
<td>a..a</td>
</tr>
</tbody>
</table>

### (II) Comments

No retracted mid vowels may occur in stems with advanced mid vowels. In addition low vowels symmetrically are excluded from occurring with retracted mid vowels. The gap [*u..o ] is unexplained. All other high vowel combinations are attested.

### (III) Vowel Harmony Properties: Babole

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Relevant Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>No Harmony</td>
<td>{LEX PATH &gt;&gt; ALIGN WL}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Assimilation</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

- $[a + e / o] = e / o$ No
- $[e / o + a] = e / o$ No
- $[i/u...e/o]$ Yes
- $[a...e/o]$ No

### (IV) References

B.2 Mbosi Oléé

(I) Vowel Sequences in Nominal Stems

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>?i..ɛ</td>
<td>?i..ɔ</td>
</tr>
<tr>
<td>v₁=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>?u..ɛ</td>
<td>?u..ɔ</td>
</tr>
<tr>
<td>v₁=[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
</tr>
<tr>
<td>v₁=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..ɛ</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..o</td>
</tr>
<tr>
<td>v₁=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..ɛ</td>
<td>*a..ɔ</td>
</tr>
</tbody>
</table>

(II) Comments

Mbosi Oléé is unique among the languages in this sample in that a stem initial low vowel provokes retraction harmony in prefixes. Otherwise, a single prefix harmonizes. The data in Fontaney’s article does not permit judgments about whether multiple prefixes harmonize or even if multiple prefixes are possible. I remain uncertain of the status of [i...e] type sequences as well.

(III) Vowel Harmony Properties: Mbosi Oléé

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>?</td>
<td>&lt;&lt;post-lexical harmony&gt;&gt;</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal</td>
<td>Assimilation</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a+e/o]= e/o
[e/o+a]= e/o
[i/u...ɛ/ɔ]
[a...ɛ/ɔ]

(IV) References

Fontaney 1989.

Notes

The property of Mbosi Oléé that distinguishes it from the rest of Bantu Zone C is that retraction harmony is triggered from stem initial low vowels onto a prefix. My analysis is that the low vowel triggered retraction harmony is a post-lexical process that takes advantage of implementation of redundant [rtr] on low vowels post-lexically. However, the triggering behavior is limited to the prosodically strong stem-initial position (and then only provokes harmony to the left); low vowels in other positions are not harmony triggers.
B.3 Likuba

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>$v_2=\text{i}$</th>
<th>$v_2=\text{u}$</th>
<th>$v_2=\text{e}$</th>
<th>$v_2=\text{o}$</th>
<th>$v_2=\text{e}$</th>
<th>$v_2=\text{a}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1=\text{i}$</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>*i..e</td>
<td>*i..a</td>
</tr>
<tr>
<td>$v_1=\text{u}$</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>*u..e</td>
<td>*u..a</td>
</tr>
<tr>
<td>$v_1=\text{e}$</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..e</td>
<td>*e..a</td>
</tr>
<tr>
<td>$v_1=\text{o}$</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..e</td>
<td>*o..a</td>
</tr>
<tr>
<td>$v_1=\text{e}$</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1=\text{o}$</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..e</td>
<td>*o..o</td>
<td>e..e</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1=\text{a}$</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..e</td>
<td>*a..a</td>
</tr>
</tbody>
</table>

(II) Comments

No retracted mid vowels may occur in stems with advanced mid vowels. In addition low vowels are symmetrically excluded from occurring with retracted mid vowels (Babole pattern). In addition Likuba has the “restrictive” high vowel pattern where retracted vowels cannot follow a stem initial high vowel.

(III) Vowel Harmony Properties: Likuba

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>No Harmony</td>
<td>{LEX PATH $\gg$ ALIGN WL}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR $\gg$ LEX PATH}</td>
</tr>
<tr>
<td>Sufffixal [a]</td>
<td>Assimilation</td>
<td>{LICENSE $|$ PARSE LO $\gg$ ALIGN SL $|$ ALIGN SR $\gg$ PARSE LO}</td>
</tr>
</tbody>
</table>

\[a+e/o]= e/o  No
\[e/o+a]= e/o  No
\[i/u/e/o]= e/o  No
\[a/e/o]= No

(IV) References

Adoua 1981.
B.4 Bobangi

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>(v_2=[i])</th>
<th>(v_2=[u])</th>
<th>(v_2=[e])</th>
<th>(v_2=[o])</th>
<th>(v_2=[e])</th>
<th>(v_2=[o])</th>
<th>(v_2=[a])</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v_1=[i])</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>*i..e</td>
<td>*i..o</td>
<td>i..a</td>
</tr>
<tr>
<td>(v_1=[u])</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>*u..e</td>
<td>*u..o</td>
<td>u..a</td>
</tr>
<tr>
<td>(v_1=[e])</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>(v_1=[o])</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..e</td>
<td>*o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>(v_1=[e])</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..a</td>
</tr>
<tr>
<td>(v_1=[o])</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..e</td>
<td>*o..o</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..a</td>
</tr>
<tr>
<td>(v_1=[a])</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..e</td>
<td>*a..o</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments

No retracted mid vowels may occur in stems with advanced mid vowels. In addition low vowels symmetrically are excluded from occurring with retracted mid vowels. In addition Bobangi shares the “restrictive” high vowel pattern of Likuba where retracted vowels cannot follow a stem initial high vowel. Bobangi only harmonizes a nominal prefix and even then only the back/round ones. Verbal prefixes do not harmonize. Suffixal low vowels assimilate as in the Babole pattern.

(III) Vowel Harmony Properties: Bobangi

Domain: Prefixes
Property: Nouns only
Analysis: \{LEX PATH >> ALIGN WL\}

Domain: Final e/o
Property: Harmonizes
Analysis: \{ALIGN WR >> LEX PATH\}

Domain: Suffixal [a]
Property: Assimilation
Analysis: \{LICENSE || PARSE LO^0 >> ALIGN SL || ALIGN SR >> PARSE LO\}

- [a + e/o] = e / o  No
- [e / o + a] = e / o  No
- [i / u...e / o]  No
- [a...e / o]  No

(IV) References


Notes

Bobangi does not have left word-edge harmony. The fact that a single nominal prefix harmonizes is analyzed as alignment to a prosodic domain edge which is defined via a subcategorized-for prefixal element (hence nominal prefixes only).
B.5 Bolia

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>$v_2=[i]$</th>
<th>$v_2=[u]$</th>
<th>$v_2=[e]$</th>
<th>$v_2=[o]$</th>
<th>$v_2=[ɛ]$</th>
<th>$v_2=[ɔ]$</th>
<th>$v_2=[a]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1=[i]$</td>
<td>i.i</td>
<td>i.u</td>
<td>i.e</td>
<td>i.o</td>
<td>i.ɛ</td>
<td>i.ɔ</td>
<td>i.a</td>
</tr>
<tr>
<td>$v_1=[u]$</td>
<td>u.i</td>
<td>u.u</td>
<td>u.e</td>
<td>u.o</td>
<td>?u.ɛ</td>
<td>?u.ɔ</td>
<td>u.a</td>
</tr>
<tr>
<td>$v_1=[ɛ]$</td>
<td>e..i</td>
<td>e..u</td>
<td>e.e</td>
<td>e.o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
<td>e.a</td>
</tr>
<tr>
<td>$v_1=[ɔ]$</td>
<td>o..i</td>
<td>o..u</td>
<td>o.e</td>
<td>o.o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
<td>o.a</td>
</tr>
<tr>
<td>$v_1=[a]$</td>
<td>a..i</td>
<td>a..u</td>
<td>a.e</td>
<td>a.o</td>
<td>*a..ɛ</td>
<td>*a..ɔ</td>
<td>a.a</td>
</tr>
</tbody>
</table>

(II) Comments
No retracted mid vowels may occur in stems with advanced mid vowels. In addition low vowels symmetrically are excluded from occurring with retracted mid vowels. I am not certain of the status of the [i/u..e/o] type sequences. What is unique about Bolia is that it has neither prefix harmony, nor final e/o harmony; essentially it is a stem-harmony-only language under my analysis. It shows derived coalescent retraction in some environments, which is documented in Chapter 6.

(III) Vowel Harmony Properties: Bolia
Domain                              Property  Analysis
Prefixes                            No Harmony  {LEX PATH >> ALIGN WL}
Final e/o                           No Harmony  {LEX PATH >> ALIGN WR}
Suffixal [a]                        Assimilation {LICENSE || PARSE LO || ALIGN SL || ALIGN SR >> PARSE LO}

[a + e/o] = e / ɔ Yes
[e/o+a] = e / ɔ ?
[i/u...e/o] = ?
[a...e/ɔ] = No

(IV) References
Mamet 1960.
B.6 Ntomba

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>(v_2=[i])</th>
<th>(v_2=[u])</th>
<th>(v_2=[e])</th>
<th>(v_2=[o])</th>
<th>(v_2=[\varepsilon])</th>
<th>(v_2=[\alpha])</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v_1=[i])</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..\varepsilon</td>
<td>i..\alpha</td>
</tr>
<tr>
<td>(v_1=[u])</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..\varepsilon</td>
<td>?u..\alpha</td>
</tr>
<tr>
<td>(v_1=[e])</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..\varepsilon</td>
<td>*e..\alpha</td>
</tr>
<tr>
<td>(v_1=[o])</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..\varepsilon</td>
<td>*o..\alpha</td>
</tr>
<tr>
<td>(v_1=[\varepsilon])</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..\varepsilon</td>
<td>e..\alpha</td>
</tr>
<tr>
<td>(v_1=[\alpha])</td>
<td>o..i</td>
<td>o..u</td>
<td>*a..e</td>
<td>*a..o</td>
<td>a..\varepsilon</td>
<td>a..\alpha</td>
</tr>
<tr>
<td>(v_1=[a])</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..\varepsilon</td>
<td>*a..\alpha</td>
</tr>
</tbody>
</table>

(II) Comments
Normal stem-harmony is assumed. Ntomba has full left word edge prefixal harmony combined with suffixal low vowel assimilation. In addition Ntomba fails to harmonize final -e/\o; this is analyzed as failure to align [rtr] with the right WORD edge. Like Babole, Nkundo seems to lack forms with the sequence [u...\o] (this gap is not addressed by my analysis). As with Bolia, its closest neighbor, Ntomba does have derived nominal forms with disyllabic sequences of the [e/\o..e/\o] type, where the second vowel is a word-level suffix. The generalization that such sequences do not occur in non-derived nominals holds, hence the chart above is accurate. Ntomba shows transparency of initial high vowels to retraction harmony.

(III) Basic Vowel Harmony Properties: Ntomba

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Left word-edge</td>
<td>{ALIGN WL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>No Harmony</td>
<td>{LEX PATH &gt;&gt; ALIGN WR}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Assimilation</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

\[
[a + e/o] = \varepsilon / \alpha \\
[e/o+a] = \varepsilon / \alpha \\
[i/u...e/\sigma] = \text{Yes} \\
[a...e/\sigma] = \text{No}
\]

(IV) References

Mamet 1955.
B.7 Ngombe

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..ɛ</td>
<td>i..ɔ</td>
<td>i..a</td>
</tr>
<tr>
<td>v₁[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..ɛ</td>
<td>u..ɔ</td>
<td>u..a</td>
</tr>
<tr>
<td>v₁[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>v₁[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
<td>o..a</td>
</tr>
<tr>
<td>v₁[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..ɛ</td>
<td>e..ɔ</td>
<td>*e..a</td>
</tr>
<tr>
<td>v₁[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..ɛ</td>
<td>a..ɔ</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments

For Ngombe normal stem-harmony is attested. Ngombe lacks prefixal harmony and has suffixal low vowel assimilation (Babole pattern). Ngombe, like Ntomba and Bolia, fails to harmonize final -e/o. Ngombe has the full range of high vowel / retracted vowel sequences, including the elusive [u...o] sequence. In addition, Ngombe allows some forms with sequences of the type [a..ɛ/ɔ], a property shared with the C-50 languages further to the east.

(III) Basic Vowel Harmony Properties: Ngombe

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>No Harmony</td>
<td>{LEX PATH &gt;&gt; ALIGN WL }</td>
</tr>
<tr>
<td>Final e/o</td>
<td>No Harmony</td>
<td>{LEX PATH &gt;&gt; ALIGN WR }</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Assimilation</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[ɔ + e/o] = e / ɔ
[ɛ/o+a] = e / ɔ
[i/u...e/ɔ] = Yes
[a...ɛ/ɔ] = Yes

(IV) References

B.8 Likile

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁=[i]</td>
<td>i.i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>?i..ɛ</td>
<td>?i..ɔ</td>
<td>i..a</td>
</tr>
<tr>
<td>v₁=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>?u..ɛ</td>
<td>?u..ɔ</td>
<td>u..a</td>
</tr>
<tr>
<td>v₁=[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
<td>o..a</td>
</tr>
<tr>
<td>v₁=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>*ɛ..ɛ</td>
<td>*ɛ..ɔ</td>
<td>e..ɛ</td>
<td>e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>*ɔ..ɛ</td>
<td>*ɔ..ɔ</td>
<td>ɔ..ɛ</td>
<td>ɔ..ɔ</td>
<td>ɔ..a</td>
</tr>
<tr>
<td>v₁=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..ɛ</td>
<td>a..ɔ</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments
The database of forms available for Likile in Carrington 1977 is quite small. It is therefore impossible to make a confident generalization about the high vowel / retracted vowel sequences. Like Ngombe, Likile allows some forms with the [a..e/ɔ] type of vowel sequence; it is this property that is in focus in my study with all the C-50 languages. Unlike Ngombe, however, Likile retains suffixal low vowels and they are opaque to [rtr] harmony, following the Nkundo pattern.

(III) Basic Vowel Harmony Properties: Likile

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Yes (at least one?)</td>
<td>{ALIGN φ-DL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + e/o] = e / ɔ  
[e/o+a] = e / ɔ  
[i/u..ɛ/ɔ]  
[a...ɛ/ɔ] = Yes

(IV) References

Carrington 1977.

Notes
The paucity of data and the uncertainties above make an overall proposal for Likile untenable at this point. For partial ranking proposals for C-50 languages see §§ 5.1.4.
B.9 Lokele

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th>(v_1)</th>
<th>(v_2)</th>
<th>(v_3)</th>
<th>(v_4)</th>
<th>(v_5)</th>
<th>(v_6)</th>
<th>(v_7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>i.i</td>
<td>i.u</td>
<td>i.e</td>
<td>i.o</td>
<td>?i.e</td>
<td>?i.o</td>
</tr>
<tr>
<td>u</td>
<td>u.i</td>
<td>u.u</td>
<td>u.e</td>
<td>u.o</td>
<td>?u.e</td>
<td>?u.o</td>
</tr>
<tr>
<td>e</td>
<td>e.i</td>
<td>e.u</td>
<td>e.e</td>
<td>e.o</td>
<td>*e.e</td>
<td>*e.o</td>
</tr>
<tr>
<td>o</td>
<td>o.i</td>
<td>o.u</td>
<td>o.e</td>
<td>o.o</td>
<td>*o.e</td>
<td>*o.o</td>
</tr>
<tr>
<td>e</td>
<td>e.i</td>
<td>e.u</td>
<td>*e.e</td>
<td>*e.o</td>
<td>e.e</td>
<td>e.o</td>
</tr>
<tr>
<td>o</td>
<td>o.i</td>
<td>o.u</td>
<td>*o.e</td>
<td>*o.o</td>
<td>o.e</td>
<td>o.o</td>
</tr>
<tr>
<td>a</td>
<td>a.i</td>
<td>a.u</td>
<td>a.e</td>
<td>a.o</td>
<td>a.e</td>
<td>a.o</td>
</tr>
</tbody>
</table>

(II) Comments

As with Likile, it is impossible to make a confident generalization about the high vowel / retracted vowel sequences. Also like Likile, Lokele allows some forms with the [a..e/o] type of vowel sequence. Instead of retaining suffixal low vowels, however, Lokele shows assimilation on the Babole pattern. The C-50 languages are therefore mixed in this respect. There are contradictory data in Carrington 1972b which makes other generalizations about Lokele vowel harmony difficult. A more robust data source and further research are required.

(III) Basic Vowel Harmony Properties: Lokele

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Yes (at least one?)</td>
<td>{ALIGN O-DL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o Harmonizes</td>
<td></td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a] Assimilation</td>
<td></td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

\[a + e/o = e / \sigma\] ?

\[e/o+a = e / \sigma\] ?

\[i/u...e/o\] ?

\[a...e/o\] Yes

(IV) References

Carrington 1972a, 1972b.

Notes

For partial ranking proposals for C-50 languages see §§ 5.1.4. In general the documentation available on C-50 languages is poor and thorough basic linguistic description is needed for many of the languages.
B.10 Nkundo

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th>v_2=[i]</th>
<th>v_2=[u]</th>
<th>v_2=[e]</th>
<th>v_2=[o]</th>
<th>v_2=[e]</th>
<th>v_2=[a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_1=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
</tr>
<tr>
<td>v_1=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..e</td>
</tr>
<tr>
<td>v_1=[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>e..e</td>
</tr>
<tr>
<td>v_1=[o]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>o..e</td>
</tr>
<tr>
<td>v_1=[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..e</td>
</tr>
<tr>
<td>v_1=[o]</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..e</td>
<td>*o..o</td>
<td>o..e</td>
</tr>
<tr>
<td>v_1=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..e</td>
</tr>
</tbody>
</table>

(II) Comments

Nkundo is the best-documented representative language of the "Mongo" C-60 group. It has single prefixal harmony in verbs and nouns. It harmonizes final -e. It retains suffixal low vowels and they are opaque to retraction vowel harmony. No retraction producing coalescence is found and [a...e/o] sequences are unattested. As with Babole, the sequence [u...e/o] is not found.

(III) Basic Vowel Harmony Properties: Nkundo

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Single Prefix</td>
<td>{ALIGN $\phi$-DL &gt;&gt; LEX PATH &gt;&gt; ALIGN WL}</td>
</tr>
<tr>
<td>Final</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal</td>
<td>Retention / Opacity</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + e/o] = e / o  No
[e/o+a] = e / o  No
[i/u...e/o] Yes
[a...e/o] No

(IV) References


Notes

Languages with single-prefix harmony are analyzed as involving a covert phonological domain left edge which dominates LEX PATH: {ALIGN $\phi$-DL >> LEX PATH >> ALIGN WL}. See §§ 2.2.6 and §§ 2.2.7 for the justification of this left phonological domain edge.
B.11 Losikongo

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>$v_2$=i</th>
<th>$v_2$=u</th>
<th>$v_2$=e</th>
<th>$v_2$=o</th>
<th>$v_2$=e</th>
<th>$v_2$=o</th>
<th>$v_2$=a</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1$=i</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
<td>i..o</td>
<td>i..a</td>
</tr>
<tr>
<td>$v_1$=u</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..o</td>
<td>u..e</td>
<td>u..a</td>
</tr>
<tr>
<td>$v_1$=e</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..e</td>
<td>e..e</td>
<td>e..e</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1$=o</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>o..o</td>
<td>o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1$=e</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..e</td>
<td>e..e</td>
<td>e..e</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1$=o</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>o..o</td>
<td>o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1$=a</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..e</td>
<td>a..o</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments
Losikongo is another language of the “Mongo” C-60 group and has an identical grammar to Elembe Nkutu with respect to the phenomena in this study. It has single prefixal harmony in verbs and nouns. It harmonizes final -e. It retains suffixal low vowels and they are opaque to retraction vowel harmony. In addition [a...e/o] sequences are unattested. As with Nkundo, the sequence [u...o] is not found. Losikongo is distinguished by prefixal harmony which extends to the left word edge.

(III) Basic Vowel Harmony Properties: Losikongo

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Left Word Edge</td>
<td>{ALIGN WL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE [PARSE LO] &gt;&gt; ALIGN SL &gt;&gt; PARSE LO &gt;&gt; ALIGN SR}</td>
</tr>
</tbody>
</table>

[a + e/o] = e / o
[e/o + a] = e / o
[i/u...e/o] = Yes
[a...e/o] = No

(IV) References
Hulstaert 1984b.

Notes
The distinguishing property of Losikongo (and Elembe-Nkutu) with respect to my study is the presence of harmony extending right to the left word edge and the left word edge.
B.12 Nkengo

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
<td>i..ɔ</td>
</tr>
<tr>
<td>v₁=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..e</td>
<td>?u..ɔ</td>
</tr>
<tr>
<td>v₁=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
</tr>
<tr>
<td>v₁=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..ɛ</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..ɔ</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..ɛ</td>
<td>*o..o</td>
<td>o..e</td>
<td>o..ɔ</td>
</tr>
<tr>
<td>v₁=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..ɛ</td>
<td>*a..ɔ</td>
</tr>
</tbody>
</table>

(II) Comments

Nkengo is another language of the “Mongo” C-60 group. It has single prefixal harmony in verbs and nouns. It harmonizes final -e. It retains suffixal low vowels and they are opaque to retraction vowel harmony. In addition [a...e/o] sequences are unattested.

Nkengo is significant for my study because of the coalescence phenomenon where [a + e/o] = e / ɔ.

(III) Basic Vowel Harmony Properties: Nkengo

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Single Prefix</td>
<td>{ALIGN φ-DL &gt;&gt; LEX PATH &gt;&gt; ALIGN WL}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + e/o] = e / ɔ  Yes
[e/o+a] = e / ɔ  No
[i/u...e/ɔ]  Yes
[a...e/ɔ]  No

(IV) References

Hulstaert 1970.
B.13 Lwankamba

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>*i..ε</td>
<td>*i..ɔ</td>
<td>i..a</td>
</tr>
<tr>
<td>v₁=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>*u..ε</td>
<td>*u..ɔ</td>
<td>u..a</td>
</tr>
<tr>
<td>v₁=[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ε</td>
<td>*e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ε</td>
<td>*o..ɔ</td>
<td>o..a</td>
</tr>
<tr>
<td>v₁=[ε]</td>
<td>ε..i</td>
<td>ε..u</td>
<td>*ε..ε</td>
<td>*ε..o</td>
<td>ε..ε</td>
<td>ε..ɔ</td>
<td>ε..a</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..ε</td>
<td>*o..o</td>
<td>o..ε</td>
<td>o..ɔ</td>
<td>o..a</td>
</tr>
<tr>
<td>v₁=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>*a..ε</td>
<td>*a..ɔ</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments
Lwankamba is another language of the “Mongo” C-60 group. It has single prefixal harmony in verbs and nouns. It harmonizes final -e. It retains suffixal low vowels and they are opaque to retraction vowel harmony. In addition [a...ε/ɔ] sequences are unattested. Lwankamba is significant for my study because of the coalescence phenomenon where [ε/ɔ + a] = ε / ɔ, and because it does not allow high vowel-retracted vowel sequences (like Bobangi and Likuba).

(III) Basic Vowel Harmony Properties: Lwankamba

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Single Prefix</td>
<td>{ALIGN ϕ-_DL &gt;&gt; LEX PATH &gt;&gt; ALIGN WL}</td>
</tr>
<tr>
<td>Final ε/ɔ</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + ε/ɔ] = ε / ɔ No
[e/ɔ+a] = ε / ɔ Yes
[i/u...ε/ɔ] No
[a...ε/ɔ] No

(IV) References

Hulstaert 1977.
B.14 Tetela

(I) Vowel Sequences in Nominal Stems
* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th>$v_2$=[i]</th>
<th>$v_2$=[u]</th>
<th>$v_2$=[e]</th>
<th>$v_2$=[o]</th>
<th>$v_2$=[ɛ]</th>
<th>$v_2$=[ɔ]</th>
<th>$v_2$=[a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1$=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..ɛ</td>
<td>i..ɔ</td>
<td>i..a</td>
</tr>
<tr>
<td>$v_1$=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..ɛ</td>
<td>?u..ɔ</td>
<td>u..a</td>
</tr>
<tr>
<td>$v_1$=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>e..ɛ</td>
<td>e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1$=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>o..ɛ</td>
<td>o..ɔ</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1$=[ɛ]</td>
<td>ɛ..i</td>
<td>ɛ..u</td>
<td>*ɛ..ɛ</td>
<td>*ɛ..ɔ</td>
<td>ɛ..ɛ</td>
<td>ɛ..ɔ</td>
<td>ɛ..a</td>
</tr>
<tr>
<td>$v_1$=[ɔ]</td>
<td>ɔ..i</td>
<td>ɔ..u</td>
<td>*ɔ..ɛ</td>
<td>*ɔ..ɔ</td>
<td>ɔ..ɛ</td>
<td>ɔ..ɔ</td>
<td>ɔ..a</td>
</tr>
<tr>
<td>$v_1$=[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..ɛ</td>
<td>a..ɔ</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments
Tetela, as can be seen from the above chart, allows many apparently disharmonic sequences (note especially the underlined pairs which are seen in no other languages of my sample). I hypothesize that Tetela has the same fundamental vowel harmony system as the other Bantu C. languages examined, and that the “disharmonic” sequences are simply cases of affixation with a “retracted” suffix. There are productive verbal suffixes that are retracted as well, so this is not surprising.

(III) Vowel Harmony Properties: Tetela

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Single Prefix</td>
<td>{ALIGN φ-DL &gt;&gt; LEX PATH &gt;&gt; ALIGN WL}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + e/o] = ɛ / ɔ
[e/o+a] = ɛ / ɔ
[i/u...ɛ/ɔ] = Yes
[a...ɛ/ɔ] = Yes

(IV) References
B.15 Ombo

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th>$v_2$</th>
<th>$v_2$= [i]</th>
<th>$v_2$= [u]</th>
<th>$v_2$= [e]</th>
<th>$v_2$= [o]</th>
<th>$v_2$= [e]</th>
<th>$v_2$= [o]</th>
<th>$v_2$= [a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_1$= [i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
<td>i..o</td>
<td>i..a</td>
</tr>
<tr>
<td>$v_1$= [u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..e</td>
<td>u..o</td>
<td>u..a</td>
</tr>
<tr>
<td>$v_1$= [e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>e..e</td>
<td>e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>$v_1$= [o]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>o..e</td>
<td>o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>$v_1$= [a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>a..e</td>
<td>a..o</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments

Ombo has low-vowel retention and opacity, full left word-edge prefixal harmony, and harmony of final -e / -o.

(III) Vowel Harmony Properties: Ombo

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Left Word Edge</td>
<td>{ALIGN WL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opacity</td>
<td>{LICENSE | PARSE LO$^*$ &gt;&gt; ALIGN SL &gt;&gt; PARSE LO &gt;&gt; ALIGN SR }</td>
</tr>
</tbody>
</table>

[a + e/o] = e / o
[e/o+a] = e / o ✓
[i/u...e/o] permitted ✓
[a...e/o] ✓

(IV) References

*Meeussen 1952.*
B.16 Ndengese

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v1-[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>i..e</td>
<td>i..o</td>
<td>i..a</td>
</tr>
<tr>
<td>v1-[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>u..e</td>
<td>u..o</td>
<td>u..a</td>
</tr>
<tr>
<td>v1-[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>v1-[o]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..e</td>
<td>*o..o</td>
<td>o..a</td>
</tr>
<tr>
<td>v1-[e]</td>
<td>e..i</td>
<td>e..u</td>
<td>*e..e</td>
<td>*e..o</td>
<td>e..e</td>
<td>e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>v1-[o]</td>
<td>o..i</td>
<td>o..u</td>
<td>*o..e</td>
<td>*o..o</td>
<td>e..e</td>
<td>e..o</td>
<td>e..a</td>
</tr>
<tr>
<td>v1-[a]</td>
<td>a..i</td>
<td>a..u</td>
<td>a..e</td>
<td>a..o</td>
<td>?a..e</td>
<td>?a..o</td>
<td>a..a</td>
</tr>
</tbody>
</table>

(II) Comments

Ndengese is unique among the languages in the sample in that suffixal low vowels are transparent to retraction harmony rather than opaque or assimilating. In fact Ndengese shows transparency of low vowels to retraction harmony even in the prefixal domain. In my analysis, this is due to the low ranking of the constraint LICENSE which prohibits linkings between the features [low] and [rtr]. In Ndengese, {HARMONY || PARSE LO >> LICENSE}. Note that there is some uncertainty about the status of sequences [a..e] and [a..o] due to the scarcity of nominal data in the source reference. If LICENSE is no longer playing a decisive role, the analysis predicts that sequences of this sort (with harmonic [rtr]) should be possible since they do not constitute ALIGN SL violations. A more robust data source would be required to confirm this.

(III) Basic Vowel Harmony Properties: Ndengese

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Left Word Edge</td>
<td>{ALIGN WL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Trans.</td>
<td>{PARSE LO &gt;&gt; ALIGN SL &gt;&gt; PARSE LO &gt;&gt; ALIGN SR &gt;&gt; LICENSE}</td>
</tr>
</tbody>
</table>

| [a + e/o] = ε / ɔ | ? |
| [e/o+a] = ε / ɔ | ? |
| [i/u...ε/o] | Yes |
| [a...ε/ɔ] | ? |

(IV) References

B.17 Mituku

(I) Vowel Sequences in Nominal Stems

* = non-attested (cells are shaded to give visual prominence)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>v₁=[i]</td>
<td>i..i</td>
<td>i..u</td>
<td>i..e</td>
<td>i..o</td>
<td>*i..ɛ</td>
<td>i..ɔ</td>
<td>i..a</td>
</tr>
<tr>
<td>v₁=[u]</td>
<td>u..i</td>
<td>u..u</td>
<td>u..e</td>
<td>u..o</td>
<td>*u..ɛ</td>
<td>u..ɔ</td>
<td>u..a</td>
</tr>
<tr>
<td>v₁=[ɛ]</td>
<td>e..i</td>
<td>e..u</td>
<td>e..e</td>
<td>e..o</td>
<td>*e..ɛ</td>
<td>*e..ɔ</td>
<td>e..a</td>
</tr>
<tr>
<td>v₁=[ɔ]</td>
<td>o..i</td>
<td>o..u</td>
<td>o..e</td>
<td>o..o</td>
<td>*o..ɛ</td>
<td>*o..ɔ</td>
<td>o..a</td>
</tr>
</tbody>
</table>

(II) Comments

Although Mituku is classified as a Bantu D. language (D-13 in Guthrie 1948), it has a vowel harmony system closely resembling the other languages in this study. It has suffixal low vowels that are retained and are opaque to retraction harmony. Mituku is unique in the sample here in that it allows high vowel \ retracted vowel sequences where the retracted vowel is non-front or round but not where the retracted vowel is front. This can be seen in the above chart.

(III) Basic Vowel Harmony Properties: Mituku

<table>
<thead>
<tr>
<th>Domain</th>
<th>Property</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefixes</td>
<td>Left Word Edge</td>
<td>{ALIGN WL &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Final e/o</td>
<td>Harmonizes</td>
<td>{ALIGN WR &gt;&gt; LEX PATH}</td>
</tr>
<tr>
<td>Suffixal [a]</td>
<td>Retention / Opaque</td>
<td>{LICENSE</td>
</tr>
</tbody>
</table>

[a + e/o] = e / ɔ ?
[e/o+a] = e / ɔ ?
[i/u...e/ɔ] only {PARSE HI || FR / RTR >> ALIGN SL >> PARSE RTR ROOT >> ALIGN SR}
[a...e/ɔ] Yes

(IV) References