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OCP EFFECTS IN OPTIMALITY THEORY*

The Obligatory Contour Principle (OCP) forbids representations in which identical elements are adjacent. A sequence of two high tones, for example, is avoided in a variety of ways: one of the tones is deleted or retracted away from the other, or the two are fused into a single high tone. Processes that would create such a sequence are blocked. The problem is how to derive all these different ways of avoiding this configuration from a single principle.

It is argued here that Optimality Theory (OT) provides the means to derive the full range of dissimilatory effects from the OCP, through the ranking of the OCP with Faithfulness constraints. Examples of tonal dissimilation in three Bantu languages are examined: Shona, Rimi, and Kishambaa. The analysis supports the OT interpretation of constraints as violable and ranked.

0. Introduction

The Obligatory Contour Principle has been proposed as a fundamental constraint on autosegmental representations (Leben 1973, 1978, McCarthy 1986).

(1) *Obligatory Contour Principle (OCP)*
Adjacent identical elements are prohibited.

In the domain of tone, for example, the OCP rules out representations such as that in (2), in which two high tones are adjacent:[1]

```
(2)   *H   H
       |   |
       σ   σ
```

Three different effects have been attributed to the OCP, depending on whether it is interpreted as: (1) a *morpheme structure constraint*, (2) a *rule blocker*, or (3) a *rule trigger*.

According to the interpretation of the OCP as a morpheme structure

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[1] In (2), the two tones are associated with adjacent syllables. This is just one kind of adjacency (Archangeli and Pulleyblank 1987, Odden 1994), and the OCP has different effects depending on which kind one assumes (Myers and Carleton 1996). All the tone patterns discussed in this paper involve syllable adjacency.

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constraint, no morpheme can have a violation of the OCP in its underlying representation. Thus a sequence of high-toned syllables within a morpheme must be represented underlyingly with a single multiply-linked high tone, as in (3), and never with two high tones as in (2).

```
(3)     H
       / \
      σ   σ
```

Considerable evidence has accumulated in favor of this interpretation: Leben (1973), McCarthy (1986), Hyman (1987), Kenstowicz and Kidda (1987), and Myers (1987).

According to the interpretation of the OCP as a *rule blocker* (McCarthy 1986), the application of a phonological rule is blocked if it would create a violation of the OCP. In Shona, a Bantu language of Zimbabwe, a high tone spreads onto a following toneless syllable, as illustrated in (4a). There is no spread, however, if the syllable following the target syllable is also high, as in (4b). Application in that case would create a violation of the OCP, as in (4c).[2]

(4) a. á-rí kú-gar-a
3rdsg-copula inf-stay-term

```
      H
    / | \
  a  ri  kugara
```

he/she is staying
(cf. árí 'he/she is', kugara 'to stay'

b. árí ku-téng-á
3rdsg-copula inf-buy-term

```
   H       H
  / \     / \
 a   ri  ku tenga
```

c. *á-rí kú-téng-á

```
     *H      H
    / | \   / \
  a  ri  ku  tenga
```

Evidence for the OCP as a rule blocker is presented in McCarthy (1986), Archangeli (1986), Itô and Mester (1986), Borowsky (1987), and Myers (1987).

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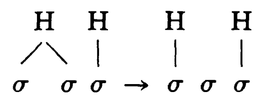
[2] Here and in the following, acute accent marks high tone, and the absence of an accent indicates low tone. Hyphens indicate morpheme boundaries. Cardinal numbers in the morpheme-by-morpheme glosses denote noun classes, and ordinal numbers denote person categories. The abbreviation "term" indicates the terminal verb suffix, which can mark inflectional categories or nominalization.

According to the interpretation of the OCP as a *rule trigger* (Yip 1988), if a violation of the OCP arises in the derivation through morphological or syntactic concatenation, some operation must intervene to 'repair' the violation. For example, if an expression ending in a high tone is juxtaposed with an expression beginning with a high tone, that OCP-violating representation must be converted into a representation that conforms to the OCP. In Shona, the first high tone is retracted, as in (5), or, if that is not possible, the second high tone is deleted, as in (6).

(5) a.



b. bánga gúrú cf. bángá
knife big *knife*
a big knife

(6) a. H → Ø / H _

b. í-banga cf. bángá
copula-knife *knife*
(it) is a knife

In other Bantu languages there are other operations that convert an OCP-violating representation into an OCP-obeying one:

(7) /. . . H_1 H_2 . . ./
a. H_2 is deleted (Shona)
b. H_1 is deleted (Rimi)
c. H_1 is retracted away from H_2 (Shona)
d. H_2 is retracted away from H_1 (Chichewa)
e. H_1 and H_2 are fused into one $H_{1,2}$ (Shona, Kishambaa)

Most of the possible ways in which an OCP violation in tone could be eliminated are attested in one or the other of these Bantu languages. All of these cases will be discussed below except for (7d) (for which see Myers and Carleton 1996).

Yet another possible response to an OCP violation is to do nothing. Surface forms that violate the OCP occur in Kishambaa (Odden 1982), Supyire (Carlson 1983), and Igbo (Clark 1990, Liberman et al. 1993). In these languages, two adjacent high tones originating from separate morphemes remain phonetically distinct, corresponding to distinct pitch levels. A multiply-associated H originating from one morpheme, on the other hand, is realized as a sequence of syllables at the same high pitch. These languages therefore have a surface contrast between (2) and (3), in violation of the OCP. The case of Kishambaa will be discussed below in Section 2.3.

The passive interpretations of the OCP (as morpheme structure constraint and rule blocker) are straightforward in that they can be applied in the same way to all languages. However, because of the variety of ways in which OCP-violating configurations are altered in languages, it has proven difficult to derive the active effects (OCP as rule trigger) from a single principle.

It has often been suggested that dissimilation is a result of the OCP, but it has not been demonstrated how this result is to be derived. One might propose, for example, that there is a convention that in case of an OCP violation, the 'minimal' change in the representation is made that eliminates the violation. But the variety of attested dissimilation patterns, all involving one simple change in the representation, make such a proposal untenable. If these changes are all minimal, what determines the choice among them in a given language?

Yip (1988) suggests another approach to the active effects of the OCP. She cites the case of Seri, in which a glottal stop is deleted if there is another glottal stop earlier in the same syllable (.ʔVʔ. → ʔV.). Yip proposes that all that needs to be specified for this dissimilatory process is the domain (syllable), the tier (laryngeal), and the structural change "delete second" (p. 76). The trigger is the universal OCP and can be left out of the formulation of the language-particular rule.

There are two problems with this proposal. First, it is not clear exactly how the OCP triggers the rule. Out of the set of universal constraints, what determines that it is the OCP that is relevant here? Second, Yip's informal rule format obscures a covert recapitulation of the OCP in the dissimilatory rule. The structural change "delete second" is intended to mean "delete the second of two laryngeal articulations that violate the OCP". It conveys this information only because of the anaphoric possibilities of ellipsis in English. Any more formal statement of this change would have to refer to the sequence of two glottal stops in order to express which one is affected, which would simply be a recapitulation of the OCP. This is therefore not a model in which dissimilatory effects are derived as effects from the OCP.

One could conclude that the OCP is not a universal constraint (Odden 1986, 1988), or that only the passive interpretations are universal (Myers 1991). But in either case one would miss the generalization that instances of the configuration in (2) tend strongly to be reshaped into other configurations, and that this is the same configuration that is avoided in the cases that motivate the passive interpretations of the constraint.

The same problem occurs with other constraints on representations. The Clash Filter (Prince 1983) blocks processes that would lead to stress clashes, and it also motivates the active responses of destressing and stress movements. Exhaustive Syllabification or Prosodic Licensing (McCarthy 1982, Selkirk 1981, Itô 1986) blocks rule applications that would result in unsyllabifiable segments, but it also triggers operations such as epenthesis and Stray Erasure that eliminate such segments. Structure Preservation and constraints on feature co-occurrence constrain the application of phonological rules (Kiparsky 1985), but they also motivate language-particular 'repair strategies' (Paradis 1988, Myers 1991, Calabrese 1995). In all of these cases, it has been unclear how to derive the passive effects and the various active effects from the same constraint, given traditional interpretations of constraints.

In this paper, I argue that Optimality Theory (OT) provides the means to derive the full range of dissimilatory effects from the OCP. After briefly introducing the essential properties of OT in Section 1, I turn in Section 2 to dissimilatory tone patterns in three Bantu languages. I show that the various responses in these languages to OCP violations can be captured through the ranking of the OCP with various members of the set of Faithfulness Constraints. In Section 3, I review the analyses, arguing that these data support the OT interpretation of constraints as violable and ranked.[3]

1. Optimality Theory

Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a,b, 1994, 1995) is a theory of constraints and constraint interaction. In this model, there is a mapping GEN from any input representation to a large set of potential outputs. The candidate outputs are evaluated against a ranked set of constraints, and the candidate that best satisfies those constraints is selected as the actual output.

The part of GEN relevant to tones can be expressed as in (8), where T is a tone and X is a tone-bearer (mora or syllable).

(8)a. $\emptyset \rightarrow T$	b. $T \rightarrow \emptyset$	c. T ⋮ X	d. T ǂ X

The operations in (8a) and (8b) insert and delete tones, while those in

[3] Alderete (1996) proposes a convincing account of dissimilation in terms of self-conjoined markedness constraints. In such an approach, the tonal OCP as discussed here can be seen as one member of a family of constraints forbidding two instances of the same marked property in two adjacent syllables.

(8c) and (8d) insert and delete tone associations. The operations are optional and unordered, so they generate every conceivable matching of the tone tier and the tone-bearing tier for a given input.

Most sounds do not alternate according to context. The default is to do nothing. In OT, this inertia is expressed by the Faithfulness Constraints, which deal with the correspondence of the input (I) and the output (O) of GEN (McCarthy and Prince 1995). Correspondence is defined in (9).

(9) *Correspondence* is a relation between an element *a* of one representation and an element *a'* of another representation.

Correspondence between the input and the output is constrained by Faithfulness Constraints, such as those in (10), which require corresponding elements to resemble each other:[4]

(10) a. MAX-IO (X): Every element of type X in the input has a correspondent of type X in the output.
b. DEP-IO (X): Every element of type X in the output has a correspondent of type X in the input.
c. UNIFORMITY-IO (X): If *a* and *b* are distinct elements of type X in the input, then their output correspondents *a'* and *b'* are also distinct elements of type X.

MAX-IO penalizes deletion, DEP-IO penalizes insertion, and UNIFORMITY-IO penalizes fusion.

An output representation that obeys all Faithfulness constraints is identical to the input. Faithfulness can, however, be overridden by higher-ranked constraints on outputs, and it is this that results in alternations.[5] Deletion arises, for example, when an output constraint dominates MAX-IO, and insertion arises when an output constraint dominates DEP-IO.

A crucial aspect of OT for the analysis of OCP effects is the way in which it can express both the active (triggering) and the passive (blocking) effects of constraints (Prince and Smolensky 1993, p. 23). This is schematized in (11):

[4] The definitions in (10) are based on those of McCarthy and Prince (1995), differing from them only in that correspondence is here generalized to all entities in a phonological representation, rather than being restricted to segments. For other applications of such generalized Faithfulness, see Pulleyblank (1994) and Itô, Mester and Padgett (1995).

[5] I assume that the Faithfulness Constraints are the only ones that refer to the input. All constraints that can override the Faithfulness Constraints and so induce alternations are constraints on output representations. Conversely, all constraints that refer to the input must require correspondence between some element of the input and some element of the output. For an alternative view, see McCarthy (1994).

(11)a. Phonological changes occur when an output constraint C crucially dominates a Faithfulness Constraint. C *triggers* a change in the input.

b. If C_1 triggers a change in the input because it dominates a Faithfulness constraint, then that change is *blocked* if there is another constraint C_2 that crucially dominates C_1.

The constraint Prosodic Licensing, for example, requires each segment to be associated with a syllable or mora (Itô 1986, cf. Exhaustive Syllabification (Selkirk 1981), or PARSE (Prince and Smolensky 1993)). If Prosodic Licensing dominates MAX-IO (Segment), then a segment that does not fit into the syllable structure of a language will be deleted (Stray Erasure: Itô 1986, Prince and Smolensky 1993). If Prosodic Licensing dominates DEP-IO (Segment), there will be epenthesis to render unsyllabifiable strings syllabifiable. Prosodic Licensing can also block deletion, if it dominates a constraint C that dominates MAX-IO. This leads to the familiar pattern in which vowel deletion is blocked just in case the result would be unsyllabifiable, as in the doubly open syllable context VC__CV (McCarthy 1982, p. 33).

Prince and Smolensky (1993) demonstrate that a single constraint can have both triggering and blocking effects depending on its ranking with respect to other constraints. This suggests that we might be able to use the same approach to derive the various effects of the OCP noted in the introduction.

2. The OCP in Three Bantu Tone Systems

Interpreted as an OT constraint, the OCP assigns a violation for each sequence of identical elements. In the case of tone, it assigns a violation for each pair of identical adjacent tones, as in (2). The effects of this constraint depend on its interaction with other constraints.

I will argue that the ranking of the OCP with respect to the Faithfulness constraints enables us to capture the diverse effects of the OCP, both active and passive. We will look at dissimilatory patterns in tone in three Bantu languages: Shona (Section 2.1), Rimi (Section 2.2), and Kishambaa (Section 2.3). In each case, we will be looking at what happens when two high tones from different morphemes are brought together through morpheme concatenation.

I focus on what happens when two *high* tones come together because low tone is completely inert in all three languages considered, as in other Bantu languages (Stevick 1969). Tonological patterns in Bantu languages depend on high tones, not low tones. For example, when two high tones are juxtaposed, something generally happens, but nothing happens when two low-toned syllables are juxtaposed. Moreover, low-toned syllables are also phonetically inert. The pitch of low-toned syllables is a function of the pitch of surrounding high tones (Stevick 1969, Myers 1997).

I will therefore assume that the tone contrast in Bantu languages is a privative one between the presence of a high tone and its absence. This is expressed through the following constraint:

(12) *L

This constraint forbids low tones. It crucially dominates a Faithfulness Constraint in all the Bantu languages under consideration. This insures that no actual output will include a low tone (Prince and Smolensky 1993, pp. 175–196).

2.1. *Shona*

In this section we will consider tonal alternations in Zezuni Shona, a Bantu language spoken in Zimbabwe, described by Fivaz (1970), Fortune (1985), Myers (1987) and Hewitt (1992). The closely related Karanga dialect has been studied by Odden (1981). Some preliminary assumptions about morphological domains in the language are presented in Section 2.1.1. The configuration of two adjacent high tones, forbidden by the OCP, is avoided in Shona in four different ways, discussed in Sections 2.1.2–2.1.5, respectively.

2.1.1. *Domains*

In Shona, as in other Bantu languages, tone alternations are often restricted so that they occur in one set of morphological constructions, but not in others. Myers (1987, to appear) argues that this morphological conditioning can be stated in terms of three domains: *stem*, *macrostem*, and *phonological word.*

Only the distinction between the macrostem and the phonological word will be important in the following analysis. The *macrostem* (Hyman and Ngunga 1994, Myers, to appear) consists of the stem (i.e. the root plus suffixes) and optional prefixes, as in (13). The macrostem prefixes include the object marker (as in (13a)), and the subject and tense markers of the subjunctive, participial, and negative inflections (designated $\text{Subject}_{\text{macro}}$ and $\text{Tense}_{\text{macro}}$, as in (13b) and (13c). The minimal macrostem is a stem, as in (13d).

(13) Macrostem: [(Subject$_{macro}$ – Tense$_{macro}$) – (Object) – Root – (Suffix)* – (Term)]

a. . . . [mú-ón-á] as in kumúóná
him/her-see-term 'to see him/her'

b. [tí-ón-é]
1stpl/subjunctive-see-term
we see (subjunctive)

c. [va-chí-tárís-a]
3rdpl-present participial-look-term
while/if they are seeing

d. . . . [gar-o] as in chigaro
sit-term 'chair'

In the examples that follow, macrostems will be delimited with square brackets.

The *phonological word* (PW) consists of a lexical macrostem (e.g. noun or verb) preceded by optional clitics, as in (14). The clitics in Shona include the copula, the prepositions ("associative markers"), the class markers, and all the inflectional prefixes that aren't included in the macrostem. Examples are given in (14d–f).

(14) a. PW: Macrostem$_{lexical}$
b. PW: Clitic PW
c. Clitic: Copula, Preposition, Class, Subj$_{clitic}$ + Tense$_{clitic}$, . . .
d. [í][banga]
copula-knife
(it) is a knife

e. [né][banga]
with-knife
with a knife

f. [ndi-chá][teng-a]
1stsg-fut-buy-term
I will buy

Phonological words are marked off in the following examples with spaces, as in the orthography.

I will assume these domains in the following analysis because they simplify the reference to morpheme classes in Shona, but they are not crucial to the analysis. Any analysis, whether derivational or constraint-based, must distinguish the relevant classes of morphological constructions in some way. The skeptical reader can interpret references to the macro-stem and phonological word domains as merely referring to the sets of morphological constructions subsumed under those terms, as summarized in (13) and (14).

2.1.2. *Meeussen's Rule*

The first of the ways in which OCP violations are avoided in Shona is found when a high-tone-initial word is preceded by a high-toned clitic (i.e. a high-toned member of the morpheme classes in (14c)). In this case, there is lowering of the whole high-toned sequence after the clitic, as in (15). The underlyingly high toned vowels are underlined, here and henceforth.[6]

(15) a. [í̲][ba̲nga̲]
copula-knife
(it) is a knife
cf. bá̲ngá̲ 'knife'

b. [vá̲][se̲ku̲ru]
2a-grandfather
grandfather (honorific)
cf. sé̲kú̲ru 'grandfather'

c. [ndi-chá̲][te̲ng-es-a]
1stsg-future-buy-causative-term
I will sell
cf. [ku][té̲ng-és-á] 'to sell'[7]

d. [v-á̲][te̲ng-es-a]
3rdpl-past-buy-causative-term
they sold
cf. [ku][té̲ng-és-á] 'to sell'

This process is known as Meeussen's Rule (Goldsmith 1984).

[6] In accordance with Lexicon Optimization (Prince and Smolensky 1993, Inkelas 1995), I assume that the underlying representation is as fully specified as possible. Thus the high tone of the verb root /téng/ (in (13c) and (13d) is assumed to be underlyingly associated, although this association is predictable. An input with a floating tone would be mapped to the same output, but would incur violations of DEP-IO (A) that would not be incurred by the alternative input with the associated tone.

[7] The high tones on the vowels following /téng/ are due to tone spread. See Sections 2.1.3 and 2.1.5.

In a derivational analysis (e.g. Myers 1987), one would posit a rule deleting a high tone after a high tone, as in (16).

(16) a. H → Ø / H __ (Phonological word)

```
   b. H   H      H
      |  / \     |
      i ba  nga → i ba nga
```

The problem with this account is that it does not relate the operation of tone deletion to the crosslinguistic generalization that a sequence of high tones is avoided. It thus does not relate this way of avoiding a sequence of high tones to the other ways discussed above in (4)–(7). The OT account, on the other hand, can make this connection.

In OT, deletion of a tone occurs if an output constraint dominates MAX-IO (T), the member of the MAX constraint family that requires a tone in the input to have a correspondent in the output. The input in the Meeussen's Rule cases violates the OCP, so we can account for the deletion by ranking the OCP over MAX-IO (T). It is higher priority in Shona to obey the OCP than it is to keep all the underlying high tones.

But what determines that it is the second high tone that is deleted and the first one that survives? I propose that the relevant constraint is of the ALIGN family (McCarthy and Prince 1993b):

(17) ALIGN-L: ALIGN (H, L, PWd, L)

ALIGN-L requires that the left edge of each tone (defined as the left edge of the leftmost syllable associated with that tone) be aligned with the left edge of the prosodic word. A violation is assessed for each syllable that separates a given tone from that edge.

The influence of this constraint is seen in the tendency of tones in Shona to associate with the leftmost available tone bearer, as illustrated in (18).[8]

(18) a. *H of the verb root*

[té̱ng-és-ér-a] (*te̱ngésérá)	[ká̱ngá̱nw-á] (*ka̱ngá̱nwá)
buy-causative-applicative-term	*forget-term*
sell to!	forget!

[8] Tone spread, to be discussed in the next section, is responsible for the strings of high-toned syllables in (18a) and (18b).

b. *Copula /H/*
[chí][gár-o] cf. [chi][gar-o]
7/copula-sit-nominalizer *7-sit-nominalizer*
(it) is a chair chair

c. *Participial /H/*
[ndí-cha-téng-a]
1stsg/participial-future participial-buy-term
I having bought

cf. [ndi-chá][teng-a]
1stsg-future-buy-term
I will buy

The tone of a verb root is always associated with the first syllable of the verb stem, as in (18a).[9] There is no lexical contrast in the position of tones in verb roots. The floating high tone marking the copular form of a noun, as in (18b), always associated with the first syllable of the noun (i.e. the first class marker), and the floating high tone marking the participial form of a verb, as in (18c), is always associated with the first syllable of the verb (i.e. the subject marker). ALIGN-L reflects the general crosslinguistic preference for left-to-right association of tones (Pulleyblank 1986), a preference that can be motivated by considerations of speech perception (Myers, in press).

The Meeussen's Rule pattern can be expressed through the following ranking:

(19) Meeussen's Rule Pattern: OCP ≫ MAX-IO (T) ≫ ALIGN-L

MAX-IO (T) must dominate ALIGN-L, because high tones do occur in non-initial position (e.g. *badzá* 'hoe'). If ALIGN-L dominated MAX-IO (T), then the best way to satisfy alignment in this case would be to delete the offending tone (**badza*).[10]

The evaluation of *íbanga* (15a) is as in tableau (20):

---

[9] A high tone within the verb stem occurs on the first syllable of the verb stem, as in *[ku][téngéséra]* 'to sell to', rather than the first syllable of the phonological word as demanded by ALIGN-L: **[kú][téngéséra]*. I assume that there is a dominant constraint requiring that a high tone belonging morphologically to the verb stem must be realized in the verb stem. Satisfying this constraint while minimally violating ALIGN-L leads to association with the verb-stem-initial position.

[10] The output candidate **bádza*, with displacement of the tone to satisfy ALIGN-L, violates MAX-IO (A) in (32) below.

(20) Input: H_1 H_2 / i banga

Candidates	OCP	MAX-IO (T)	ALIGN-L
a. H_1 H_2 / i banga	*!		*
b. → H_1 / i banga		*	
c. H_2 / i banga		*	*!

Candidate (20a) violates the OCP, the highest ranked constraint, and so is less harmonic (optimal) than either of the less faithful candidates (20b) or (20c). Both of these candidates violate MAX-IO (T). Candidate (20c), however, violates ALIGN-L as well, which leaves (20b) as the dptimal candidate.

In the Meeussen's Rule pattern, the OCP, an output constraint, triggers a dissimilatory change because it dominates a Faithfulness Constraint, MAX-IO (T). Other potential ways of avoiding the OCP violation are ruled out by ranking MAX-IO (T) below other Faithfulness constraints, so that deletion of the tone is the optimal solution. Consider the candidates in (21), all of which obey the OCP.

(21) Input: H_1 H_2 / i banga

Candidates	Violated Constraint
a. $H_{1,2}$ / i banga	UNIFORMITY-IO (T)
b. H_1 H_2 / i i banga	DEP-IO (σ)
c. H_1 L H_2 / i banga	DEP-IO (T), *L

Candidate (21a), with fusion of the two input high tones into one output tone, violates UNIFORMITY (T), which requires that correspondence be one-to-one. Candidates (21b) and (21c), with insertion of a buffer syllable or a buffer tone, violate different members of the DEP-IO family. All of these Faithfulness constraints must be ranked above MAX-IO (T) to guarantee that (20b) is the optimal output.

2.1.3. *Blocking of Tone Spread*

Another tone pattern in Shona in which a sequence of high tones is avoided is tone spread. A high tone on a syllable followed by a toneless syllable in another morpheme spreads onto that toneless syllable. This occurs, for example, when a high-toned clitic precedes a low-tone-initial word, as in (22a–c).

(22) a.	[í̲][sádza] *copula-porridge* (it) is porridge	cf. [sadza] 'porridge'
b.	[ti-chá̲][véreng-a] *1stpl-future-read-term* we will read	cf. [ku][vereng-a] *infinitive-read-term* to read
c.	[ndi-ngá̲][véreng-e] *1stsg-potential-read-term* I could read	cf. (b)
d.	[bá̲zi] branch	
e.	[í̲][badzá̲] *copula-hoe* (it) is a hoe	cf. [badzá̲] 'hoe'

However, spread fails to occur if the target syllable is in the same morpheme as the trigger, as in (22d), or if it is followed by a high-toned syllable, as in (22e). Spread in the latter case would create a violation of the OCP.

To analyze this blocking pattern, we must first account for the spread. In any case of spread, the output has associations that have no counterpart in the input. None of the feature specifications change when a specification is spread, but the position of the specification vis-à-vis other specifications does change. The default, as usual, is to have no change. To express this, we need a Faithfulness constraint that takes as its argument the associations themselves (cf. Pulleyblank 1994):

(23) DEP-IO (A): An association in the output must have a correspondent in the input.

An association is a binary relation between two elements, so there is no question of a tone association if either the tone or the tone-bearer are missing. Therefore, DEP-IO (A) is violated if and only if (a) there is an output tone T' that has an input correspondent T, (b) there is an output syllable S' that has an input correspondent S, and (c) T' is associated with S' but T is not associated with S.

For there to be spread, this Faithfulness constraint must be dominated. I assume that the basic driving force behind spread is a requirement that syllables bear tones:

(24) SPECIFY (T): A syllable must be associated with a tone.

This constraint is equivalent to a clause of the Well-Formedness Condition of Goldsmith (1976). McCarthy and Prince (1995, p. 266) note that it can be interpreted as a member of the MAX family of constraints, since it requires an element of one subrepresentation (the tone-bearing tier) to have a correspondent in another subrepresentation (the tone tier). DEP-IO (T), which forbids the insertion of tone, must dominate SPECIFY (T), since otherwise the optimal output for a toneless input would have an inserted high tone associated with all its syllables.[11]

If SPECIFY (T) dominates DEP-IO (A), then the optimal output for an input with a high tone will, all else being equal, have that high tone spread to all the syllables in the form, leaving none unspecified. But the correct output has the high tone spread just one syllable to the right. We therefore need constraints to limit spread.

Consider first the direction of spread. Spread is always rightward in Shona. We can express this with a Faithfulness constraint requiring the preservation of the left edge of a 'tone span', i.e. the string of all the syllables associated with the same (high) tone.

(25) ANCHOR-L (preliminary formulation): If an output syllable S' is the leftmost syllable in a tone span then its input correspondent S is the leftmost syllable in a tone span.

[11] The choice of analysis for spread is not crucial to the argument about OCP blocking effects. One could just as well use an ALIGN constraint to drive spread, as in much recent work in OT (e.g. Cole and Kisseberth 1994).

ANCHOR-L requires that the left edge of any tone in the output correspond to a left edge in the input (cf. ANCHOR-L-FT in McCarthy 1995). Any leftward spread violates this constraint, since in such a case the left edge of the tone span in the output is shifted to the left in comparison to the input.

Now consider the limit of spread to one syllable. It's important to note here that tone spans in Shona are not limited to two syllables. In the phrase *kuténgésá sádza* 'to sell porridge', for example, only the verb root */-téng-/* is underlyingly high-toned.[12] Spread therefore can't be limited by limiting tone spans. Rather, a high tone on a syllable at the end of one macrostem or phonological word spreads onto a syllable in another macrostem or phonological word, but a nonfinal high tone does not spread to another syllable in the same domain. Thus there is no spread within a morpheme such as *bázi* in (22d), and the spread in such a form as *[tichá][vérenga]* in (22b) does not continue further into the stem as in **[tichá][vérénga]*. We can express this generalization as in (26).

(26) BOUND: Successive syllables in a tone span must be in different domains.

Underlying tones within a morpheme are not eliminated, so BOUND must be dominated by MAX-IO (T) and MAX-IO (A). The constraint only has decisive effects on inserted association lines, limiting them to domain edges.[13]

To limit spread, both BOUND and ANCHOR-L must dominate SPECIFY (T). The crucial rankings involved in spread are thus as in (27):

(27) Spread pattern: BOUND, ANCHOR-L $\gg$ SPECIFY (T) $\gg$ DEP-IO (A)

---

[12] The high tone of the root *téng* spreads two syllables to the right, as is the usual pattern within a macrostem (see fn. 17 below). Then the high tone spreads one syllable further to the right, as is the usual pattern between phonological words.

[13] This formulation of BOUND allows for spreading beyond one syllable rightward just in the case of a string of monosyllabic clitics, as in (i) (Odden 1981, p. 83).

(i) [Vá̲][má][zí][mí][chéro]
2a-6-21-4-fruit
Mr. Big-ugly-fruits (cf. ma-zi-mi-chero 'Big, ugly fruits')

According to the definition of the phonological word in (14), each class marker initiates a new recursively embedded phonological word dornain (cf. McCarthy and Prince's (1993) analysis of Axininca Campa). Thus each syllable in the class markers follows a syllable in another domain, as required by BOUND.

Spread is triggered through the domination of the Faithfulness Constraint DEP-IO (A) by the output constraint SPECIFY (T). Spread is blocked if it is leftward or unbounded through the domination of that output constraint by the higher constraints BOUND and ANCHOR-L.

The tableau in (28) illustrates how this constraint ranking accounts for the choice of output in the case of *tichávérenga* in (22b).

(28) Input: H_1
|
[ticha][verenga]

Candidates	ANCHOR-L	BOUND	SPECIFY (T)	DEP-IO (A)
a. H | [ticha][verenga]			****!	
b. → H /\ [ticha][verenga]			***	*
c. H /\\ [ticha][verenga]		*!	**	**
d. H /\ [ticha][verenga]	*!		***	*

Candidate (28b) is more harmonic than (28a) because it violates SPECIFY (T) less severely. The other candidates violate more highly ranked constraints. Candidate (28c), with the tone spread onto more than one syllable, crucially violates BOUND, since high-toned *ré* is not adjacent to a domain edge. Candidate (28d), with leftward spread of the high tone, violates ANCHOR-L. The optimal candidate is thus (28b), with the high tone of *chá* spread one syllable to the right.

Having outlined an analysis of tone spread, we can now return to the fact that spread is blocked if it would create an OCP violation, as in (22e). We can express this blocking by ranking the OCP above the constraint SPECIFY (T) that motivates spread. We see this in the tableau (29), of example (22e).

(29) Input: H_1 H_2
| |
i - badza

Candidates	OCP	MAX-IO (T)	SPECIFY (T)	DEP-IO (A)
a. → H_1 H_2 (i ba dza; H_1 linked to i, H_2 linked to dza)			*	
b. H_1 H_2 (i ba dza; H_1 linked to i and ba, H_2 linked to dza)	*!			*
c. H_1 (i ba dza; H_1 linked to i, ba and dza)		*!		**

Candidate (29a) violates SPECIFY (T) because the medial syllable is toneless. This candidate is nevertheless more harmonic than (29b), with spread of the first high tone, because this violates the OCP. Candidate (29c) obeys the OCP, but violates MAX-IO (T) because one of the input high tones has been deleted. The optimal candidate is therefore (29a), without spread.

We have seen the OCP in both an active and a passive role. In the Meeussen's Rule pattern, the OCP triggers tone deletion. In OT, this is expressed through the domination of the OCP over the Faithfulness constraint MAX-IO (T). In the tone spread pattern, on the other hand, the OCP blocks tone spread. Tone spread occurs because the output constraint SPECIFY (T) dominates the Faithfulness constraint DEP-IO (A). Blocking occurs because the OCP in turn dominates SPECIFY (T).

2.1.4. *Tone Slip*

The third tone pattern in Shona that displays an avoidance of a sequence of two high tones is illustrated in (30). Affected vowels are italicized.

(30) a. báng*a* gúrú — cf. bángá 'knife', gúrú 'big'
big knife

b. [á-ch*a*][téng-á] — cf. [á-chá][véreng-a]
3rdsg-future-buy-term — *3sg-future-read-term*
he/she will buy — he/she will read

c. [á-cha][téng-*a*][bángá] cf. (a), (b).
he/she will buy a knife

When a high tone span of more than one syllable precedes another high tone span, the last syllable of the first span is lowered, separating the two spans. One consequence of this is the neutralization of the contrast between word-final HL as in *bázi* 'branch' and word-final HH, as in *bángá* 'knife'. Before a H-initial word, only HL occurs.[14]

This dissimilation process applies wherever the appropriate tone configuration arises, regardless of morphological level. The process affects only one syllable, not a whole high-toned span as in the case of Meeussen's Rule. In a derivational analysis, therefore, we would posit a delinking rule, as in (31) (cf. Myers 1987).

(31) *Tone Slip*:
```
  H     H
 / ╳    |
σ  σ    σ
```

This rule, like Meeussen's Rule (16a), takes an input that violates the OCP and converts it into an output that obeys the OCP. Tone deletion (Meeussen's Rule) occurs if the first of the two high tones is associated to only one, and otherwise tone delinking Crone Slip) occurs.

To distinguish tone deletion from tone delinking in OT we need to distinguish the constraint requiring preservation of underlying tones (MAX-IO (T)) from a constraint requiring the preservation of underlying associations:

(32) MAX-IO (A): A tone association in the input must have a correspondent in the output.

Parallel to DEP-IO (A) in (23), we assume that MAX-IO (A) is only violated when (a) an input tone T has an output correspondent T', (b) an input syllable S has an output correspondent S', and (c) T is associated with S but T' is not associated with S'. Thus if a tone is deleted, that violates MAX-IO (T) but not MAX-IO (A). Only delinking violates MAX-IO (A).

[14] Note that because there is a contrast between HH and HL, we cannot derive the alternations in (30) through OCP blocking of spread onto the final syllable. HH words like *bángá* must be distinguished lexically from HL words like *bázi*, and that contrast must be undone in the pre-high-tone context.

The tone slip pattern arises from the following ranking:

(33) Tone Slip pattern: OCP, ANCHOR-L ≫ MAX-IO (T) ≫ MAX-IO (A)

The OCP dominates both MAX-IO constraints, because deletion of tones or associations is allowed if it alleviates an OCP violation. MAX-IO (T) must dominate MAX-IO (A), because in forms such as those in (30), tone delinking is preferred to tone deletion. Undominated ANCHOR-L captures the fact that it is the left tone that retracts away from the right tone, rather than the reverse. Retraction of a tone rightward would shift the position of the left edge of a tone span, violating ANCHOR-L.

Tableau (34) illustrates the evaluation of example (30a).

(34) Input: H_1 H_2 /\ /\ banga guru

Candidates	OCP	ANCHOR-L	MAX-IO (T)	MAX-IO (A)
a. H_1 H_2 /\ /\ banga guru	*!			
b. → H_1 H_2 | /\ banga guru				*
c. H_1 H_2 /\ | banga guru		*!		*
d. H_1 /\ banga guru			*!	

The faithful candidate (34a) is less harmonic than (34b) because the former violates the OCP and the latter doesn't. Of the candidates that pass this first test, (34c) is excluded because it violates ANCHOR-L. The output syllable *rú* in this candidate is the left edge of a tone span in the output, but it does not correspond to the left edge of a tone span in the input. Candidate (34d), with deletion of the second tone, is less harmonic than (34b) because it violates MAX-IO (T), which is higher ranked than MAX-IO (A). The optimal output is therefore (34b), with tone slip.

If delinking a tone is preferable to deleting a tone, why is there tone deletion in the Meeussen's Rule cases? In those cases, the first high tone is associated with only one syllable. Thus delinking that tone would yield a floating tone. We can account for the fact that delinking does not happen in this case if we posit a constraint ruling out floating tones:

(35) *FLOAT: A tone must be associated with a syllable.

Such a constraint is part of Goldsmith's (1976) Well-Formedness Conditions. McCarthy and Prince (1995, p. 266) point out that it can be subsumed as a member of the DEP family (10b), since it requires that an element in one representation (the tone tier) have a correspondent in another representation (the tone-bearing tier), the inverse of SPECIFY (T). Given such a constraint, a form such as *íbanga* (15a) is evaluated as in tableau (36).

(36) Input: H_1 H_2
| /\
i banga

Candidates	OCP	*FLOAT	ANCHOR-L	MAX-IO (T)	MAX-IO (A)
a. → H_1 | i banga				*	
b. H_1 H_2 /\ i banga		*!			*

Candidate (36a), with deletion of the second high tone, is more harmonic than (36b), with delinking of the first high tone, because delinking leaves a floating high tone in violation of *FLOAT.[15]

There is one more candidate that needs to be excluded – **íbánga* – with the high tone of the stem deleted and the high tone of the clitic *í* spread one syllable to the right, as in (37).

[15] The candidate in (36b) could also be said to violate another version of the OCP assuming a tier adjacency rather than syllable adjacency (e.g. Myers 1987, Odden 1994).

(37) Input:

```
H1 H2
|  /\
i banga
```

Candidates	OCP	*FLOAT	ANCHOR-L	MAX-IO (T)	MAX-IO (A)	SPECIFY (T)
H_1 /\ i banga				*		*

As the constraints stand, candidate (37) is more harmonic than the actual output (36a), since it ties with that candidate on all the higher constraints, but better satisfies SPECIFY (T). I would suggest that what is wrong with this candidate is that it fails to preserve the left edge of a tone span. The syllable *bá* is at the left edge of a high tone span in the input, but not in the output. We can exclude such a case by revising ANCHOR-L, as in (38):

(38) ANCHOR-L (final formulation): Assign a violation if and only if:
(a) there is an output syllable *S′* that has an input correspondent *S*,
(b) both *S* and *S′* bear tone, and
(c) either *S* or *S′* is the leftmost syllable associated with its tone, and its correspondent syllable is not the leftmost syllable associated with its tone.

According to this formulation, if an input syllable and an output syllable correspond and bear tone, then they must correspond in whether they are a left edge of a tone span.

Given this reformulation, the candidate in (37), repeated here as (39b), now violates ANCHOR-L, since the syllable *bá* is at the left edge of a tone span in the input, but noninitial in a tone span in the output. The actual output (39a), on the other hand, does not violate ANCHOR-L, since the only syllable that bears tone in both the input and the output, *í*, is a left edge in both.

(39) Input: H_1 H_2
| /\
i banga

Candidates	OCP	*FLOAT	ANCHOR-L	MAX-IO (T)	MAX-IO (A)	SPECIFY (T)
a. → H_1 | i banga				*		**
b. H_1 /\ i banga			*!	*		*

Candidate (39a) is now correctly selected as the optimal candidate.[16]

2.1.5. *Fusion*

The fourth way in which OCP violations are avoided in Shona occurs only within the macrostem. If a high tone on a single syllable is juxtaposed with another high tone within the macrostem, the Meeussen's Rule pattern never results. Both high-toned morphemes remain high-toned, as in (40).[17]

(40)a. [ku]-[mú̱-té̱ng-és-ér-a]
infinitive-object-buy-causative-applied-term
to sell to him/her

cf. [ku]-[mú̱-vérénġ-er-a]
infinitive-object-read-applied-term
to read to him/her

---

[16] The constraints ANCHOR-L, MAX-IO (A) and DEP-IO (A) are faithfulness constraints requiring preservation of association. An alternative approach wouuld be to use a member of the IDENT-IO family proposed by McCarthy and Prince (1995), requiring that corresponding vowels must have identical tonal specifications. One problem with such a constraint as applied to the pattern we have seen here would be that it would be violated indiscriminately by tone deletion, tone delinking, tone delinking, and tone spread. We have seen, however, these patterns are subject to different conditions in Shona.

Furthermore, such a constraint would treat as equivalent a string with two high tones, as in (2), and a string with one high tone on two syllables, as in (3). These are not phonetically equivalent representations, however (see Section 2.3 below).

[17] Within the macrostem, a high tone spreads *two* syllables to the right, rather than one syllable to the right as in the phonological word or between words. The expression of this distinction is not relevant to the issues at hand, so I will not present an analysis here. In tableaux we will consider only candidates with appropriate spreading. On tone spread and tone placement within the macrostem, see Myers (1987) and Hewitt (1992).

b. [tí̱-té̱ng-és-é]
1stpl/subjunctive-buy-causative-term
we should sell

cf. [tí̱-táris-e]
1stpl/subjunctive-look-term
we would look

It might appear that in these constructions violations of the OCP are simply tolerated. There is evidence, however, that the OCP-violating sequences are subject to a fusion operation, which converts the sequence of two tones into a single multiply-linked high tone. This evidence is provided by hortative constructions in which forms as in (40b) occur after a high-toned clitic (Myers 1987).

(41) a. [há̱][ti̱-te̱ngese]
hortative-1stpl/subjunctive-buy-causative-term
let us sell

b. [há̱][ti̱-tarise]
hortative-1stpl/subjunctive-look-term
let us look

The hortative form consists of the hortative prefix *há-* followed by the subjunctive form (cf. 40b). All the high tones in the subjunctive macrostem are deleted after the hortative marker – an instance of the Meeussen's Rule pattern. The subjunctive forms that have two underlying high tones pattern with regard to this lowering like the subjunctive forms with just one underlying high tone.

Myers (1987) accounts for these facts by positing a cycle-final operation of OCP Fusion: $\underline{H\ H \rightarrow H}$. Such an operation has been motivated in other tone languages (Leben 1978, Kenstowicz and Kidda 1987), and McCarthy (1986) argues that such a fusion is built into Tier Conflation. Once the two high tones have been fused, they act as a single multiply-linked tone.

To account for these facts within OT, we must make some assumptions as to how sensitivity to morphological domains is to be expressed in that model. It is well-established that phonological patterns are different in different morphologically-defined domains. In a derivational model, this is expressed by assigning rules to the appropriate domains (Kiparsky 1985). Following McCarthy and Prince's (1993a) analysis of Axininca Campa, I will assume here that each domain has an independent constraint ranking. In this approach, the output of one domain is taken as the input of the succeeding domain.[18]

Fusion of two input tones to form one output tone is a violation of UNIFORMITY-IO (T) in (10c), which requires correspondence to be one-to-one (Lamontagne and Rice 1995, McCarthy 1995). The fusion takes an input that violates the OCP and yields an output that obeys the OCP, so we can conclude that the OCP dominates UNIFORMITY-IO (T) in the macrostem domain in Shona. However, we know that the OCP is dominated by the UNIFORMITY-IO (T) in the phonological word domain, since fusion is never an option when a high-toned clitic is juxtaposed with a high tone (cf. (15)).

The crucial ranking differences, then, are as in (42):[19]

(42) a. Macrostem: OCP ≫ MAX-IO (T) ≫ <u>UNIFORMITY-IO (T)</u> ≫ MAX-IO (A).
b. Phonological word: <u>UNIFORMITY-IO (T)</u>, OCP ≫ MAX-IO (T) ≫ MAX-IO (A).

The evaluation of the subjunctive macrostem *títéngése* in (40b) is then as in (43).

(43) Input: H_1 H_2
| |
[ti- teng-es-e]

Candidates	OCP	MAX-IO (T)	UNIFOR-MITY (T)
a. H_1 H_2 [ti tengese]	*!		
b. H_1 [ti tengese]		*!	
c. → $H_{1,2}$ [ti tengese]			*

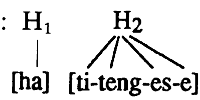
[18] A promising approach to levels in OT, using output-to-output correspondence, is proposed in Burzio (1994), Benua (1995) and Kenstowicz (1995). We stick to the conservative quasi-serial approach to avoid adding a distracting side issue to the exposition.

[19] UNIFORMITY (T) must dominate MAX-IO (A) in the macro stem domain. Fusion occurs only if the first of the two high tones is associated with just one syllable. In cases where the first of the two high tones is associated with more than one syllable, there is tone slip. For examples and discussion, see Myers (1987) and Hewitt and Prince (1989).

Candidate (43a) faithfully preserves the two input tones, but fatally violates the OCP. This renders this candidate less harmonic than candidate (43b), with deletion of the second tone. However, this candidate is in turn less harmonic than the candidate (43c) with fusion of the two tones. Candidate (43c) is therefore the optimal output.

The output form of the macrostem (43c) serves as part of the input for the phonological word that is derived from that macrostem: *hátitengese* as in (41a). This form is subject to evaluation against the constraint ranking in (42b), as illustrated in tableau (44). Correspondence indices are assigned by GEN (McCarthy and Prince 1995), and so are not maintained from the macrostem evaluation in (43).

(44) Input:



Candidates	OCP	UNIFOR-MITY (T)	MAX-IO (T)
a. H_1 H_2 [ha] [ti-teng-es-e]	*!		
b. → H_1 [ha] [ti-teng-es-e]			*
c. $H_{1,2}$ [ha] [ti-teng-es-e]		*!	

The faithful candidate (44a) violates the OCP and so is less harmonic than candidate (44b) with a deleted tone. Candidate (44c), with tone fusion, is also less harmonic than (44b), since in this domain a violation of UNIFORMITY (T) is more serious than one of MAX-IO (T). The optimal form is (44b).[20]

[20] A reviewer suggests that the lowering in (41a) might just represent a double application of Meeussen's Rule, with lowering of *tí* conditioned by *há* and lowering of *téng* conditioned by *tí*. But Meeussen's Rule applied to three successive high tones generally leads to an alternating HLH output:

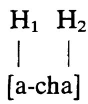
(i) [í̲][mbwa̲][wó̲] cf. imbwá̲
copula-dog-also 'dog'
(it) is a dog also

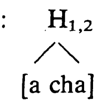
There would also be problems with a rule that lowers all high tones within the macrostem after a high tone. Such a rule would have to apply nonlocally, since the target would often

In other forms, tone fusion interacts with tone slip. In the form *ácha-téngá* in (45), for example, there are three high-toned morphemes: the subject marker */á/* the future marker */chá/*, and the root */-téng-/* 'buy'.

(45) [á̲-cha̲][té̲ng-á] cf. [ndi-chá̲][vére ng-a]
3rdsg-future-buy-term *1stsg-future-read-term*
he/she will buy I will read

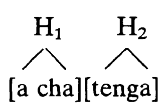
The input for the inflectional macrostem in (45) would be as in (46a), with two different high tones. The output, by an evaluation entirely parallel to that in (44), would be as in (46b), with one fused tone.

(46)a. Input (Stem): 

b. Output: 

This output is a component of the input for (45) in the phonological word level. Tableau (47) illustrates the evaluation of the form in (45), consisting of the inflectional macrostem in (46b) plus a verb macrostem:

(47) Input (Phonological Word):



Candidates	OCP	UNIFOR-MITY (T)	MAX-IO (T)	MAX-IO (A)
a. H_1 H_2 [acha] [tenga]	*!			
b. → H_1 H_2 [acha] [tenga]				*
c. H_1 [acha] [tenga]			*!	
d. $H_{1,2}$ [acha] [tenga]		*!		

Given an input derived from two macrostem-level outputs, the optimal

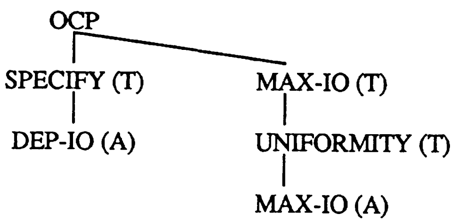
be considerably removed from the trigger. Assuming that phonological processes apply locally, tone fusion is the only way to get the right result in these cases.

output is one with tone slip (47b), rather than an OCP violation (47a), tone deletion (47c), or tone fusion (47d).

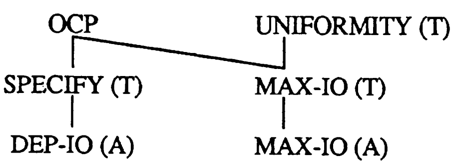
2.1.6. *Summary of the Shona Analysis*

The most important constraint rankings in our analysis as far as the OCP is concerned are summarized in (48).

(48) a. Macrostem:



b. Phonological word:



Within the phonological word, the OCP dominates MAX-IO (T), yielding the Meeussen's Rule pattern. But tone delinking is the preferred means of avoiding OCP violations where it is possible, so MAX-IO (T) dominates MAX-IO (A). Spread is due to the domination of SPECIFY (T) over DEP-IO (A). Spread is blocked when it would yield an OCP violation, so the OCP dominates SPECIFY (T). The same rankings hold in the macrostem domain, except that UNIFORMITY (T) is ranked lower than MAX-IO (T). This has the consequence that tone fusion is preferred to tone deletion in this domain.[21]

[21] At the phonological phrase level, where phonological words are juxtaposed with each other, only Tone Slip occurs and Meeussen's Rule never occurs. There is, for example, no lowering of the tone of *gúrú* in (i), as pointed out by a reviewer:

(i) badzá gúrú
hoe big
a big hoe

Thus at the phonological phrase level, the OCP must dominate MAX-IO (A), but not MAX-IO (T) or UNIFORMITY-IO (T).

2.2. *Anti-Meeussen's Rule in Rimi*

Tone patterns in Rimi, a Tanzanian Bantu language, have been described by Olson (1964), and reanalyzed by Schadeberg (1978, 1979) and Goldsmith (1984). When two high tones come together in Rimi, the *first* of two successive high tones is deleted, rather than the second (as in Shona). Goldsmith (1984) refers to this as Anti-Meeussen's Rule.

Before we consider the tone deletion, we must first address a pervasive pattern in Rimi tonology that interacts with it. A high tone in Rimi is regularly shifted one syllable to the right of its underlying position, as can be seen in (49). As before, the underlyingly high-toned vowel is underlined. Phrase-final high tone is always lowered (Schadeberg 1979, p. 289); forms given here with word-final high tone are as they would be in non-phrase-final position.

(49) a. u-pųm-á
infinitive-go away-term
to go away

cf. u-hang-a (Schadeberg 1979, p. 290)
infinitive-meet-term
to meet

b. ra̲-mú-ntu
5/gen-1-person
of a person

cf. mu-ntu (Schadeberg 1978, pp. 193, 204)
1-person
person

c. mu-te̲m-į́
1-cut-nominalizer
chief

cf. u-huvi-į (Schadeberg 1978, p. 199)
14-believe-nominalizer
belief

In all of these examples, the shift has led to alternations. The final vowel *-a* of the infinitive in (49a), the class marker *mu-* in the noun in (49b), and the nominalizing final vowel *-į* in (49c) are all low-toned except if the morpheme preceding them has a high tone. Historically, the Proto-Bantu contrast between *HL, *LH and *HH stems was neutralized in Rimi to LH (Schadeberg 1978, p. 198).[22] The shift probably has its origins in the general tendency for a pitch peak to be realized phonetically after the vowel that bears it phonologically (Silverman and Pierrehumbert 1990, Liberman et al. 1993).

We can express this tone shift with the following constraints.

(50) a. ALIGN-R: ALIGN (H, R, PP, R)
  b. LOCAL: If an input tone *T* has an output correspondent *T'*, some edge of *T* must correspond to some edge of *T'*.
  c. NO-LONG-T: A tone may be associated with at most one syllable.
  d. Tone shift pattern: NO-LONG-T, LOCAL, MAX-IO(T) $\gg$ ALIGN-R $\gg$ MAX-IO (A), DEP-IO (A)

ALIGN-R in (50a) requires a tone to occur at the right edge of the phonological phrase. It dominates MAX-IO (A) and DEP-IO (A), which means that tones can be displaced to satisfy alignment. However, this rightward shift is limited by the ANCHOR constraint LOCAL (50b), which requires the tone's output position to be adjacent to its input position. LOCAL is violated if (a) there is an output tone *T'* that has an input correspondent *T*, and (b) no edge (L or R) of the output syllable that bears *T'* corresponds to any edge (L or R) of the input syllable bearing *T*. The constraint is satisfied if the syllable bearing *T'* is the output correspondent of the input syllable bearing *T*, or if it is adjacent to that syllable. NO-LONG-T (50c) forbids multiple association of a tone, so if it dominates DEP-IO (A) and MAX-IO (A) it insures that the tone is shifted rather than spread. Domination of MAX-IO (T) over ALIGN-R insures that deleting the tone is not a viable way to satisfy the alignment

---

[22] There is a class of exceptional morphemes that have high tones which do not shift in this way but stay in their underlying location. Schadeberg (1979, p. 303) points out that these are generally morphemes that developed from Proto-Bantu morphemes with long vowels (e.g. *-ét-* 'bring' < PB **-déet-*). In Rimi, the original vowel length distinction has been lost, but if shift originated before vowel length neutralization, then in these cases the tone would just have shifted from the first mora to the second. For other cases in Bantu in which a length distinction has been neutralized but has left a trace in an exceptional tone class, see Meeussen (1955), Kisseberth (1984), Odden (1982) and Carleton (1995).

It is unclear how to handle these cases in the synchronic grammar. Schadeberg (1979) proposes an abstract representation in which the tone of such morphemes is essentially unassociated with an underlying vowel. Alternatively, this class of morphemes could be subject to a lexically restricted Faithfulness constraint.

requirements. The result of this ranking is tone shift one syllable to the right.

The evaluation of *ramúntu* in (49b) is as in (51).

(51) Input:
```
H
|
/ra-muntu/
```

Candidates	NO-LONG-T	LOCAL	MAX-IO (T)	ALIGN-R	MAX-IO (A)	DEP-IO (A)
a. H | ramuntu				*!*		
b. → H | ramuntu				*	*	*
c. H | ramuntu		*!			*	*
d. H / | \\ ramuntu	*!					**
e. ramuntu			*!			

Candidate (51a) is the most faithful to the input, but it violates ALIGN-R worse than (51b). Candidate (51c) satisfies ALIGN-R even better than (51b), but it fatally violates LOCAL, since the tone's output location is not adjacent to its input location. Candidate (51d) is less harmonic than (51b) because it has a tone associated with two syllables, in violation of the undominated constraint NO-LONG-T. Candidate (51e), with tone deletion, is less harmonic than (51b) because it violates MAX-IO (T). Thus the optimal output is (51b), with the input tone shifted one syllable to the right.

With those preliminaries out of the way, we can now consider the cases of Anti-Meeussen's Rule. When two or more high tones are juxtaposed in Rimi, only the last one surfaces (Schadeberg 1979, p. 292). In the following examples, the underlined segments have a high tone underlyingly. But there is only one high tone of the sequence in the output, placed by tone shift on the syllable following the sequence.

(52) a. a-qa-qi̱-kųnúku-a . . . (Schadeberg 1979, p. 292)
3rdsg-narrative-it-open-term
he opened it (the book)

b. ri̱-ú-va̱-jųnc-á . . . (Schadeberg 1979, p. 293)
5-present-them-drive out-term
It will drive them out . . .

c. ṉ-a̱-va̱-te̱ghéey-a . . . (Olson 1964, p. 190)
1stsg-past-them-look for-term
I looked for them (the people) . . .

As in Shona, a sequence of underlying high tones is repaired by deletion of one of the high tones. Therefore, the OCP dominates MAX-IO (T). But in Rimi it is the first of two tones that is deleted rather than the second. ALIGN-R is the dominant tone alignment constraint, as evidenced by rightward tone shift, and thus it determines which tone survives in tone deletion. The tableau for form (52a) is given in (53).

(53) Input: H_1H_2
| |
/a-qa-qi-kųnuku-a . . ./

Candidates	OCP	MAX-IO (T)	ALIGN-R	MAX-IO (A)	DEP-IO (A)
a. H_1 H_2 | | a-qa-qi-kųnuku-a...	*!		*** ****		
b. H_1 | a-qa-qi-kųnuku-a...		*	***!	*	*
c. → H_2 | a-qa-qi-kųnuku-a...		*	**	*	*

Candidate (53a) is out because it violates the OCP, and there are candidates available that do not. Of the candidates that do not violate the OCP, (53c) is the optimal one because it has the fewest violations of ALIGN-R.[23]

In Rimi, as in Shona, the response to an OCP violation is to delete one of the offending tones. The two languages have in common, then, that the OCP dominates the Faithfulness constraint MAX-IO (T). They differ just in how the deleted tone is chosen. We have shown that the choice is

[23] Another difference between Shona and Rimi is what happens in a sequence of more than two underlying high tones. In Shona, every other tone is lowered, so that /H + H + H/ ends up as *HLH* (and /H + H + H + H/ as *HLHL*), as in fn. 19. In Rimi, however, the generalization is that of a series of high tones only the last surfaces, so that /H + H + HL/ is realized as *LLLH*, e.g. (52c).

To capture the Rimi pattern, we extend the Faithfulness constraint CONTIGUITY (McCarthy and Prince 1995) by applying it to a *tone-type span*:

a. A *tone-type span* is a maximal sequence of identical tone specifications.
b. CONTIGUITY (T-TYPE): If a sequence of tones in the input form a continuous tone-type span in the input, then the corresponding tones in the output must also form a continuous tone-type span.

According to CONTIGUITY (T-TYPE), a sequence of high tones in the input must correspond to such a sequence in the output. This constraint is violated if a continuous sequence of high tones in the input corresponds to an interrupted sequence in the output. CONTIGUITY (T-TYPE) must dominate MAX-IO (T). Thus in (52c), the input /*ń-á-vá-téheey-a*/ has a tone-type span as indicated by underlining. The actual output [*n-a-va-teghéey-a*] has a corresponding tone-type span, but corresponding tones in the *[*n-a-vá-teghéey-a*] make up two distinct tone-type spans.

determined by the dominant ALIGN constraints that also determine the placement of high tones.

2.3. *Kishambaa*

Kishambaa is a Bantu language spoken in Tanzania, the tone patterns of which have been described and analyzed by Odden (1982, 1986). He shows that there are surface violations of the OCP in Kishambaa that are inconsistent with the interpretation of the OCP as an inviolable constraint on surface representations. I will argue, though, that the OCP still plays an important role in the language.

Odden shows that, with one exception to be considered below, the concatenation of a high-final morpheme and a high-initial morpheme is left untouched. Both tones remain in place in the output, in violation of the OCP:

(54) a. nwá̱ná̱ 'child' dṵ́ 'only' nwá̱ná̱!dṵ́ 'only a child'
b. kṵ́i 'dog' ní̱ 'cop' ní̱!kṵ́i 'it is a dog'
c. á̱-!wá̱-ghóshó-é-a u-ghoe 'he's making them a rope'
d. a-té̱-!kó̱m-á 'he killed (verb focus)' (cf. kukó̱má 'to kill')

The second of the two high tones is downstepped.

A sequence of high-toned syllables can also result from tone spread. A high tone spreads rightward over a sequence of toneless syllables up to the penult of the phrase.

(55) a. ku-ví̱-ghóshó-a cf. ku-ghosho-a
to do them (Cl. 8) *to do*

b. ni-té̱-ghóshó-a
I have done (verb-focus)

c. nyumbá̱ zá-wá-ghánga cf. za-wa-ghanga
house of the doctors *of the doctors*

The successive high-toned syllables of these high tone spans are not downstepped, but rather are realized at the same pitch.

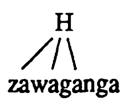
Spread interacts with downstep when two underlying high tones are separated by toneless syllables. The first high tone spreads up to the second high tone, and the latter is downstepped:[24]

(56)	ni-on-í̲y̲é̲ má-!kú̲i̲	cf. ni-on-í̲y̲é̲,	ma-kú̲i̲
	I saw dogs	*1stsg-see-perfect*	*6-dog*
		I saw	
b.	ni-on-í̲y̲é̲ nyú!mbá̲	cf. ni-on-í̲y̲é̲,	nyumbá̲
	I saw the house	*1stsg-see-perfect*	house
		I saw	

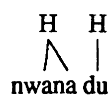
Again we see that two high tones that are distinct underlyingly remain phonetically distinct, even though they are on adjacent syllables.

Odden points out that the contrast between these two kinds of high-toned sequences can be expressed simply as in (57). Tone spread, as in (55), yields just a single high tone, as in (57a). In the cases with more than one high-toned morpheme, as in (54) and (56), on the other hand, there are two high tones in the surface representation, as in (57b).

(57)a.



b.



In phonetic implementation, the pitch range is contracted and lowered alter each tone, downstepping each successive H tone. Such an analysis of downstep has been proposed for Igbo by Clark (1990) and Liberman et al. (1993), and for Supyire by Carlson (1983).

There is no motivation in Kishambaa for a floating L tone intervening between the successive high tones and triggering downstep. Low tones play no active role in Kishambaa phonology. As Odden points out, the only function for such an abstract floating L in these cases would be to prevent these examples from counting as counterexamples to the surface-true interpretation of the OCP.

The cases in (54) and (56) provide clear counterexamples to the view that the OCP represents a universally true generalization about phonological representations. However, it is central to the interpretation of constraints in OT that they are violable. According to the OT interpretation,

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[24] The perfective is marked by the suffix *-i̲y̲e̲* and final high tone. The high tone spreads *leftward* to the second syllable of the stem, which accounts for the high tone on the first syllable of the suffix in (56a) and (56b) (Odden 1982, p. 196). In accordance with our assumptions about Lexicon Optimization (fn. 6), I mark both syllables as high in the input.

the OCP represents not a surface-true generalization about languages, but rather the assertion that there is a cost to any representation violating it.

Because there are surface exceptions to the OCP in Kishambaa, the OCP must be ranked below the Faithfulness Constraints such as MAX-IO (T) and MAX-IO (A). Preserving input tones in their input locations is a higher priority in this language than obeying the OCP. The OCP must also be ranked below the constraint that drives spread, SPECIFY (T) (24), since spread can create an OCP violation, as in (56). The evaluation of phrasal example (56a) would then be as in (58):[25]

(58) Input: H
/\
/ni-on-iye makui/

Candidates	MAX-I O (T)	SPECIFY (T)	OCP
a. H_1 H_2 /\ | nioniye makui		**!	
b. → H_1 H_2 /|\ | nioniye makui		*	*
c. H_1 /|\\ nioniye makui	*!	*	

The OCP-violating representation (58b) is more harmonic than (58a) because the latter has a more severe violation of SPECIFY (T).[26] Candidate (58b) is also more harmonic than (58c), with tone deletion, because that violates the highly-ranked Faithfulness constraint MAX-IO (T). Thus the optimal output is the one that violates the OCP.

A natural conclusion might be that the OCP simply doesn't hold for Kishambaa. In terms of parameters, one could say that the OCP is 'on' in languages such as Shona where it is surface-true, and 'off' for languages such as Kishambaa where it is not. Such a perspective would be counter to the OT approach, according to which constraints are violable and not to be interpreted as necessarily surface-true generalizations.

There is evidence favoring the OT perspective, in that there are condi-

[25] Spread is rightward in all domains except the macrostem, so as in Shona ANCHOR-L (38) must dominate SPECIFY (T).

[26] Odden argues that all vowel sequences are diphthongs. Thus *nio* and *kui* in (56) are each counted as a single tone-bearer for SPECIFY (T).

tions in Kishambaa in which OCP violations are not tolerated. Within a macrostem, a downstep occurs between two adjacent high-toned morphemes only in the case of a high-toned object marker followed by a monosyllabic root, as in (59). Otherwise, no downstep occurs between high-toned morphemes within the macrostem, as we see in (60).

(59) a. ku-[chí̱-!já̱]
infinitive-it(7)-eat
to eat it (Class 7)

b. ni-té̱-[!í̱-!nywá̱]
1stsg-past-it(9)-drink
I drank it (Class 9)

(60) a. ku-[wá̱-kó̱má]   cf. ku-[kó̱má]
infinitive-them-kill   *infinitive-kill*
to kill them   to kill

b. ní̱-kí-[!chí̱-kó̱má]
1stsg.-progressive-it-kill
I was killing it (Cl. 7)

c. ni[ká̱á̱ng-é̱] nyáma   cf. ku-[ká̱á̱ng-a]
1stsg-fry-perfect meat   *infinitive-fry-term*
I fried meat   to fry

d. [ká̱á̱ng-á̱]
fry-term
Fry!

In the macrostem forms in (59), the object marker bears stress, which always falls on the penultimate syllable of a word. A stressed object marker, then, follows the pattern we have noted above in (54), while all other high-toned morphemes within the macrostem, including unstressed object markers as in (60a), follow the pattern in (60).

To account for these facts, Odden (1982, p. 200) proposes a rule of Tone Absorption, which spreads the second high tone onto the syllable occupied by the first high tone, and simultaneously delinks the first high tone. The rule bears the lexical condition that the target not be a stressed object marker. Application of the rule results in two adjacent high tones within a stem being replaced with a single high tone. This is the same result as in the process of tone fusion we saw in Shona (see Section 2.1.5.).

Odden (1982) provides independent evidence for tone absorption, on the basis of the subjunctive pattern. In the subjunctive, the contrast between high-toned roots and toneless roots is neutralized, the otherwise high-toned root surfacing as toneless. Moreover, any other high-toned morpheme within the subjunctive stem also surfaces as toneless in this context, as in (61).

(61) a.	né ní̱-[wa̱-ka̱a̱ng-iy-e̱] I will fry for them (soon)	cf. ku-[ká̱á̱ng-a] to fry
b.	ní̱-[wa̱-ko̱m-e̱] I should kill them	cf. ku-[kó̱m-á] to kill

Here both the high-toned object marker *wá* and the high-toned roots *kááng* and *kóm* surface without high tone. Odden (1982, p. 202) posits a rule lowering a root high tone in the subjunctive. The important point for our purposes is that all the high tones of the macrostem are lowered in this process, as would be expected if they are fused into one tone. This can be compared to the lowering in the hortative in Shona as in (41).[27,28]

The analysis of the Kishambaa fusion pattern can be the same as the analysis of the parallel Shona pattern. Fusion is a violation of the constraint UNIFORMITY (T), which requires that correspondence be one-to-one. As in Shona, fusion only occurs if two high tones are juxtaposed within the macrostem, so we must assume that the OCP dominates UNIFORMITY (T) in the macrostem domain, but the reverse ranking holds in the phonological word domain.

The evaluation of the form in (60b) *ní-kí[ꜜchí-kómá]* ('I was killing it') consists of two parts: the evaluation of the macrostem in (62), and the evaluation of the whole phonological word in (63).

[27] The subjunctive lowering exemplified in (61) could also be another instance of an OCP effect. This lowering only occurs in the subjunctive, and Odden notes that the subjunctive subject marker is always high-toned. Thus in all instances of the lowering cited in Odden (1982), an OCP-violating sequence of high tones is converted into an OCP-obeying representation through deletion of the second H.

[28] Due to the unbounded leftward spread within the macrostem (see fn. 24), all high tones within a macrostem end up adjacent, even if they are underlyingly nonadjacent as in (61a). SPECIFY (T) must outrank the OCP in the macrostem as in the higher domains.

(62) Input (Macrostem): H_1 H_2
| |
[chi- kom-a]

Candidates	MAX-IO (T)	OCP	UNIFORMITY (T)
a. H_1 H_2 (| /\\) [chi-koma]		*!	
b. → $H_{1,2}$ (/ | \\) [chi-koma]			*

(63) Input (Phonological Word): H_1 H_2
| /|\
niki-[chikoma]

Candidates	MAX-IO (T)	SPECIFY (T)	UNIFORMITY (T)	OCP
a. H_1 H_2 (| /|\\) ni-ki-[chikoma]		*!		
b. → H_1 H_2 (/\\ /|\\) ni-ki-[chikoma]				*
c. H_1 (/\\) ni-ki-[chikoma]	*!	***		
d. $H_{1,2}$ (// |\\ \\) ni-ki-[chikoma]			*!	

In the macrostem in (62), the output with the two tones fused is more harmonic than the one that violates the OCP. In the phonological word in (63), on the other hand, the output that violates the OCP is more harmonic than the various unfaithful candidates in which the OCP is obeyed.

The exceptions to tone fusion involve stressed object markers. This can be seen as an instance of the preservation of contrast in a stressed syllable, which can be expressed through positional faithfulness constraints (Steriade 1995, Beckman 1997). I propose the constraint (64), which is a lexicalized version of the positional ANCHOR constraints for stressed syllables:

(64) ANCHOR-R-σ' (restricted to object markers): If a stressed syllable in the output bears a tone T' that has a correspondent T in the input, then the right edge of T' must correspond to the right edge of T.

This constraint must dominate the OCP, blocking tone fusion. Tableau (65) shows how this works for the form *ku-[chí*ꜜ*já]* in (59a):

(65) Input (Macrostem): H_1 H_2
| |
[chi- j-a]

Candidates	ANCHOR-(R)	MAX-IO (T)	OCP	UNIFORMITY (T)
a. → H_1 H_2 / | | / [chi- ja]			*	
b. $H_{1,2}$ / /\ / [chi- ja]	*!			*

The object marker *chí* is stressed in this case because it is in penult position; it is therefore subject to ANCHOR-R.[29] According to ANCHOR-R, the right edge of the object marker tone H_1 must have a position in the output corresponding to its position in the input. This is the case in candidate (65a), where the right edge of H_1 occurs at the right edge of *chí* in both the input and the output. However, the constraint is violated by the fused candidate (65b), since the right edge of the output H_1 tone is at the right edge of *já*. The latter candidate therefore violates ANCHOR-R, and candidate (65a) is optimal.

Kishambaa provides evidence that the OCP is a violable constraint, since there are abundant surface exceptions to it. However, even in this

[29] Stress occurs on the penult of the word, rather than the penult of the macrostem. We could assume that stress is assigued to the penult at both the macrostem and phonological word domains, since the macrostem is always at the end of the phonological word. Alternatively, such an effect of phonological-word level phonology on macrostem tonology might be addressed by an output-output correspondence approach to level distinctions, as in fn. 18.

language, the OCP plays a role in motivating tone fusion within the macrostem. Furthermore, it would not be possible to say that the OCP is 'on' within the macrostem domain and 'off' in all other domains, since the OCP is violated in the object marker constructions in (59). I have analyzed these constructions as involving a special faithfulness constraint ANCHOR-R, which blocks the usual OCP-induced tone fusion.

3. Conclusion

We have seen that in different Bantu tone systems, there are different responses to OCP violations. Given a concatenation of high tones in the input, we have seen the following strategies:

(66) /. . . H_1 H_2 . . ./
- a. H_2 is deleted (Shona).
- b. H_1 is deleted (Rimi).
- c. H_1 is retracted away from H_2 (Shona).
- d. H_1 and H_2 are fused into one $H_{1,2}$ (Shona, Kishambaa).
- e. Both H_1 and H_2 are preserved unchanged (Kishambaa).

There is also the retraction of H_2 away from H_1 in Chichewa (Kanerva 1989, Myers and Carleton 1996).

I have argued that the choice of response to OCP violations depends on which Faithfulness constraint is dominated by the OCP, and on which Alignment constraint is dominant.

(67)a. H_2 is deleted (Shona):
OCP ≫ MAX-IO (T), ALIGN-L ≫ ALIGN-R.
- b. H_1 is deleted (Rimi):
OCP ≫ MAX-IO (T), ALIGN-R ≫ ALIGN-L.
- c. H_1 is retracted away from H_2 (Shona):
OCP ≫ MAX-IO (A)
- d. H_1 and H_2 are fused into one $H_{1,2}$ (Shona, Kishambaa):
OCP ≫ UNIFORMITY-IO (T)
- e. Both H_1 and H_2 are preserved unchanged (Kishambaa)
Faithfulness ≫ OCP

The wide variety of dissimilatory patterns can thus be derived from the OCP, using the language-particular ranking of universal constraints that is central to OT.[30]

[30] For a perceptual explanation of why a sequence of identical elements is disfavored, see Ohala (1981) and Myers (in press). Myers (in press) also provides a perceptual account of

The blocking effects of the OCP, as in the case of Shona spread in Section 2.1.3, can also be derived in this analysis. Such effects occur when the OCP dominates an output constraint that dominates a Faithfulness constraint. In the case of Shona tone spread, the OCP dominates the output constraint SPECIFY (T) that drives spread by dominating the Faithfulness constraint DEP-IO (A).

All of the patterns discussed here can of course be captured in a derivational model without the OCP. In such a model, each dissimilatory process would be expressed through a different autosegmental rule. The blocking of spread can be expressed by adding conditions to the spread rule. But what any such model misses is the clear generalization that all of these processes have the effect of avoiding a configuration in which two high tones are adjacent. It is a remarkable coincidence in such a model that in language after language there are changes that have the result of changing a tone configuration of the form of (2) into some other configuration that does not have adjacent identical tones. Such a model wrongly suggests that the default should be to leave such a configuration unchanged. Likewise, it predicts that shifting two high tones toward each other should be just as common as shifting them away.

The same crosslinguistic generalizations are missed by any model in which the OCP is interpreted as a passive filter, which can block rules but cannot trigger them. Only a model like OT in which both active and passive effects can be derived from the same constraint is capable of capturing the full range of OCP effects.

For similar reasons, the Shona data are problematic for approaches in which a constraint such as the OCP is interpreted as a trigger of language-specific repair operations (Paradis 1988, Calabrese 1995). In such a model, violation of the OCP would trigger a designated repair operation: deletion, delinking, insertion, or fusion. Within phonological words in Shona, however, tone delinking and tone deletion both occur in response to OCP violations. Which one occurs depends on whether the first high tone is associated with one syllable or more than one. This distinction is not part of the OCP, so the OCP alone cannot trigger the appropriate repair. In the OT analysis, on the other hand, the choice of repair mechanism is determined by the interaction of the OCP with Faithfulness constraints and with other independently motivated constraints such as *FLOAT and ALIGN-L.

The Kishambaa facts provide evidence against an absolute interpreta-

why deletion of the second high tone, as (66a), is more common crosslinguistically than deletion of the first high tone, as in (66b).

tion of the OCP as a condition on the well-formedness of representations. But the tone fusion facts in Kishambaa also provide evidence against a parameterized OCP that is 'off' in some languages. This supports the OT interpretation of constraints as universal but violable.

The OCP rules out a sequence of adjacent high tones, but does not specify which of the two tones should be affected. In OT, this means that some other constraint must determine whether it is the left or the right tone that is affected. The choice of which tone is affected is not arbitrary, but must coincide with some more general tone placement pattern. In the analysis of Shona, I argued that the fact that it is the left tone that survives in Mecussen's Rule should be related to the fact that tones are associated with the leftmost available tone bearer. In Rimi, on the other hand, the fact that it is the right tone that survives was related to the rightward shift of tones. The recurrence of the same directional asymmetry in different tone patterns in a language supports the modular approach to constraints that is central to OT, since in that approach the recurring directional asymmetry can and must be expressed with an alignment constraint. On the other hand, it argues against the derivational approach, in which the linear order conditions for one rule cannot be carried over to another.[31]

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[31] It should be noted that even if the OCP is ranked low, input representations of morphemes will conform to it. If there is a sequence of high-toned syllables within a morpheme, a representation obeying the OCP is always available, and no Faithfulness constraint is relevant. Therefore the OCP-obeying representation will be chosen through Lexicon Optimization (Prince and Smolensky 1993).

Likewise, the OT interpretation of the OCP still requires assimilation to be expressed as spread rather than copy (Yip 1988). Spreading H, for example, does not violate the OCP and only violates DEP-IO (A). Copy of H, on the other hand, not only violates the OCP, but also both DEP-IO (T) and DEP-IO (A). Spread H will therefore always be a more optimal representation of tone assimilation, even if the OCP is dominated.

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