INTRODUCTION

No snakes of any kind are to be met with throughout the whole island.

—(The complete text of)
Chapter LXXII, Concerning
snakes. Niels Horrebow, *The
Natural History of Iceland*

1.1   The Emergent Noniterativity Hypothesis

To what extent are grammars concerned with the processes that turn underlying forms into surface representations? In a rule-based generative theory, grammars are composed nearly exclusively of lexical representations and rules. These rules are just formalized processes. Since processes are formal constructs in this kind of theory, it is reasonable to suppose that grammars have an interest in specifying how this large component of the grammar operates. For example, grammars might specify how many times a process can apply. In practice, phonologists have limited this kind of specification to a dichotomy between iterative and noniterative rules: Some rules are permitted to apply to their own outputs, but others are not.

On the other hand, in an output-oriented theory like Optimality Theory (OT; Prince & Smolensky 1993[2004]), processes are not formal constructs, but rather emerge from constraint interaction. Instead of dictating the number of times

a process applies, grammars are concerned with optimal satisfaction of output demands. When a process applies (non)iteratively, it does so because that happens to be the best way to satisfy some output desideratum, not because the process is specifically required to be (non)iterative. Because processes have no formal place in the theory, OT does not make available the ability to specify whether or not a process is allowed to apply to its own output.

Thus rule-based phonology and OT answer the question above in very different ways. As the existence of iterativity parameters and the like show, rule-based grammars are immensely concerned with the properties of processes. But in eschewing processes as formal entities, OT refrains from delineating their attributes.

This dissertation supports the OT approach to processes by arguing that there are no noniterative phenomena in phonology,[1] and therefore grammars should not have the power to stipulate whether a process is iterative or noniterative:

(1)   **Emergent Noniterativity Hypothesis (ENH):** *No formal entity in phonological grammars may require noniterativity.*

What is meant by the terms *iterative* and *noniterative*? I take an iterative phenomenon to be one that must be analyzed with a self-feeding rule that is allowed to reapply to its own output. A self-feeding rule is one that creates an environment to which the rule can apply again (non-vacuously). For example, consider the rule in (2).

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[1]Just as Niels Horrebow (*The Natural History of Iceland. Translated from the Danish original of Mr. N. Horrebow. And illustrated with a new general map of the island.* London, 1758. Eighteenth Century Collections Online. Gale Group. http://galenet.galegroup.com/servlet/ECCO p. 91) devoted a whole chapter—quoted in its entirety above—to pointing out that snakes do not live in Iceland, this dissertation spends significantly more ink arguing for the same conclusion with respect to noniterativity in phonology.

(2)   V   C$_0$ V
              ⌐----------⌐│
                   [±ATR]
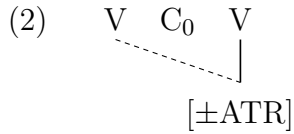
This rule spreads the feature [±ATR] leftward from one vowel to the preceding vowel. This rule is self-feeding in that it results in a vowel that is newly specified for [±ATR] and would, were the rule to apply again, be a potential source of spreading so that [±ATR] could spread yet another syllable leftward. If the rule does in fact apply again and again, then it applies iteratively. This is exactly what we find in phenomena like vowel harmony; the rule in (2) is a good first approximation of an analysis of ATR harmony in Kinande (Archangeli & Pulleyblank 1994, Cole & Kisseberth 1994). In this language, verbal prefixes harmonize with root ATR specifications (a is invariant and transparent and roots are italicized):

(3)   a.   /E-rI-*lib*-a/   → ɛriliba   'to cover'[2]

       b.   /tU-ka-kI-*lim*-a/   → tukakilima   'we exterminate it'

       c.   /E-rI-*huk*-a/   → ɛrihuka   'to cook'

       d.   /tU-ka-kI-*huk*-a/   → tukakihuka   'we cook it'

       e.   /E-rI-*lɪm*-a/   → ɛrɪlɪma   'to cultivate'

       f.   /tU-ka-kI-*lɪm*-a/   → tʊkakɪlɪma   'we cultivate it'

       g.   /E-rI-*hʊm*-a/   → ɛrɪhʊma   'to beat'

       h.   /tU-ka-mU-*hʊm*-a/   → tʊkamʊhʊma   'we beat him'

Setting aside the transparency of a (but see Gick et al. (2006) for evidence that this vowel is not transparent), it is clear that the ATR feature of the root propagates leftward from vowel to vowel. Applying (2) iteratively achieves this.

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[2]Archangeli & Pulleyblank (1994) state that the *E-* prefix is outside the domain of lexical harmony and is optionally harmonized postlexically.

On the other hand, if a rule applies just once, then it applies noniteratively. The Nilotic language Lango (Noonan 1992) provides an ostensible example of noniterative application of (2).

(4)   a.   /bòŋɔ́-ní/   → bòŋóní   'your dress'

      b.   /còŋɔ̀-ní/   → còŋòní   'your beer'

      c.   /àmʊ́k-ní/   → àmúkkí   'your shoe'

In the examples in (4), [+ATR] spreads from the suffix vowel to the root-final vowel. Crucially, it does not spread any farther. It appears that [+ATR] is allowed to spread exactly one syllable leftward. Archangeli & Pulleyblank (1994), for example, account for Lango with explicitly noniterative versions of a vowel harmony rule. From this point of view, the only significant difference between the vowel harmony systems in Kinande and Lango is that the rule producing them is iterative in the former but noniterative in the latter. They are both analyzable with (something like) (2), a self-feeding rule that reapplies to its own output in Kinande but not in Lango.

The argument put forward in this dissertation is that the close similarity between Kinande and Lango is illusory, and that it is in fact incorrect to characterize Lango's harmony as noniterative. More broadly, the claim is that true noniterativity is absent from the phonologies of the world's languages: There is no phenomenon that must be analyzed with a self-feeding rule that is not permitted to apply to its own output. Subsequent chapters of this dissertation examine the best candidate examples of noniterativity and argue that these cases are best understood without resorting to formal noniterativity requirements. Chapter 2

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addresses Lango, which I argue exhibits the effects of a desire for suffix features to be root-licensed rather than a proper noniterative harmony rule.

Chapter 3 discusses umlaut in Chamorro, where [–back] spreads from prefixes to root-initial vowels (see (5)), but only if the target vowel is stressed (cf. (6)).

(5)   nánɑ   'mother'   i nǽnɑ   'the mother'

       gúmaʔ   'house'   i gímaʔ   'the house'

       cúpɑ   'cigarettes'   i cípɑ   'the cigarettes'

       sóŋsuŋ   'village'   i séŋsuŋ   'the village'

(6)   pulónnun   'trigger fish' i pulónnun   'the trigger fish'

       mundóŋgu   'cow's stomach' i mundóŋgu   'the cow's stomach'

Umlaut appears noniterative in that it appears that [–back] is permitted to spread exactly one syllable rightward, and if its target—the stressed syllable—cannot be reached with this operation, spreading is not allowed. That is, we cannot spread iteratively to reach the stressed syllable (*i pilénnun). I argue that there is a better way to view umlaut: Spreading is motivated by the weakness of pretonic syllables in Chamorro, and to compensate for this weakness, [–back] features in pretonic position must spread to the root. The lack of umlaut in (6) has nothing to do with noniterativity. Instead, the prefix's [–back] feature is not pretonic, so it is not a valid umlaut trigger.

Of course, noniterativity might be expected to appear in domains other than segmental phonology. Chapter 4 takes up the issue of tonal phenomena. Tones commonly spread or move one syllable away from their underlying hosts. Consequently, these phenomena present the most convincing examples of noniterativity

that I am aware of. However, two developments, one empirical and one theoretical, provide alternative explanations for these phenomena. On the empirical front, Myers (1999) argues that what has been called noniterative tone spread in Chichewa is best understood as the consequence of peak delay, a crosslinguistically attested phenomenon in which a high tone's f_0 maximum is reached relatively late in the tone's host syllable, or even in the next syllable. That is, tones do not spread or move noniteratively in Chichewa. Rather, their phonetic implementations give rise to this impression. Experimental evidence from Myers (1999) supports this contention, and Chapter 4 presents an Optimality Theoretic analysis of peak delay that is extendable to other languages with similar phenomena.

The second development is Optimal Domains Theory (Cole & Kisseberth 1994 *et seq.*), which posits that phenomena like harmony and tone spread/shift result from the extension of abstract domains (similar to feet) for some feature/tone beyond the underlying host syllable. In the case of spreading, the feature or tone is realized throughout the new larger domain. For shifting, only the last potential host in the domain realizes the feature or tone. So-called noniterative spreading or shifting result from the construction of binary domains.

Peak delay and Optimal Domains Theory present very different views of noniterative tonal phenomena, but neither explicitly calls on noniterativity. The one-syllable spreading/shifting limit results either from tones' pitch targets being reached "too late," or confinement of the tones to a binary domain.

Chapter 5 turns to noniterativity in domains larger than the word. It is not unusual to find a process that spreads some feature from the first syllable or segment of one word to the last syllable or segment of the preceding word.

Such spreading appears noniterative because just the last syllable or segment of the preceding word is targeted. Several such phenomena are examined in that chapter, and it is argued that they are driven by NONFINALITY. For example, in Nez Perce, vowel harmony extends throughout a word. But in fast speech, the last vowel of one word optionally harmonizes with the following word rather than its own word (harmonic domains are indicated with curly braces):

(7)   a.   {ʔitam'yá·t'as} {ʔewsí·x.}   'They are for sale.'

          {ʔitam'yá·}{t'es ʔewsí·x.}

Postlexical spreading displaces the harmonic domain-final vowel from the last syllable of the word. If harmonic domains are right-headed, NONFINALITY can be used to motivate this minimal misalignment by preventing domain heads from falling in word-final syllables. Noniterative spreading results because further spreading (*{ʔita}{m'yé·t'es ʔewsí·x.}) is not motivated by NONFINALITY. No formal declaration of noniterativity is necessary.

Investigation of these postlexical phenomena leads the discussion in Chapter 5 to iterative optionality, a class of processes that Vaux (2003b) identifies as problematic for OT. In these phenomena, the decision to apply (or not) an optional process to one locus in a form is independent of the choice made at another locus in the same form. When an optional process is applicable at several points in a form, it may apply at some points but not others. Vata's postlexical spreading, which is similar to Nez Perce's, has this property. As shown in (8), in a string of monosyllabic words, [+ATR] may spread from the last word to any number of the preceding words.

(8)   a.   ɔ̗ ká zā̄ {pī̄}   'he will cook food'

        b.   ɔ̗ ká {zā̄ pī̄}

        c.   ɔ̗ {kʌ́ zā̄ pī̄}

        d.   {ȯ kʌ́ zā̄ pī̄}

I argue that like Nez Perce, postlexical spreading is driven by NonFinality in Vata, and the optionality is a product of Markedness Suppression, a modification of OT in which violation marks for designated markedness constraints may be ignored in the evaluation of a form. In essence, the forms in (8) without exhaustive spreading are possible outputs because we can ignore their violations of NonFinality.

Other (ostensible) cases of noniterativity, such as nasal place assimilation and noniterative foot assignment, are sufficiently straightforward that they do not warrant chapters of their own. They are discussed later in this chapter.

1.2   (Non)iterativity in Rule-Based Phonology

The contrast between iterative and noniterative processes has been a central area of inquiry since the advent of generative phonology with Chomsky & Halle (1968; henceforth *SPE*). Under the formalism of *SPE*, a rule may apply only once per cycle. When a rule applies, the string is scanned for all possible targets, and these targets are changed simultaneously. A first approximation of an SPE-style vowel harmony rule for Kinande is given in (9), assuming that only the root vowel is underlyingly specified for ATR.

(9)   [+syll] $\rightarrow$ [αATR]/__ [–syll][αATR]

But even with *SPE*'s simultaneous application, this rule will only change the vowel immediately preceding the root vowel. Other vowels do not meet the structural description for the rule because they do not precede a vowel specified for ATR at the time the rule scans for applicable loci. To deal with this problem, *SPE* introduces the parenthesis-star notation, by which we can specify that any number (including zero) of a string in parentheses may be present in the string that the rule applies to. For example, we can amend (9) as in (10).

(10) $[+\text{syll}] \rightarrow [\alpha\text{ATR}]/\underline{\quad} ([-\text{syll}][+\text{syll}])^* [-\text{syll}][\alpha\text{ATR}]$

The new rule says that a vowel takes on the ATR feature of a vowel to its right, no matter how many CV sequences (i.e. syllables) intervene. (Formally, (10) is actually an abbreviation for an infinite set of rules, one rule with zero CV sequences between the target and trigger, another rule with one intervening CV sequence, a third rule with two such sequences, etc.) This rule will now change every vowel that precedes the root vowel.

The parenthesis-star notation is essentially the earliest implementation of an iterativity parameter. The parenthesis-star convention is needed precisely for self-feeding rules: such a rule applies at just one point in a form, but its application creates a new environment for a subsequent application, and parenthesis-star notation gives us a way to formalize this. Roughly speaking, rules that contain a parenthesis-star element are iterative (in the self-feeding sense), and those that lack it are noniterative. Anderson (1974) argues against this approach explicitly and in favor of one in which rules are tagged as either iterative or noniterative, and

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the ungainly and repetitive[3] parenthesis-star notation has been largely abandoned in favor of simpler formalisms like an iterativity parameter.

The early generative phonology literature also makes the distinction between *linear* rules and *iterative* rules. Johnson (1970) argues in favor of linear rules (which start at one end of a string and change the first target they find, and then proceed to the next target without backtracking through parts of the string they've already scanned) as opposed to iterative rules (which are roughly the same except that they backtrack to the beginning of the string on each iteration). Linear rules are also roughly what Howard (1973) argues for, and Kenstowicz & Kisseberth (1977) point out that linear (what they call "directional") rules can produce an iterative/noniterative contrast through reversals of the direction of application. For example, consider a rule that spreads some feature F rightward from vowel to vowel. Applied starting at the left edge to a form like /CVCVCVCV/, where underlining indicates the presence of F, this rule will generate /CVCVCVCV/, with each application of the rule feeding the next. This is the equivalent of iterative spreading. But applied from the right edge, /CVCVCVCV/ is the output, with seemingly noniterative spreading.

Finally, many rule-based theories adopt an iterativity parameter whereby a single rule such as (2) can be used for either iterative or noniterative processes depending on the parameter's setting. With respect to (2), when the iterativity parameter is turned on, the rule will spread ATR features leftward from one vowel to another until the beginning of the word is reached. But when it is turned off, the rule applies just once, producing a Lango-style assimilation pattern. This

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[3]Notice that the string in parentheses in (10) repeats the environmental context that must be stated elsewhere—namely the CV sequence that follows the target vowel.

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kind of rule is proposed by Anderson (1971, 1974), Kenstowicz & Kisseberth (1973, 1977), Jensen & Strong-Jensen (1976), Vago (1973), Kiparsky (1985), Pulleyblank (1986), Myers (1987), Steriade (1993), and Archangeli & Pulleyblank (1994), among others. (Iterativity parameters are not exclusive to Autosegmental Phonology (Goldsmith 1976), of course, but I adopt the autosegmental rule formalism in this dissertation as an expository convenience.)

Rule-based theories, then, have several means at their disposal to make a distinction between iterative and noniterative phenomena. It is worth emphasizing that for all of the frameworks mentioned above, there is a very close formal connection between an iterative phenomenon and its noniterative counterpart. Returning to the Kinande and Lango examples, in *SPE*, the major difference between these harmony systems is that Kinande's harmony rule includes a parenthesis-star element that Lango's rule lacks. For systems with linear rules, Kinande and Lango differ only in the direction in which the harmony rule applies. And theories with an iterativity parameter account for both harmony systems with a single rule whose iterativity parameter takes different settings in the two languages. From this point of view, there is very little substantive difference between iterative and noniterative phenomena.

1.3   (Non)iterativity in OT

The picture is very different in Optimality Theory. The proper treatment of iterative vowel harmony (and similar phenomena) has been the subject of much debate. Many different formalisms that produce iterative spreading in OT have

been proposed, such as AGREE (Baković 2000, Lombardi 1996, 1999), ALIGN (Cole
& Kisseberth 1995, Kirchner 1993, McCarthy & Prince 1993, Pulleyblank 1996,
Smolensky 1993), Optimal Domains Theory, Headed Spans (McCarthy 2004), and
feature co-occurrence restrictions (Pulleyblank 2002). Constraints like PARSE
produce iterative syllabification, foot construction, etc. Research has uncovered
various drawbacks of each formalism, and I wish only to point out the ease with
which iterativity can be produced in OT. I remain neutral on the question of
which formalization of iterativity is best.

The noniterative vowel harmony in Lango, on the other hand, presents OT
with two related difficulties. The first problem is that OT cannot account for
Lango and Kinande with analyses that differ only in the setting of a parameter.
Thus OT seems to lose the insight that these are related harmony processes.
(But I argue in Chapter 2 that this similarity is misleading.) To illustrate the
point, two analyses of Kinande vowel harmony are sketched in (11) and (12)
(abstracting away from the issue of vowel transparency) using AGREE and ALIGN,
respectively. Each constraint motivates spreading throughout a word. AGREE
motivates total spreading in an effort to avoid disharmonic sequences of vowels,
and ALIGN motivates total spreading in an effort to match feature domains with
word edges (in both cases setting aside the question of how to accommodate a).

(11)

/tU-ka-kI-lim-a/	IDENT[ATR]-Root	AGREE
a. tʊkakɪlima		*!
b. tʊkakilima		*!
☞ c. tukakilima		
d. tʊkakɪlɪma	*!	

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(12)

/tU-ka-kI-lim-a/	IDENT[ATR]-Rt	ALIGN([±ATR],L;Wd,L)
a. tʊkakɪlima		*!**
b. tʊkakilima		*!*
☞ c. tukakilima		
d. tʊkakɪlɪma	*!	

However, AGREE and ALIGN cannot replicate the simple switch from iterative harmony to noniterative harmony seen in rule-based theories. The iterative force of these constraints is an emergent property, so it cannot be switched off in any easy way to transform the analysis of Kinande into an analysis of Lango. By their very nature, AGREE and ALIGN motivate spreading throughout a word, so they cannot be satisfied with the minimal spreading seen in Lango—iterativity is not a parameter. In terms of processes, the spreading process in Kinande is iterative not because it is explicitly required to be iterative, but because iterative spreading is the best way to ensure either that all vowels match in terms of [±ATR], or that all ATR domains are left-aligned. To produce noniterative spreading, we have to impose a new output condition—we need a different constraint. Rule-based approaches make it much easier to switch between iterativity and noniterativity, and this contrast appears to argue for derivational theories over OT.

The second problem OT faces is that it has no way to formalize the notion of "spreading to the next unit" because OT is output-oriented and process-blind. If it is correct to characterize Lango's harmony as one in which [+ATR] spreads one vowel to the left, an adequate constraint-based analysis must compare the underlying distribution of ATR features with the output featural configuration and determine whether [+ATR] has spread to exactly one vowel. For exam-

ple, the inputs /bɔ̀ŋɔ́-ní/ and /bɔ̀ŋó-ní/ (the latter is hypothetical) should yield the outputs *bɔ̀ŋóní* and *bòŋóní*, respectively, if the correct generalization is that [+ATR] spreads exactly once. Obviously, to select correct output candidates, the markedness constraint that drives harmony must know which input is under consideration. This state of affairs is generally avoided in OT: markedness constraints must not compare inputs and outputs. With OT banned from adopting markedness constraints that access the input, it cannot formally require noniterativity.

OT therefore claims not only that iterative and noniterative phenomena are qualitatively different, but that noniterativity should not exist at all. This claim seems unlikely at first considering the existence of well-known (seemingly) noniterative processes like Lango's harmony, Chamorro's umlaut, tonal processes, and other cases discussed below, but this dissertation argues that it is correct.

This dissertation, in essence, raises the question of what noniterativity's place in phonology is. The argument advanced here is that noniterativity has no formal status in phonology. At best it is a descriptive label we can apply when grammatical factors conspire to produce certain patterns. The OT perspective is correct: The apparent minimal difference between Lango and Kinande is an illusion masking deeper, more fundamental differences. The two languages' harmony systems are not as related as the rule-based analysis claims.

This result means that OT does not need an explicit formalization of noniterativity, and in fact such a formalization would be misguided. Since the noniterative nature of the phenomena considered here can be captured by appealing to deeper motivations, the analyses developed in the following chapters are instructive in that they suggests that all cases of apparently noniterative spreading can be ex-

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plained without recourse to a formalization of that notion. Therefore, OT, which cannot formalize noniterativity, has a leg up on rule-based phonologies that need (something like) iterativity parameters.

An investigation of noniterativity contributes to the broader understanding of the status of processes in phonology. This issue has received some attention recently, with some researchers (Nevins & Vaux 2008b, Vaux 2003b) returning to the question of rules versus constraints and others (McCarthy 2006, to appear) exploring the possibility of reintroducing serialism in a parallel framework. Noniterativity is a fact about processes, not phonological representations, and a linguistic theory can require noniterativity only if it explicitly recognizes processes. As we have seen, rule-based phonology can mandate (non)iterativity because it includes formal, explicitly stated processes in the form of rules. OT, in contrast, has no place for processes (but see McCarthy (2006, to appear) for an elaboration of the Gen component of OT in which processes become an explicit part of the theory). Epenthesis, deletion, spreading, etc., are terms that characterize the dimensions along which input and output forms differ, not steps that are taken to produce licit outputs. OT therefore cannot regulate processes through, e.g., an iterativity parameter.

Viewed in this way, the Emergent Noniterativity Hypothesis is a statement about the kinds of requirements grammars may impose on processes. In particular, grammars cannot regulate the number of times a process is allowed to occur. Other researchers (e.g. McCarthy 2003) have argued that grammars cannot count, or may not count beyond two. If that claim is correct, then grammars are also unable to designate a particular numerical location (such as the fifth syllable)

as the preferred site for a process to occur or an entity to appear. Like this earlier research, the current dissertation identifies and argues for a dimension along which grammars are prohibited from making demands of processes. Taken together, all of this research suggests that grammars may be unable to directly regulate processes. This conclusion supports the view that processes are not part of the grammar to begin with. If grammars cannot directly regulate how processes apply, processes themselves, as formal entities, become expendable. OT, whose architecture precludes processes and regulations on them, seems well suited for this state of affairs.

1.3.1 Conjoined Faithfulness

Conjoined constraints can be used to generate noniterativity.[4] The self-conjunction of IDENT[F] within an AGREE-style analysis would eliminate candidates in which the feature [F] is changed twice but permit a single segment to change its specification for [F]. That is, IDENT[ATR]^2 (=IDENT[ATR] & IDENT[ATR]) rules out *bòŋó-ní but not bòŋó-ní because only the former has two violations of IDENT[ATR]. In this way, OT can mimic noniterativity.

There are reasons to dislike the self-conjunction approach. If IDENT[ATR]^2 is allowed, the conjunction of this constraint with IDENT[ATR] must also be allowed, yielding IDENT[ATR] & IDENT[ATR] & IDENT[ATR], or IDENT[ATR]^3. The new constraint permits spreading through two syllables but not three. Yet another conjunction gives us IDENT[ATR]^4, which permits spreading across three syllables but not four. Self-conjunction provides a way of counting syllables and permitting

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[4]I thank Armin Mester for pointing this out to me, as well as for raising the objections I repeat in this section.

spreading by n syllables but not by $n + 1$ syllables for any n. This is surely too powerful. Others have argued that phonological mechanisms must not have the power to count past two (McCarthy 2003), and self-conjunction of faithfulness constraints violates this limitation.

Nonetheless, even this approach does not stipulate noniterativity directly, and OT analyses that adopt conjoined faithfulness are compatible with the Emergent Noniterativity Hypothesis. No part of a conjoined faithfulness analysis says "spread exactly once"—rather, the analysis permits as much spreading as one likes, provided it does not go beyond the arbitrary numerical stipulation. That is, there's nothing special about noniterativity in this approach. It's just one of many possibilities that fall short of full-fledged iterativity.

1.4 Simple Cases of Noniterativity

1.4.1 Foot Assignment

Iterative and noniterative foot assignment is a central distinction in prosodic phonology, but phonologists have come to tacitly agree that noniterative foot assignment is not in fact noniterative. Consider the data in (13) from Southeastern Tepehuan (Willett 1982):

(13) níi'cartam   'dancing'

      vacóocos'am   'they went to sleep'

      cóocroidya'   'tadpole'

      tóohlguiom   'mouse'

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Stress appears on one of the first two syllables of the word depending on weight factors. Kager (1997) argues that each word contains a single word-initial iamb.[5]

The most common approach to this sort of system (and the one developed by Kager (1997) for Southeastern Tepehuan specifically) in OT follows McCarthy & Prince (1993) in ranking an Alignment constraint over the constraint that requires all syllables to be parsed into feet, Parse-σ (non-gradient replacements for Alignment proposed by McCarthy (2003) can be used instead). The Alignment constraint requires all feet to appear at one edge of the word and is therefore in conflict with Parse-σ: If we build multiple feet so that every syllable is footed, then some feet will necessarily not be at the correct word edge, in violation of Alignment. This is illustrated schematically in (14).

(14)

/$\sigma\sigma\sigma\sigma\sigma\sigma$/	Align(Ft,L;Wd,L)	Parse-σ
☞ a. ($\sigma\sigma$)$\sigma\sigma\sigma\sigma$		****
b. ($\sigma\sigma$)($\sigma\sigma$)($\sigma\sigma$)	*!*	

Align(Ft,L;Wd,L) requires the left edge of every foot to be aligned with the left edge of some word. Obviously, only one foot per word can meet this requirement, so constructing multiple feet fatally violates this constraint, as candidate (b) shows. The only way to satisfy Align is to construct just one foot (i.e. "non-iterative" foot construction). It should be clear that with the opposite ranking, the candidate with multiple feet (i.e. "iterative" foot construction) will win.

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[5]Syncope in subsequent syllables seems to point toward the presence of other (stressless) feet: Vowels in even-numbered open syllables are deleted. But Kager (1997) argues that these feet are unnecessary if we take into account the illicit consonant clusters that would be created if adjacent rather than alternating syllables were targeted for syncope.

Under this analysis, two forces are at work, and neither has any formal or explicit connection to (non)iterativity. One constraint demands exhaustive parsing of syllables into feet, and another requires all feet to be at one end of the word. When the former constraint outranks the latter, iterative foot-building results, and under the opposite ranking, only one foot is built. No mention of iterativity is needed; the (non)iterativity is derived from constraint interaction.

In fact, noniterativity need not be invoked even in rule-based analyses of languages like Southeastern Tepehuan. Halle & Vergnaud (1987) develop an analysis of languages with just one stress that rests on iterative foot construction. After a word is exhaustively parsed and main stress is assigned, their Line Conflation mechanism eliminates the grid marks over the non-main stressed syllables. These erased marks would otherwise lead to secondary stress, but Line Conflation creates the appearance of noniterativity in an iterative system.

McCarthy (2003) notes that skepticism toward claims of noniterative footing is warranted. He quotes Hayes (1995), who points out that languages may simply refrain from providing cues (i.e. stress) for the presence of iterative footing. Under this view, noniterative footing may not be an option in the first place, and it is therefore obviously unnecessary to require noniterativity.

Keeping McCarthy's caution in mind, this is a simple and widely accepted case in which a process that appears noniterative can be more insightfully understood by building an analysis on other principles and letting the noniterativity emerge from the interaction of these principles. The research presented in this dissertation reveals similar situations for other cases of apparent noniterativity. There is always an external reason for a process to stop after one iteration: the

impetus for performing the process may be satisfied at that point, or, as with foot assignment, independent constraints may intervene to temper the motivating constraint's effect. In this way, the approach taken here follows the standard practice within OT of searching for independent motivations for phonological facts instead of settling on a stipulative solution such as an iterativity parameter. The current investigation is novel in that it puts noniterativity at the center of this analytical technique.

1.4.2 Emergent Noniterativity

1.4.2.1 Nati

There are many other processes that exhibit what I will call *emergent noniterativity.* These are phenomena that can but need not be analyzed with a self-feeding rule. The noniterativity is emergent because these processes may be analyzed with either an iterative rule or a noniterative rule, and thus noniterativity is not a defining characteristic of these processes. One such phenomenon is Nati, from Sanskrit. In Nati, retroflexion spreads from ṣ or *r* rightward to *n*. (Data from Gafos (1999) and Kiparsky (1985); see also Allen (1951), Cho (1991), Kiparsky (1985), Ní Chiosáin & Padgett (1997), Schein & Steriade (1986), Whitney (1889), among others. Following the practice of these authors, retroflexion is marked with a dot under the consonant, except that *r* is always retroflex.)

(15)   a.   pūr-ṇā   'fill'

         b.   vṛk-ṇa   'cut up'

         c.   bṛahmaṇ-ya   'devotion'

d.	kṛp-a-māṇa	'lament'
e.	kṣubh-āṇa	'quake'
f.	cakṣ-āṇa	'see'

Only the first *n* after *ṣ* or *r* is targeted. Thus /varn-anā-nām/ 'descriptions (gen. pl.)' becomes *varṇanānām*, not **varṇaṇāṇām*. This noniterativity is emergent because, as Kiparsky (1985) and Gafos (1999) point out, a second iteration of spreading is impossible: Only *ṣ* and *r* trigger spreading, so in the configuration …*ṣ/r*…*ṇ*…*n*…, the final *n* cannot become *ṇ* because retroflexion cannot spread from the preceding *ṇ*. Not even an appropriately formulated iterative rule will target the second *n* because the rule is not self-feeding. Kiparsky (1985:113) points out that Sanskrit is not alone in this regard, and that more generally, "processes only propagate when the target is itself a trigger of the rule." Iterativity only becomes an option when this criterion is met. When it is not met, the result is emergent noniterativity.

OT analyses of Nati that do not rely on noniterativity are also available. For example, it is possible to construct a Positional Licensing analysis along the lines of the analysis developed for Lango in Chapter 2. Suppose only [–continuant] consonants can license retroflexion. That this is correct—for whatever reason—is suggested by the fact that the sources of spreading, *ṣ* and *r*, are the only [+continuant] retroflex segments in Sanskrit. With a constraint motivating spreading rightward to the next [–continuant] coronal for the purposes of licensing, spreading to *n*, *t*, *d* can be produced. High-ranking faithfulness to stops' place of articulation can block this spreading when *t*, *d* are the targets, so only spreading to *n* is permitted, even though spreading to *t*, *d* would also satisfy Positional Licensing.

And once an acceptable spreading target has been reached, Positional Licensing motivates no further spreading.

1.4.2.2 Bengali

As described by Mahanta (to appear), Standard Colloquial Bengali presents a case similar to Nati. In this language, only high vowels are appropriate triggers for regressive [+ATR] harmony. Some examples are shown in (16).

(16) a. kɔtʰa   'spoken words'   kotʰito   'uttered'

                                      kɔtʰoniyo 'speakable'

      b. ɔʃɔt   'dishonest'   ɔʃoti   'dishonest (f)'

      c. ʃokti   'might'

In each form, the vowel immediately before the high vowel is [+ATR]. The last example shows that the trigger need not be a suffix. Mahanta argues that this harmony is noniterative on the basis of forms like *kɔtʰoniyo*: The [+ATR] feature spreads just once to the left. (Although Mahanta does not herself characterize harmony as spreading *per se*.) But if only high vowels are triggers, then, as in Nati, we would not expect a second iteration of spreading in the first place (**kotʰoniyo*): *o* is not a valid trigger.

Standard Colloquial Bengali's harmony is only (seemingly) noniterative because the language contains no [–ATR] high vowels. That is, there is no form /kɔtʰmiyo/ that can become *kotʰiniyo* through two iterations of spreading (once to /ɪ/ to create *i*, which is a valid trigger for harmonization of the initial /ɔ/). Since underlying high vowels are always [+ATR], they are never targets for harmony,

and this means that they cannot participate in a second (or third, or fourth...) iteration of spreading. They are always the first trigger.

Mahanta notes that in another dialect, Cachar Bengali, a vowel raising process can create new triggers. For example, *borluki* 'lavishness' is derived from /bɔr-loki/ (no morpheme-by-morpheme glosses are provided). The underlying /o/ raises to *u*, which can then trigger ATR harmony on the preceding /ɔ/.[6] Since raising and ATR harmony are both motivated by harmony constraints, Mahanta argues that this sort of example illustrates "iterativity in an apparently non-iterative language" (9). If we accept this characterization, then Bengali's harmony (in both dialects) is revealed to be iterative under the right circumstances (which only arise in Cachar Bengali) and is thus not a counterexample to the Emergent Noniterativity Hypothesis. If we treat raising and ATR harmony as separate phenomena, then ATR harmony's noniterativity is emergent for the reasons discussed above. I return to Bengali's harmony in Chapter 2.

1.4.2.3 Umlaut and Metaphony

As another example, consider German umlaut (McCormick 1981, van Coetsem & McCormick 1982). Historically, [–back] spread from suffix vowels to the root-final vowel. While this seems to require spreading of [–back] one vowel to the left and no farther, McCormick (1981) has argued that Germanic umlaut is actually prosodically constrained. The root-final vowel is prosodically prominent while the suffix vowel is reduced, suggesting the presence of a word-final trochee. [–back] spreads throughout the foot, much like (Flemming's (1994) description of) ATR

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[6]Standard Colloquial Bengali has the same raising process in verbs, but as verb roots are always monosyllabic, raising never leads to ATR harmony in that dialect.

harmony in Tudanca Spanish. Only one vowel is targeted because there are only two vowels in the foot. Alternatively, a Lango-style Licensing analysis is possible (see Chapter 2), with [–back] spreading to the root for licensing purposes. Again, no mention if noniterativity is necessary.

Similarly, in Tudanca Spanish (Flemming 1994, Walker 2004), laxness spreads regressively from word-final vowels to the stressed vowel. High vowels are obligatorily lax word-finally (Walker 2004). Following Flemming and Walker, capitalization indicates laxness ([–ATR]) and diacritics mark stress:

(17) a.   pÍntU   'male calf'

          pínta   'female calf'

      b.   sÉkU   'dry (masc.)'

          séka   'dry (fem.)'

      c.   θÚrdU   'left-handed (masc. sg.)'

          θúrdos   'left-handed (m. pl.)'

      d.   ÓhU   'eye (sg.)'

          óhos   'eye (pl.)'

      e.   sekÁlU   'to dry him'

          sekálo   'to dry it (mass)'

      f.   ahambrÁU   'hungry (masc.)'

          ahambráa   'hungry (fem.)'

      g.   antigwÍsImU   'very old'

      h.   orÉgAnU   'oregano'

      i.   pÓrtIkU   'portico'

      j.   rakÍtIkU   'rachitic'

k. kÁrAbU   'tawny owl'

l. pÚlpItU   'pulpit'

Flemming adopts the view that Spanish has a word-final trochee plus, in some cases, an extrametrical syllable. Since extrametrical syllables are adjoined to the final foot in Flemming's theory, he argues that spreading is confined to the foot (in OT terms, we might use Align(L,[–ATR];Ft,L)). Walker views the above assimilations as spreading to the stressed vowel and proposes a Positional Licensing analysis in which [–ATR] must be linked to the stressed syllable. Under either analysis, what might otherwise be analyzed as noniterative spreading is actually either exhaustive spreading within a small domain (the foot) or spreading to a prominent position. Although (17a)–(17f) appear to contain noniterative spreading, noniterativity doesn't enter the discussion.

To arbitrarily adopt Walker's characterization of Tudanca Spanish, a licensing constraint like the one in (18) can motivate metaphony. (This is a simplified version of Walker's analysis.) "Noniterative" spreading satisfies License when the stressed syllable is penultimate (and therefore adjacent to the syllable containing the lax vowel). When a syllable intervenes between the stressed and word-final syllables, spreading through the intervening vowel is required if the [–ATR] feature is to reach the stressed vowel. In neither case is spreading beyond the stressed vowel a possibility. This is illustrated in (19). The extent of spreading varies with the distance between the source vowel and the target prominent position.

(18)   License-[–ATR]/Stress: [–ATR] must be linked to a segment in a stressed syllable.

(19)

/oréganu/	*[+high, +ATR]]$_{\text{Wd}}$	LICENSE	IDENT[ATR]
a. oréganu	*!		
b. orégAnU		*!	**
☞ c. orÉgAnU			***
d. OrÉgAnU			****!

Candidate (a) is ruled out by the ban on [+ATR] high vowels in word-final position. The remaining candidates have a [–ATR] final vowel, but only candidates in which this feature spreads to the stressed vowel avoid violations of LICENSE-[–ATR]/Stress (candidates (c) and (d)). Of these, the winner is the one that incurs the fewest violations of IDENT[ATR]. In forms with penultimate stress, this will be the form in which [–ATR] has spread exactly one syllable, but when there is antepenultimate stress, as in (19), spreading cannot be characterized as noniterative under any theoretical framework. I argue in Chapter 2 that Lango's harmony is like metaphony in Tudanca Spanish in that it involves minimal spreading to license particular features. Both cases argue against viewing assimilatory phenomena in terms of (non)iterativity because some configurations in each language require ostensibly noniterative spreading and others require what looks like iterative spreading. The two sets can only be unified under an analysis that takes the target, not the extent, of spreading to be the crucial factor. The appearance of iterativity or noniterativity is not analytically significant.

1.4.2.4 Emphatic Spread in Palestinian Arabic

In Northern Palestinian Arabic, emphasis (=[RTR]) spreads leftward from the underlyingly emphatic consonant to the beginning of the word and rightward to the

next syllable nucleus following the underlyingly emphatic consonant (Davis 1995, McCarthy 1997; following the latter, capitalization marks underlying emphasis and underlining marks emphatic spread):

(20) a. <u>manTa</u>ka   'area'

      b. <u>ʔaDla</u>m   'most unjust' ($D = ð$)

      c. <u>Snaa</u>f   'brands'

      d. <u>Sa</u>baaħ   'morning'

A noniterative rule for rightward spreading could easily be written to spread [RTR] from any segment to the next low vowel and through the intervening segments. While it is true that [RTR] can continue spreading rightward through a sequence composed of laryngeals, pharyngeals, and *a* (the "low" segments) as shown in (21), this additional spreading is blocked by non-low segments whereas spreading to the first *a* (20) is blocked only by [+high] segments.

(21) a. <u>maSlaħa</u>   'interest'

      b. <u>Saħħaha</u>   'he awakened her'

      c. <u>Saħan</u>   'he ground'

      d. <u>Sah</u>hab   'he leveled a layer of small stones'

      e. <u>Taaʕan</u>   'he stabbed repeatedly'

The different blocking segments indicate that two rightward spreading operations are at work. The first spreads [RTR] noniteratively to the next low nucleus through any non-high segments, and the second spreads [RTR] iteratively through only low segments. Davis (1995) proposes a rule-based account that does just this,

except that he derives noniterative spreading through an iterative rule whose domain of application is limited to the following syllable nucleus.

But McCarthy (1997) shows that the noniterative nature of the first spreading operation can be produced with an Alignment constraint requiring the right edge of an [RTR] domain to align with *a*. Outranked by *[RTR, +high], this constraint motivates spreading through all segments except ones that are [+high]. The spreading in (21) is motivated by a low-ranking constraint requiring [RTR] to align with the right edge of the word. Its effect is curtailed by a constraint against nonlow [RTR] segments.

A Positional Licensing analysis for these data is also imaginable. Apparent noniterative spreading to the next low vowel can be motivated by a constraint stating that [RTR] is licensed only on low vowels. This would have to be formulated as a COINCIDE (Itô & Mester 1999, Zoll 1998a) constraint requiring the *right edge* of an [RTR] domain to be licensed by *a*. Otherwise leftward spreading that happens to include *a* in its domain (as in (20a)) would obviate rightward spreading. Crucially, the noniterative appearance of the spreading in (20) can be characterized in iterativity-neutral terms; the noniterativity is emergent.

1.4.2.5   High Tone Spreading in Ikalanga

The phenomena discussed so far in this section involve processes that appear noniterative, but noniterative rules can be used in combination with other rules to produce complex patterns that do not exhibit any noniterative character on the surface. For example, Hyman & Mathangwane (1998) make use of three rules of high tone spreading (HTS) to account for the tonology of verb stems in Ikalanga.

Two of these rules are noniterative, but, as (22) shows, tones do not simply spread by one syllable.[7]

(22) a. ku-cí+pótélék-á...   'to surround it...'

  b. ku-cí+fúmík-á bu-sîkú   'to cover it at night'

  c. ku-cí+táfún-á bu-sîkú   'to chew it at night'

  d. ku-cí+bákílíl-á bu-sîkú   'to fence it in at night'

  e. ku-cí+pótélék-á bu-sîkú   'to surround it at night'

  f. ku-cí+túm-á bú-sî:kú   'to send it at night'

The symbol '+' marks the boundary between prefixes and the verb stem. In each example, H links to the first syllable of the stem and spreads rightward as illustrated in (23) for (22a).

(23)   H   H
            | ╱⋰⋰⋱
        ku -ci+pote le k-a
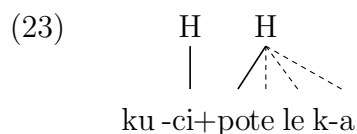
H spreads throughout the stem, and in the case of (22f), H spreads also to the first syllable of the next word, *bu-sîkú* 'at night.' All disyllabic and shorter stems (henceforth "short stems") exhibit spreading to the next word:

(24) a. ku+ch-á bú-sîkú   'to fear it at night'

  b. ku+tól-á bú-sîkú   'to take it at night'

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[7]All forms discussed here are crucially internal to Intonational Phrases. IP-final verbs show some complications that do not concern us here. See Kaplan (2006, 2007) for a treatment of these forms in OT.

The derivational analysis of HTS proposed by Hyman & Mathangwane (1998) works like this. H is linked to the stem-initial syllable. The first rule, HTS_1, spreads this H one syllable to the right. In the case of short stems, this means the domain of H already encompasses the entire stem. Next, the final syllable of the stem is declared extrametrical (i.e. impervious to further HTS). HTS_2 then spreads H iteratively to the end of (the visisble portion of) the stem. HTS_2 applies vacuously in short stems (HTS_1 already exhausted the available stem syllables), but in longer stems the result is that all but the last syllable of the stem is linked to H. Finally, extrametricality is removed, and HTS_3 spreads H one more syllable to the right. This last rule has two effects: (i) it links H to the previously extrametrical stem-final syllables in longer stems, and (ii) it spreads H from the final syllable of short stems to the first syllable of the next word. Two representative derivations are given in (25).

(25) /ku-cí+pótelek-a (bu-sîkú)/   /ku-cí+túm-a (bu-sîkú)/

HTS_1 ku-cí+pótélek-a (bu-sîkú)   ku-cí+túm-á (bu-sîkú)

EM ku-cí+pótélek-<a> (bu-sîkú)   ku-cí+túm-<á> (bu-sîkú)

HTS_2 ku-cí+pótélék-<a> (bu-sîkú)   ————

HTS_3 ku-cí+pótélék-á bu-sîkú   ku-cí+túm-á bú-sîkú

There is nothing noniterative about HTS in these examples. The only reason Hyman & Mathangwane employ noniterative rules in the forms under discussion is to account for the spreading of H to the next word in short stems. Clearly the surface generalization is that H spreads throughout the stem plus one more syllable in the case of short stems. A simple ALIGN-R constraint or something

similar is enough to account for the spreading throughout the stem, and either line of analysis proposed in Chapter 4 will suffice to effectively impose a minimum limit on the breadth of high-tone domains to motivate the "extra" spreading in short stems. See Kaplan (2006, 2007) for an analysis of Ikalanga along these lines (although that analysis does not use the analyses of Chapter 4 specifically). The noniterativity in Hyman & Mathangwane's analysis is simply an artifact of their derivational approach. Nothing in the data above demands a noniterative treatment. Thus we see another way in which noniterativity can seem relevant from a rule-based perspective. This impression disappears in the light of OT's orientation toward outputs rather than processes.

1.4.2.6   Lardil

Deletion of word-final material in Lardil is a particularly famous phenomenon, and it is worth addressing here. The discussion and data in this section come from Prince & Smolensky (1993[2004]) and Kurisu (2001), but many others have addressed this phenomenon. Lardil allows only coronal word-final codas. Underlying word-final non-coronals are deleted:

(26) | *Stem* | *Nominative* | *No-Future Acc.* | *Gloss* |
|---|---|---|---|
| ŋaluk | ŋalu | ŋaluk-in | 'story' |
| wuŋkunuŋ | wuŋkunu | wuŋkunuŋ-in | 'queen-fish' |
| waŋalk | waŋal | waŋalk-in | 'boomerang' |

In the unsuffixed nominative forms, the stem-final consonants are word-final, and since they are not coronals, they are deleted.

Word-final vowels are also deleted in the nominative:

(27) | Stem | Nominative | No-Future Acc. | Gloss |
| --- | --- | --- | --- |
| yiliyili | yiliyil | yiliyili-n | 'oyster sp.' |
| mayařa | mayař | mayařa-n | 'rainbow' |
| kaŋkari | kaŋkar | | 'father's father' |
| wiwala | wiwal | | 'bush mango' |

Vowel deletion feeds consonant deletion. If vowel deletion leaves a word-final non-coronal consonant, that consonant is deleted:

(28) | Stem | Nominative | No-Future Acc. | Gloss |
| --- | --- | --- | --- |
| yukařpa | yukař | yukařpa-n | 'husband' |
| wuţalt^{y}i | wuţal | wuţalt^{y}i-n | 'meat' |
| ŋawuŋawu | ŋawuŋa | ŋawuŋawu-n | 'termite' |
| muřkunima | muřkuni | muřkunima-n | 'nullah' |

Notice that C-deletion in (26) and (28) can yield word-final vowels. The latter examples are particularly striking: the failure of the new word-final vowels to delete is puzzling, especially in light of the fact that deletion has already targeted the original final vowel. Why doesn't V-deletion apply again to eliminate the new word-final vowels? From this perspective, V-deletion appears noniterative.[8]

But the OT analyses of Prince & Smolensky (1993[2004]) and Kurisu (2001) are couched in terms that do not invoke noniterativity. In both analyses, C-deletion is driven by a coda condition that prohibits word-final non-coronals. For Prince

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[8]The data presented here might also suggest that C-deletion is noniterative, but it is not, as shown by examples such as /muŋkumuŋku/ → *muŋkumu* 'wooden axe.' Two consonants delete in this word.

& Smolensky, V-deletion is the product of FREE-V, a constraint that prevents word-final vowels from being parsed. Their analysis makes use of Containment Theory, in which "deleted" segments are still present but not parsed. This means that ŋawuŋa is actually ŋawuŋa⟨wu⟩, and FREE-V is not violated by a because that vowel is not technically word-final. The word-final vowel, u, is not parsed and therefore satisfies FREE-V. In this analysis, the apparent noniterativity of V-deletion is a consequence of there being at most one word-final vowel in each form. FREE-V motivates no further deletion after the first vowel is deleted.

In Kurisu's analysis, deletion is driven by REALIZE MORPHEME, a constraint that requires each morphological category (such as nominative case) to have some phonological exponent. That is, derived forms must be phonologically distinct from their bare forms. Since nominative case in Lardil is not expressed by an overt morpheme, this morphological distinction must be realized through some change in the stem. Kurisu argues that V-deletion is the exponent of nominative case. Deletion ensures that the nominative form is distinct from the bare form, as required by REALIZE MORPHEME. When a consonant is deleted in accordance with the coda condition, further deletion is not required because the C-deletion form (e.g. ŋalu) is already distinct from the bare form (ŋaluk), and REALIZE MORPHEME is satisfied. Likewise, additional V-deletion in (28) is unmotivated because deletion of the original word-final vowel (not to mention the subsequent C-deletion) has already satisfied REALIZE MORPHEME. As with the FREE-V analysis, the first iteration of deletion is enough to satisfy the motivating constraint.

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Both of the analyses summarized here treat the noniterativity in Lardil's deletion as emergent. Neither makes reference to deleting just one vowel, and both propose independent reasons for deletion to target just one vowel.

1.4.2.7   Other Miscellaneous Processes

German provides yet another case of emergent noniterativity: final devoicing. Word-final (or syllable-final) obstruents devoice, but since just one segment can be word-final, only one segment can be devoiced. An iterative rule that targets word-final segments has just one segment to change no matter how many times it reapplies—it is not self-feeding. Likewise, in dialects of English in which vowels become nasalized when before a nasal (Beddor 1983), a rule that iteratively spreads nasality from nasals to adjacent preceding vowels will never affect more than one vowel because only one vowel can precede and be adjacent to a nasal consonant. And in nasal place assimilation (Padgett 1997), if nasals in NC clusters must acquire the place features of the immediately following consonant, no more than one nasal will assimilate in any instance because only one nasal segment can immediately precede a consonant. It does not matter whether one adopts an iterative or noniterative rule for this process, and a constraint-based analysis can be built on constraints promoting certain featural combinations in adjacent segments as in Pulleyblank (2002). These phenomena display emergent noniterativity because they do not require noniterative rules. They contrast with noniterative processes whose rules must be prevented from reapplying to their own outputs.

It is the latter that I claim to be nonexistent: there is no phenomenon that

requires a noniterative rule, and therefore OT need not be able to replicate the effect of a (crucially) noniterative rule. I subsequently refer to processes requiring noniterativity as *truly noniterative* (i.e. they manifest *true noniterativity*) and set aside emergent noniterativity, which clearly exists and is not problematic for any theoretical framework I am aware of, including OT.

In fact, the noniterativity discussed above from Lango and Chamorro can be viewed as emergent. I suggested above that Lango is truly noniterative because it can be produced with a self-feeding rule like (2) whose application must be noniterative. However, (2) can be refined as in (29) so that the root boundary crossed by Lango's vowel harmony is explicitly required by the rule.[9]

(29) $\quad$ V C_0]$_{\text{Root}}$ C_0 V

$$[\text{+ATR}]$$

This rule is no longer self-feeding since the right edge of the root is on the wrong side of what would be the trigger vowel on the second iteration.

Similarly, the rule in (30) satisfactorily accounts for umlaut.

(30) $\quad$ V C_0[$_{\text{Root}}$ C_0Ý

$$[\text{–back}]$$

This rule is also not self-feeding. Since there's only one primary stress in a word, only one vowel in any word is a possible target. Also, like (29), the presence of the root boundary in the rule prevents more than one application of (30). This rule can be recast as a self-feeding rule if the root boundary and stress mark are removed, but then it overgenerates. Umlaut only targets stress, and it only

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[9]In Lango, only [+ATR] spreads regressively, so [±ATR] from (2) is changed to [+ATR].

occurs at the left edge of the root—the revision would produce umlaut in other environments.

Of course, evidence is needed to show that analyses of Lango's harmony and Chamorro's umlaut that treat the noniterativity as emergent are preferable to truly noniterative analyses. Chapters 2 and 3 argue for this position explicitly and show that truly noniterative characterizations of Lango and Chamorro are flawed.

Incidentally, it is possible to view noniterativity in footing as emergent from a rule-based perspective. Footing can be produced with a rule like the one in (31), and an iterativity parameter determines whether or not this rule applies iteratively. A directionality setting can also be invoked.

(31) $\sigma \ \sigma \ \rightarrow (\sigma \ \sigma)$

But we could alternatively adopt (32) or its mirror image for noniterative footing instead. This rule applies just at a word edge and therefore is applicable only once in a word. From this point of view, noniterativity in Southeastern Tepehuan's footing is emergent: making (32) iterative would still leave us with just one foot.

(32) $\sigma \ \sigma \ \rightarrow (\sigma \ \sigma)/ \left[_{Word} \underline{\hspace{1cm}}\right.$

It might be objected that (32) misses the obvious similarity between iterative and noniterative foot assignment. But the only difference between (31) and (32) is that the latter specifies an environment for application while the former does not. Under the approach that applies (31) iteratively in one case and noniteratively in

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the other, there must be a formal change in the rule that produces iterativity on the one hand and noniterativity on the other. It seems no simpler for that change to be located in an iterativity parameter than in the addition or removal of an environmental condition, especially since the latter obviates both a directional specification (for the noniterative case at least) and (under the proposed revision suggested in Chapter 6, p. 326) the iterativity parameter.

Non-assimilatory processes can also reflect emergent noniterativity. The case of foot/stress assignment just mentioned is one example. Another well-known case is schwa insertion in English plurals (Baković 2005, Borowsky 1987):

(33)   books

  rags

  mass<u>es</u>

  dish<u>es</u>

  church<u>es</u>

In contrast with *books* and *rags,* stems ending with a sibilant like *s, ʃ,* or *ʧ* surface with an epenthetic vowel between that sibilant and the plural morpheme. This is obviously an OCP effect in which adjacent sibilants are avoided. The point here is that schwa insertion occurs at most once in these and all other plural forms. But this noniterativity is clearly emergent. A rule inserting schwa between sibilants is not self-feeding. We cannot apply this rule non-vacuously a second time. Similarly, an OT constraint that bans adjacent sibilants is satisfied when just one schwa is inserted, so there's no reason to epenthesize again.[10]

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[10]The same points could be made for English past-tense morphology as well, of course, where schwa is inserted to break up a cluster of coronal stops.

Deletion can also exhibit emergent noniterativity. For example, in Ogori (Casali 1997), when hiatus occurs between words, the first vowel is deleted (word-by-word glosses are given under the underlying forms; see Casali (1997) and Borowsky (2000) for analyses):

(34)   a.   /ɔ́tɛ́lɛ́ ɔ̀kɛ̀ka/ → ɔ̀tɛ́lɔ́kɛ̀ka   'big pot'

              pot   big

        b.   /ébí óbòrò/   → ébóbòrò   'good water'

              water good

        c.   /íjá òsúdá/   → íjósúdá   'old woman'

              woman old

        d.   /ɔ̀bɛ̀lɛ̀ ɔ̀nɛ/   → ɔ̀bɛ̀lɔ́ne   'this mat'

              mat   this

        e.   /ójí ɔ̀nɛbɛ/   → ójɔ́nɛbɛ   'that rope'

              rope that

Just one vowel deletes, but this the noniterativity is emergent in that a rule that elides a vowel the context __ V cannot apply non-vacuously more than once, at least in these examples.

The fact that the phenomena discussed in this section are amenable to analyses that recast their noniterativity as emergent underscores the thesis of this dissertation. Lango's vowel harmony and Chamorro's umlaut are the best candidates for true noniterativity within segmental phonology that I am aware of, but the OT analyses of these phenomena that are developed in subsequent chapters attribute the appearance of noniterativity to independent factors. The preceding

discussion shows that the same move is available in a rule-based framework, too, although no evidence has yet been presented in favor of these revisions. Outside of segmental phonology, we've already seen that erstwhile noniterativity in prosody is understood in modern phonology in other terms, and experimental work on tonal phenomena, I will argue, indicates that noniterativity in this domain is also only illusory. The conclusion is simply this: There are no phonological phenomena that must be analyzed with a noniterative self-feeding rule.

1.5   The Abundance of Iterativity

The dearth of true noniterativity is particularly striking in light of the pervasiveness of undeniably iterative phenomena. For example, syllabification is always iterative. No language builds just one syllable no matter how long the word is. And since every language has syllables, every language has this iterative process. Thus iterativity is found in every language in the world.

Nasal harmony and vowel harmony are also always iterative (notwithstanding Lango, which I argue in Chapter 2 does not in fact exhibit vowel harmony). These are not unusual phenomena either—Walker's (2000) condensed database of nasal harmony includes more than 80 languages, for example. (Some of these cases involve very local spreading, such as harmony within a syllable. This is analyzable as an iterative process confined to certain domain, as with German umlaut.)

Secondary stress assignment can also be iterative. (I know of no languages that permit just one secondary stress no matter how long a word is, so secondary stress

assignment may be obligatorily noniterative.) While languages like Southeastern Tepehuan may assign just one stress per word, other languages allow secondary and even tertiary stress, and when word length permits, multiple secondary or tertiary stresses can be assigned. Again, this phenomenon is widespread crosslinguistically.

As another indication of the rarity of phenomena that require noniterative rules, consider the (surely nonrandom) sample of rules in Archangeli & Pulleyblank (1994). Of the 24 rules Archangeli & Pulleyblank develop within their formalism, half are specified as iterative, and the other half are noniterative. But a closer look at these rules reveals a different picture. First, six of the noniterative rules are developed for Lango's harmony alone to account for the complex system of which (4) is just a small part (see Chapter 2). This leaves six noniterative rules. Three of these use noniterativity to account for systems in which an inserted feature surfaces only if its host is word-initial or word-final. An example is palatalization in Japanese mimetics (Itô & Mester 1989), which appears on a coronal preferentially (*kas^{y}a-kas^{y}a* 'noisy rustling sound of dry objects'), but can occur only on the initial consonant of the mimetic form in the absence of a coronal:

(35)   h^{y}oko-h^{y}oko 'lightly, nimbly'   *hok^{y}o-hok^{y}o

       g^{y}obo-g^{y}obo 'gurgling'   *gob^{y}o-gob^{y}o

       p^{y}oko-p^{y}oko 'jumping up and down'   *pok^{y}o-pok^{y}o

When the initial consonant is an ineligible host for palatalization (it cannot be followed by *e*), palatalization does not appear at all:

(36)　　keba-keba　　'gaudy'　　　　　　　　　*k^yeba-k^yeba, keb^{y}a-keb^{y}a

　　　　neba-neba　　'sticky'　　　　　　　　　*n^yeba-n^yeba, neb^{y}a-neb^{y}a

　　　　gebo-gebo　　'gurgling'　　　　　　　　*g^yebo-g^yebo, geb^{y}o-geb^{y}o

　　　　teka-teka　　'shining'　　　　　　　　　*t^yeka-t^yeka, tek^{y}a-tek^{y}a

Archangeli & Pulleyblank use noniterativity to account for this. Their rule linking the floating palatalization feature to a consonant operates from left to right noniteratively. If the first consonant is not a possible target, the rule stops searching for a target—this is what it means to be noniterative in their theory, but it is not what is usually meant by noniterativity in works such as the current one. We can instead account for the failure to palatalize in (36) by building the left word boundary into the palatalization rule or adopting a high-ranking constraint requiring palatalization to be left-aligned.

A noniterative rule is used to nontraditional effect in the analysis of Kukuya tone association. In this language, the tonal pattern LH associates with a tri-syllabic form to yield the pattern L-H-H rather than the expected (according to standard association conventions such as those found in Goldsmith (1976)) *L-L-H: m^wàrə̀gí 'younger brother.' To account for this, Archangeli & Pulleyblank adopt a noniterative rule that associates the H to the final syllable. Subsequently the "normal" rules of association yield L-H-H.

Another noniterative rule accounts for tonal polarity in Yoruba. In this language, object clitics surface with H after verbs with L or M, but they surface with L after verbs with H:

(37) a. rà á   'buy it'

         lù mí   'beat me'

     b. jẹ ẹ́   'eat it'

         pa mí   'kill me'

     c. rí i   'see it'   *rí í

         rí mi   'see me'   *rí mí

A noniterative rule inserts H on the object clitic, and this rule is blocked from applying by the OCP when the preceding verb has H. The rule is noniterative because, in Archangeli & Pulleyblank's formalism, an iterative rule will avoid an OCP violation by fusing the clitic's H and the verb's H into a single H. Noniterative rules, because they stop after the first target, cannot do this. This is yet another unconventional use of noniterativity that is specific to the theory at hand.

This leaves just one noniterative rule, which is used to account for tone spread in Kinande. I argue in Chapter 4 that this sort of phenomenon is best understood in terms that do not invoke noniterativity.

Thus of the twelve noniterative rules in Archangeli & Pulleyblank (1994), seven are adopted for phenomena that are explicitly argued to be not truly noniterative in this dissertation, and the other five use noniterativity to exploit certain properties of the theory to produce patterns that are not noniterative as that term is used in this dissertation. In contrast with the twelve rules that are iterative (most of which are used for traditional iterative purposes like vowel harmony and tone spread), this state of affairs does not suggest that noniterativity is at all common. (Archangeli & Pulleyblank seem to recognize this fact by making their iterativity parameter default to "iterative.")

Vaux (2003b) argues against OT and in favor of derivational phonological theories from the point of view of iterative and optional phenomena. He presents examples of each kind of phenomenon that, in his view, OT is unequipped to account for. I have little to add with respect to his examples of optionality, but see §5.3.2.2 in Chapter 5 for attempts to deal with some problems he points out. It is true that the correct implementation of optionality in OT is far from clear, and the issue is the subject of current research (e.g. Anttila 2007, to name an approach that comes up in Chapter 3, plus the frameworks in Chapter 5). Iterativity—whereby a phenomenon (foot construction, stress assignment, assimilation, lenition, etc.) occurs at multiple positions in a form—is easily producible by OT. In fact, this is the standard result in OT (and one reason optionality is difficult to pin down in OT): If a constraint ranking produces the configuration χ in the context ψ, then every instance of ψ will result in χ, all things being equal. The specific phenomena that Vaux considers may be problematic for OT, but every theoretical framework has similar defects. For example, Baković (2007) points out that there are opaque phenomena that are problematic for derivational phonology despite that framework's general superiority over OT in terms of opacity. One of Vaux's examples (vowel raising and elision in Uyghur) is problematic for OT not because it is iterative, but because it is opaque. It would not be surprising if this were the case with his other examples.

Derivational theories account for optionality and iterativity in Vaux's proposal with the diacritics [±optional] and [±iterative] that tag rules as optional and/or iterative. Vaux's point is that these diacritics allow rule-based phonology to effortlessly capture the phenomena that are intractable in OT. He is certainly right

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that the diacritics give us the tools to specify when a grammar may refrain from applying a process and when it may choose to apply the process over and over. But this dissertation argues the resulting theory is too powerful: we can tag a rule as [–iterative] just as easily as we can mark it as [+iterative], but no phenomenon requires the [–iterative] diacritic. Vaux may be right to criticize OT for its handling of optionality and iterativity, but derivational phonology encounters its own problems with noniterativity and is therefore not an analytical panacea. From the point of view of noniterativity, surface-oriented OT is superior.

1.6   A Typology of Psuedo-Noniterativity

The argument put forth here is that any time a process occurs exactly once, it is due to a confluence of factors, not a stipulation of noniterativity. It is worth cataloging the factors that can lead to the appearance of noniterativity. The following list contains the factors that I have identified along with phenomena that instantiate each factor. The list is surely incomplete.

Adjacency The source and trigger are or must be adjacent. (Nasal Place Assimilation, Lango vowel harmony, Chamorro Umlaut, Irish C-palatalization)

Edge Alignment The phenomenon in question is confined to one or the other edge of some domain. (Foot assignment, final devoicing)

Domain Confinement The phenomenon reaches every possible target in a domain, but the domain is small enough that only one target is present. (Ger-

man umlaut, tone spread/shift under Optimal Domains Theory, Tudanca Spanish metaphony under Flemming (1994))

Distinct Trigger and Target The trigger and target are not the same, so the rule cannot be self-feeding. (Nati, Chamorro umlaut, Bengali harmony)

Attraction to Prominence The element that is moved or spread is attracted to a prominent position, such as the root or stressed syllable. Spreading farther is not motivated once this position is reached. (Lango vowel harmony, Chamorro umlaut, Tudanca Spanish metaphony under Walker (2004))

Non-Finality Some element is banned from a domain-final position, so it is minimally relocated to avoid this position. (postlexical harmony in Nez Perce and Vata, Irish *i*-palatalization)

Uniqueness There is just one possible target in any form. (English aspiration, final devoicing, Japanese Rendaku (e.g. Itô & Mester 1986))

Minimality An element's underlying domain is too small, so it expands to encompass a larger (e.g. binary) domain. (tone spread/shift under Optimal Domains Theory, although Chapter 2 argues that there are problems with this view)

To reframe the claim of this dissertation, the Emergent Noniterativity Hypothesis is that no phenomenon is noniterative because of a stipulation of noniterativity. Instead, there is always a reason for a process to apply noniteratively. The list above gives some of the reasons for noniterativity. If this claim right,

it means that noniterative is always emergent because noniterativity universally results from some factor besides a noniterativity requirement.

1.7   True Noniterativity

What would a truly noniterative phenomenon look like? The fact that such a hypothetical process applies just once cannot be attributable to any of the factors listed in previous section. For example, that means it cannot be foot-constrained or obligatorily cross a morpheme boundary. (The latter would indicate attraction to prominence.)

Let's construct an example. Consider a language that has noniterative right-to-left backness harmony. Suppose this is a dominant/recessive system, with [+back] as the dominant feature. Since this is noniterative, only a back vowel and the preceding vowel harmonize, regardless of the morphological configuration. To rule out prosodic confinement, let's suppose this language has just one left-aligned trochee. Here are some examples of possible words in this hypothetical language (in bimorphemic forms, assume the configuration is root-suffix):

(38)   a.   /tikepo/   → (tíko)po

       b.   /katineva/   → (káti)nova

       c.   /piku/   → (púku)

       d.   /ketinove/   → (kétu)nove

       e.   /pike-sena/   → (píke)-sona

       f.   /pareti-no/   → (páre)tu-no

In all these forms, one vowel assimilates in backness to a following back vowel.

This happens whether spreading crosses a foot boundary (38a) or not (38b). Harmony can be wholly foot-internal (38c) or not (the rest of the examples). Both roots (first four examples) and suffixes (last two) can trigger harmony, and harmony may cross a morpheme boundary (38f) or not (the remainder). Harmony does not always target the root (38e). The trigger and target may be word-internal (38d) or word-final (the remainder).

The only available generalization is that backness spreads from a back vowel to the preceding vowel. No single position, like the stressed syllable or root-final vowel, is targeted. Harmony does not interact with prosodic structure, so it cannot be foot- or prosodic word-bound. The target is not confined to some edge of the form. This harmony system is truly noniterative: in rule-based terms, there is no way to analyze it except with a self-feeding, noniterative rule that spreads [+back] leftward.

To my knowledge, no language exhibits a phenomenon like this. The various parts of the harmony system are themselves attested, except for the noniterativity. Dominant/recessive harmony systems exist in languages like Nez Perce (see Chapter 5), and regressive harmony appears in Kinande. Backness harmony occurs in Turkish. The element that makes the hypothetical language unusual is that its harmony is truly noniterative. The harmony system appears strange, and this strangeness highlights the nonexistence of true noniterativity in phonology.

1.8 Outline

The remainder of this dissertation marshals evidence in favor of the Emergent Noniterativity Hypothesis. Each chapter discusses a possible counterexample to this hypothesis in detail and argues that the phenomenon in question is best understood in terms that do not invoke noniterativity; i.e., it is not truly noniterative. The phenomena that are discussed in these chapters are Lango's vowel harmony (Chapter 2), Chamorro umlaut (Chapter 3), tonal noniterativity (Chapter 4), and postlexical spreading (Chapter 5). Chapter 6 summarizes and contains concluding remarks.