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On the inevitability of non-myopic harmony*

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There are more things in heaven and earth, Horatio,
than are dreamt of in your philosophy.

Hamlet

1 Introduction

In influential unpublished work, Wilson (2003, 2006) advances the claim that all attested unbounded feature spreading patterns are MYOPIC, meaning that the success or failure of spreading a feature value from one element to another does not depend on the presence or absence of a given type of element further downstream. This myopia claim has received significant attention, with empirical and theoretical arguments made both for (McCarthy 2003, 2004, 2009, 2011, Kimper 2012, Jardine 2016, Mascaró 2019) and against (McCollum & Essegbey 2018, Walker 2010, McCollum et al. 2020, Meinhardt et al. 2024).

On its own, myopia is a strong typological claim based on observations of commonly encountered patterns of unbounded feature spreading. When paired with the common view that an adequate theoretical model of phonological knowledge should be equipped to describe all and only the patterns that one expects to find, however, this typological claim becomes a yardstick for phonological theory comparison: models from which the claim follows are to be more highly valued than those from which it does not, *ceteris paribus*. Wilson (2003, 2006) and McCarthy (2004, 2009, 2011) adopt this stance with respect to myopia in their arguments against existing approaches to feature spreading in classic Optimality Theory (OT; Prince & Smolensky 2004). These authors promote the adoption of radically different constraint types (targeted constraints; Wilson 2003, 2006), alternative feature spreading representations and associated constraints (headed spans theory; McCarthy 2004), or step-wise computations (McCarthy's (2009, 2011) Harmonic Serialism analysis, and the computations associated with Wilson's proposal). Hence, whether all unbounded feature spreading patterns are indeed myopic is a question with potentially profound consequences for phonological theory.

We have four goals in the present contribution. The first is to clarify the definition and scope of Wilson's myopia claim, a task we undertake in §2. Second, we offer evidence for non-myopic spreading in three patterns of vowel harmony (§§3–5), arguing against the myopia claim on empirical grounds. Third, while individual spreading *processes* may be myopic, familiar process interactions can render an overall spreading *pattern* non-myopic (§6); this demonstration is grounded in Meinhardt et al.'s (2024) computational characterization of the class of *unbounded circumambient* patterns to which non-myopic spreading belongs (Jardine 2016), and constitutes a theoretical argument against the myopia claim. Our final goal is to address the typological question why non-myopic spreading patterns appear to be considerably more rare than myopic spreading patterns (§7), a tendency we attribute to the collective unlikelihood of the conditions necessary for the emergence of non-myopic spreading.

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2 The myopia claim

Wilson's (2006: 9) claim, schematized in (1) and adapted and generalized from the original, is that the realization of a potential undergoer (U) of feature spreading from a trigger (T) should not depend in any way on more peripheral information (Z); if it does, the feature spreading pattern is not myopic.

(1) All attested unbounded spreading patterns obey a myopia ("no look ahead") generalization

Successful spreading from T to U is independent of the content of Z in any string $\ldots TXUYZ \ldots$ (left-to-right spreading) or any string $\ldots ZYUXT \ldots$ (right-to-left spreading).

The prototypically myopic character of feature spreading can be exemplified by forms with opaque vowels in patterns of unbounded vowel harmony. For example, in Maasai (Nilotic; Tucker & Mpaayei 1955), the [−ATR] low vowel /ɑ/ is opaque to the unbounded leftward spread of [+ATR]. As illustrated by the extent of underlining in (2d), all vowels between a dominant vowel and a blocking opaque vowel undergo spreading; compare the ungrammatical alternative on the right.[1]

(2) Myopic [+ATR] spreading in Maasai (Tucker & Mpaayei 1955)

a.	/ɪsʊʄ-ɪʃɔ/	⟶	[ɪsʊʄ-ɪʃɔ]	'wash-INTR'		p. 120
b.	/ɪsʊʄ-ɪʃɔ-ɾe/	⟶	[isuʄ-iʃo-ɾe]	'wash-INTR-APPL'		p. 144
c.	/ɑ-ɑs-ɪʃɔ/	⟶	[ɑ-ɑs-ɪʃɔ]	'INF-work-INTR'		p. 244
d.	/ɪ-ɑs-ɪʃɔ-ɾe/	⟶	[ɪ-ɑs-iʃo-ɾe]	'2S-work-INTR-APPL'	*[ɪ-ɑs-ɪʃɔ-ɾe]	p. 144

Referring back to the myopia generalization in (1): the dominant applied suffix /ɾe/ is T, the vowels of the recessive intransitive suffix /ɪʃɔ/ are U, and the opaque low vowel of the verb root /ɑs/ is Z. Spreading from T to U is successful despite the fact that Z blocks further spread. The ungrammatical alternative in (2d) illustrates what the result would be if vowel harmony were not myopic in this way, failing to spread from T to U because continued spreading is bound to fail due to the downstream presence of Z. Wilson (2006) refers to the hypothetical state of affairs illustrated by this non-myopic alternative as *'sour grapes' spreading*.[2]

A sour grapes spreading process can be compactly described as "spread from T to U unless Z is present further downstream." Another type of non-myopic process identified by (1) is one that can be described as "spread from T to U only if Z is present further downstream." Wilson's (2006: 9) original statement of the claim appears to identify only the 'unless' case as non-myopic: "spreading from T to U is independent of *whether spreading can proceed into* Z." We justify our generalized restatement in (1) with reference to recent work, beginning with Jardine (2016), demonstrating that the computationally relevant properties of the 'unless' case are shared by the 'only if' case. Specifically, both are UNBOUNDED CIRCUMAMBIENT: whether U undergoes spreading depends on both T and Z — that is, elements on *both sides* of U (hence 'circumambient') — and T and Z can each in principle be *any distance* from U (hence 'unbounded'). Jardine (2016) shows that — in formal language theoretic terms — unbounded circumambient patterns require the expressivity of the non-deterministic regular functions whereas other phonological patterns are at most weakly deterministic (Heinz & Idsardi 2013, Meinhardt et al. 2024).

[1]Following Archangeli & Pulleyblank (1994: 460, note 20), we do not mark tone in these forms because it is not consistently marked in Tucker & Mpaayei (1955). Additionally, tone is irrelevant to the harmony pattern.

[2]The term 'sour grapes' is adapted from Padgett (1995: 154–155), where it refers to unattested patterns of all-or-nothing spreading of features within a class (e.g. [labial] and [dorsal] within Place): "either assimilate all features (of some category), or assimilate none." This differs from Wilson's use of the term: "If I can't spread all the way, then I won't spread at all!"

2.1 Processes vs. patterns

Wilson's original wording of the myopia generalization mentions unbounded spreading *processes* as opposed to *patterns*. We contend that the distinction between these terms is important, that applying the generalization to *processes* is empirically inconsequential, and that *patterns* was in fact what Wilson must have intended.

Both *process* and *pattern* are understood here to refer to well-defined input-output maps, properly contained within the overall map from underlying to surface representations. An unbounded spreading PROCESS is more commonly and specifically understood to be co-extensive with a single phonological rule and the input-output map that it locally defines. An unbounded spreading PATTERN, on the other hand, subsumes *all* generalizations potentially pertaining to spreading. Suppose, for example, that the spreading feature value is [+ATR], that low vowels are raised to mid when they become [+ATR] as a result of spreading, and that vowels in closed syllables are consistently [−ATR] and thereby do not undergo [+ATR]spreading. Whether these interwoven generalizations are expressed within the confines of a single phonological rule, across two or more rules, or in some other way (e.g. a ranked set of constraints), all of them are part of the unbounded spreading pattern as this term is understood here. This is why the myopia generalization in (1) is stated in terms of *successful* spreading: conditions other than those strictly specified in the 'main' spreading process may impinge upon the success of spreading, and thus these conditions are part of the overall spreading pattern.

If only individual spreading processes are subject to (1), the empirical consequences are in principle defeasible and thus uninteresting. This is because, as we discuss in §6, observed cases of non-myopic unbounded spreading can be analyzed in such a way that they technically circumvent (1), by splitting the pattern among two or more interacting processes. The basically myopic nature of any given spreading process can in principle be undone by other interacting processes or conditions within the broader spreading pattern.

One of the goals of Wilson (2003, 2006) was to show how theories of unbounded spreading in OT straightforwardly give rise to underlying-to-surface maps that are deemed 'pathological' due to their contravention of the myopia generalization in (1). Especially given that even the relatively specific notion of a 'process' is definitively *not* co-extensive with any single basic analytical unit of OT, it would thus have been meaningless for Wilson to have intended for (1) to be a generalization that only applies to individual spreading processes and not to the broader spreading patterns of which those processes are a part.

2.2 (Un)boundedness

The myopia generalization in (1) concerns UNBOUNDED spreading patterns, those that spread a feature value as far as possible within the relevant domain; or, stated differently, those that apply and iteratively re-apply to their own output as many times as possible within the domain. As such, it does not make any claims concerning BOUNDED spreading patterns, which we define as those that apply some finite number of times. More specifically, we define bounded spreading patterns as those whose outputs do not trigger further spreading. We thus equate *bounded* with NON-ITERATIVE, a definition that is consistent with a large body of literature (Jardine 2016, McCarthy & Prince 2017, McCollum & Kavitskaya 2022, McCollum 2024).[3]

This means that the behavior of any bounded spreading pattern is technically irrelevant to the question whether (1) is a valid generalization. This is not simply because the term *unbounded* happens to be included in (1); the distinction is computational. A bounded phonological pattern only requires the expressivity of one of the STRICTLY LOCAL classes of functions (Chandlee 2014), the least expressive classes of functions in phonology, regardless of whether it can be characterized as myopic or non-myopic. Feature spreading patterns that are both bounded and non-myopic are attested; e.g. Woleiaian vowel raising (Sohn 1975, Nevins 2010) and bounded tone spreading in Shona (Myers 1997). In both myopic and non-myopic bounded spreading

[3] A reviewer alternatively defines bounded spreading as "a process that targets a particular position (e.g., a stressed syllable), and in doing so may restrict its own domain to something smaller than a word or phrase [...]. The steps required to reach that target are not counted [...]." This definition makes the bounded vs. unbounded distinction, and thus the myopia generalization in (1), entirely defeasible: the initial or final syllable of the domain of evaluation could also be said to be targeted as "a particular position" in patterns that would otherwise uncontroversially be described as unbounded.

patterns, so long as the distance between the potential triggers, targets, and blockers is known in advance, the pattern is strictly local.

Metaphony, a type of pattern whereby a post-tonic high vowel triggers raising of a preceding stressed vowel (Maiden 1991, Calabrese 2011, Torres-Tamarit et al. 2016), is one of a range of stress-dependent harmony patterns discussed in the literature (Mascaró, 2024). Whether metaphony patterns are in general bounded or unbounded is contested. The metaphony pattern found in Antrodoco (Italo-Romance; Scorretti 2012, cited in Mascaró, 2024) suggests that metaphony is unbounded, since raising extends from the final vowel through the penult to the stressed antepenult (3c).[4]

(3) Metaphony in Antrodoco (Mascaró, 2024)

a.	[vénn-o]	[vínn-i]	'sell-PRS.1S/2S'
b.	[kórr-o]	[kúrr-i]	'run-PRS.1S/2S'
c.	[mének-a]	[mínik-u]	'Dominic-F/M'

Given our definition of boundedness above, any metaphony pattern that affects more than a single target vowel is unbounded. This is consistent with the characterization of metaphony in a wide body of literature (e.g. Calabrese 1998, 2011; Hualde 1989; Flemming 1994; Mascaró 2019, 2024). However, if the term 'bounded' refers to processes with an *a priori* fixed maximum number of applications, then whether metaphony is bounded or unbounded is less clear, even if the domain itself is delimited by the position of stress. Stress in Romance language varieties typically falls within a window of three syllables at the right edge of the word. Under this alternative definition, if metaphony is bounded, then (exceptionally) stressed vowels outside the three-syllable window might not be expected to undergo raising. (*Might* not, because it of course depends on what the fixed maximum number of applications is.) We know of no facts bearing on this empirical question.

Walker (2010) asserts that metaphony may be non-myopic, drawing on data from the Central Veneto and Grado varieties of Italo-Romance (cf. Kimper 2012). In these varieties, metaphony raises the mid vowels /e, o/ to [i, u] when followed by a final high vowel.[5] When stress is antepenultimate and the final vowel is high, both the stressed antepenult and the unstressed penult undergo raising if eligible (4a–b). But according to Walker, an otherwise eligible penult fails to undergo raising when the antepenult is ineligible (4c–d).[6] Referring back to (1): the final high vowel in these examples is T, the penult is U, and the stressed antepenult is Z. The pattern appears to be non-myopic because spreading to U depends on the content of Z: it succeeds when Z is an eligible mid vowel (4a–b) and it fails when Z is an ineligible low vowel (4c–d).

(4) Metaphony in Central Veneto and Grado (Walker 2010: 171)

a.	[órden-o]	[úrdin-i]	'order (1sg/2sg)'	(Central Veneto)
b.	[zóven-e]	[zúvin-i]	'young man (sg/pl)'	(Grado)
c.	[ázen-o]	[ázen-i]	'donkey (m sg/pl)'	(Central Veneto)
d.	[boʤánten-o]	[boʤánten-i]	'crab before the last molt (m sg/pl)'	(Grado)

Mascaró (2019) argues against the basic facts presented in Walker (2010). He notes that (4d) is exceptional and that raising usually affects the penult in Grado even when the stressed antepenult is ineligible. Mascaró contends that data scarcity and lexical exceptions undermine Walker's claim that metaphony can be non-myopic, and concludes that the evidence adduced for non-myopic spreading more generally is inconclusive at

[4]The examples in (3) and (4) are presented as mini-paradigms rather than underlying-surface pairs. Underlining highlights eligible targets of metaphony in the forms on the right and their (presumed basic) correspondents on the left.

[5]Raising is obligatory up to the stressed vowel and variable beyond it (Walker 2005).

[6]The singular form in (4d) is from Mascaró (2019: 865), as is the gloss for these two forms.

best and directly contradicted at worst. “The theoretical consequences are clear”, he writes: “the fact that (1) still holds means that we want our theory to predict myopic spreading and disallow nonmyopic spreading” (Mascaró 2019: 868).

This dispute over these data aside, their significance to the question of the validity of (1) depends on whether metaphony is bounded or unbounded. This leaves us with six possible scenarios to entertain, summarized in Table 1 below. If metaphony is bounded, then whether a given metaphony process appears to be myopic or non-myopic has no bearing on the level of computational expressivity required to describe it. Bounded spreading processes are input strictly local: these kinds of processes can exhibit bounded look-ahead, in which case a seemingly non-myopic pattern only requires an increase in the size of the input window that the function needs to scan. Strictly local processes cannot have unbounded look-ahead. If metaphony is bounded while simultaneously depending on information about the stressed vowel a potentially unbounded distance from the end of the word, then metaphony would be subsequential. That being said, de-linking the extent of spreading from the location of stress is inconsistent with almost all previous work on metaphony. As such, we ignore this possibility.

	No look-ahead	Bounded look-ahead	Unbounded look-ahead
Bounded	Input strictly local		Subsequential
Unbounded	Output strictly local	Subsequential	Non-deterministic

Table 1 The computational consequences of boundedness and look-ahead in metaphony

If metaphony is unbounded, as contended by Calabrese (2011) and Mascaró (2024), then whether a given metaphony process obeys the myopia generalization in (1) is computationally relevant. Metaphony processes that require no look-ahead at all — consistent with the strictest possible interpretation of (1) — are *output* strictly local, the minimum level of expressivity required to model unbounded iterativity (Chandlee et al. 2015).[7] If, however, an unbounded metaphony process requires bounded look-ahead, then it is subsequential, a greater level of expressivity than output strict locality. Finally, if an unbounded metaphony process requires unbounded look-ahead — that is, if it is truly unbounded circumambient — then the pattern is non-deterministic, at the outer bounds of the regular functions.

Computationally consequential evidence for non-myopic feature spreading can thus only come from indisputably unbounded patterns of feature spreading. Therefore, the unboundedness of metaphonic raising renders the question of non-myopic metaphony part of the larger question about the existence of non-myopic feature spreading in general.

With this in mind, we proceed with descriptions of three distinct patterns of unbounded, non-myopic vowel harmony across four languages: Tutrugbu and Tafi (§3), Yaka (§4), and Liko (§5). Heeding Mascaró’s (2019) call for clarifying the strength of the empirical evidence for a theoretical claim, we devote some space in each section to describing the amount and consistency of relevant data from each source.

3 Tutrugbu and Tafi

Tutrugbu (Essegbey 2019, McCollum & Essegbey 2018, 2020, McCollum et al. 2020) and Tafi (Bobuafor 2013) are closely related Ghana-Togo Mountain languages with identical non-myopic ATR harmony patterns. Both languages have the same nine-vowel inventory, /i ɪ e ɛ a ɔ o ʊ u/. The [+low, −ATR] vowel [a] alternates harmonically with the [−low, +ATR] vowel [e] due to the lack of a [+low, +ATR] counterpart, a phenomenon dubbed ‘re-pairing’ by Baković (2000). Also, in Tutrugbu, historical *ʊ and *ɔ have merged to

[7]The definition of output strictly local in Chandlee (2014) is refined in Chandlee et al. (2015) and later work.

[ɔ] and *ɪ and *ɛ have merged to [ɛ]. Despite these mergers, the historically [+high, −ATR] vowels still behave as [+high], as demonstrated in McCollum et al. (2020). To make these generalizations clear, we transcribe surface [ɛ] and [ɔ] in Tutrugbu that derive from *ɪ and *ʊ and that still behave as [+high] vowels as [ɪ] and [ʊ]. Spreading of [+ATR] in each language proceeds leftward from the root to strings of only [+high] prefix vowels (5a)/(6a), to strings of only [−high] prefix vowels (5b)/(6b), and to strings of prefix vowels in which the word-initial vowel is [−high] (5c–d)/(6c–d). Roots are indicated with a preceding '√' and that tone is transcribed on surface forms only throughout the remainder of this paper.

(5) Tutrugbu ATR harmony ((McCollum & Essegbey 2020)

a.	/bʊ-ʊ-√wu/	[bu-ú-√wū]	'1P-PROG-climb'	p. 16, (25d)
b.	/a-ba-√wu/	[e-be-√wu]	'3S-FUT-climb'	p. 26, (43a)
c.	/a-tɪ-√wu/	[e-tí-√wu]	'3S-NEG-climb'	p. 26, (43e)
d.	/a-tɪ-ba-√wu/	[e-tí-be-√wu]	'3S-NEG-FUT-climb'	p. 4, (9c)

(6) Tafi ATR harmony (Bobuafor 2013)

a.	/bʊ-ʊ-√bi/	[bu-ú-√bī]	'SM-PROG-be.cooked'	p. 438, (36)
b.	/a-ba-√dzi/	[e-be-√dzi]	'3S.DEP-FUT-become'	p. 272, (28)
c.	/ba-tɪ-√tsu/	[bé-tí-√tsú]	'3P-NEG-set'	p. 362, (38b)
d.	/a-tɪ-ba-√bi/	[é-tí-be-√bí]	'3S-NEG-FUT-be.cooked'	p. 280, (62)

However, when the word-initial prefix vowel is [+high] and is followed by a [−high] prefix vowel, harmony is blocked by the rightmost [−high] vowel (7–8). Although Bobuafor does not explicitly discuss blocking in Tafi, it mirrors the pattern found in Tutrugbu. The examples in (7c–e)/(8c–d) demonstrate that this two-part blocking condition is in principle unbounded, since in these examples the distance between the initial-syllable [+high] vowel and rightmost [−high] prefix vowel may be quite large. Finally, observe in (7f) that [+high] vowels that occur to the right of the blocking context still undergo harmony in Tutrugbu. (We know of no comparable data from Tafi.)

(7) Long-distance blocking in Tutrugbu (McCollum et al. 2020: 221, (8))

a.	/ɪ-ba-√wu/	[ɪ-ba-√wu]	'1S-FUT-climb'
b.	/kɪ-ba-√ʃe/	[kɪ-ba-√ʃē]	'CM.5-FUT-climb'
c.	/ɪ-tɪ-ka-√wu/	[ɪ-tí-ka-√wu]	'1S-NEG-PFV-climb'
d.	/ɪ-tɪ-ka-a-√wu/	[ɪ-tí-ka-á-√wū]	'1S-NEG-PFV-PROG-climb'
e.	/ɪ-tɪ-ka-a-ba-√wu/	[ɪ-tí-ka-á-bā-√wū]	'1S-NEG-PFV-PROG-VENT-climb'
f.	/ɪ-ba-dɪ-√wu/	[ɪ-ba-di-√wu]	'1S-FUT-ITIV-climb'

(8) Long-distance blocking in Tafi

a.	/lʊ-ba-√bi/	[lʊ̌-ba-√bí]	'3S.DEP-FUT-be.cooked'	(Bobuafor 2013: 222, (167b))
b.	/kɪ-ba-√dzi/	[kɪ-ba-√dzí]	'3S-FUT-become'	(Bobuafor 2013: 273, (30))
c.	/lɪ-tɪ-ba-√dzi/	[lɪ-tí-ba-√dzí]	'3S.DEP-NEG-FUT-become'	(Bobuafor, p.c.)
d.	/ɪ-tɪ-ba-√dzu/	[ɪ-tí-ba-√dzu]	'1S-NEG-FUT-build'	(Bobuafor, p.c.)

The relevant conditions on each harmony pattern are summarized in Table 2. Blocking of [+ATR] harmony depends on the [±high] feature values of both the initial syllable and other, medial prefix vowels: harmony is blocked only when both the initial syllable vowel is [+high] and at least one medial prefix vowel is [−high]. In cases where only one of these two conditions is satisfied, harmony obtains.

	All medial Vs are [+high]	At least one medial V is [−high]
Initial V is [+high]	✓[bu-ú-√wū] (5a) / [bu-ú-√bī] (6a)	✗[ɪ-ba-√wu] (7a) / [lʊ̆-ba-√bí̄] (8a)
Initial V is [−high]	✓[e-tí̄-√wu] (5c) / [bé-tí̄-√tsú] (6c)	✓[e-be-√wu] (5b) / [e-be-√dzi] (6b)

Table 2 Conditions on ATR harmony in Tutrugbu and Tafi

In sum, the realization of a [−high] prefix vowel U depends on both the ATR quality of the root vowel T to its right and the height of the word-initial prefix vowel Z to its left — circumambience — each of which may in principle be separated from U by any number of vowels — unboundedness. The height of Z determines whether U undergoes [+ATR] spreading from T: if Z is [−high], then U undergoes spreading; if Z is [+high], then U does not undergo spreading. So, whether spreading from T to U succeeds is not independent of the content of Z. Thus, ATR harmony in Tutrugbu and Tafi is non-myopic.

We offer here additional information concerning the evidence for this non-myopic unbounded harmony pattern. Tutrugbu data have been collected since 2007, almost entirely through the efforts of James Essegbey. The pattern, first noted in Essegbey (2009), is discussed more extensively in subsequent work (Essegbey 2019: 36–39; McCollum & Essegbey 2018, 2020; McCollum et al. 2020). The pattern holds for speakers of older and younger generations, and by speakers from different villages, and is well-attested in data from formal elicitation and a relatively large collection of recorded texts. Thus, the pattern exemplified in (5) and (7) and summarized in Table 2 is robust across speakers, generations, locations, and data types.

As for Tafi, only a few instances of the relevant data points are presented in Bobuafor (2013). In particular, since Bobuafor doesn't explicity discuss the long-distance blocking pattern in (8), it is critical to examine the ATR harmony pattern more generally. In total, 703 verbs with at least two prefixes are transcribed in Bobuafor's grammar. Of these, 519 word forms are unique, 170 of which have [+ATR] roots, among which 10 disharmonic tokens are reported. Table 3 presents counts of harmonic forms over total token count by initial and medial prefix vowel height. Despite no discussion of this facet of ATR harmony in Bobuafor (2013), the data in her grammar show the same general pattern found in Tutrugbu. [−high] prefix vowels assimilate to the ATR value of the leftmost root vowel unless the initial-syllable prefix is [+high].

	All medial Vs are [+high]	At least one medial V is [−high]
Initial V is [+high]	19/20	0/7
Initial V is [−high]	28/28	113/115

Table 3 [+ATR] harmony counts in Tafi by initial and medial prefix vowel height

4 Yaka

Yaka is a Bantu language with five contrastive vowels, /i e a o u/. Although many Bantu languages exhibit progressive height harmony, Hyman (1998) demonstrates that lowering of high vowels to mid only occurs in the presence of two mid vowel triggers, one root-internal and the other word-final. In (9a), a [+high] suffix vowel occurs without any trigger. In (9b–d), [+high] suffix vowels surface faithfully if the root vowel is mid but the word-final vowel is not.

(9) High suffixes (Hyman 1998)

a.	/√kik-il-a/	[√kik-il-a]	'strike.out-APPL-FV'	p. 44, (5a)
b.	/√bet-idik-a/	[√bet-idik-a]	'lower-POS?-FV'	p. 44, (6e)
c.	/tu-√keb-i/	[tu-√keb-í]	'1P-pay.attention-COND'	p. 45, (7b)
d.	/tu-√keb-id-i/	[tu-√keb-id-í]	'1P-pay.attention-APPL-COND'	p. 45, (7d)

The data in (10) show that high suffixes lower to mid if both the root and word-final vowels are mid.

(10) High suffixes between mid vowels (Hyman 1998)

a.	/√keb-ile/	[√keb-ele]	'pay.attention.to-PFV'	p. 43, (3b)
b.	/√bet-ilik-ile/	[√bet-elek-ele]	'lower-POS?-PFV'	p. 44, (6e)
c.	/√kos-ik-ile/	[√kos-ek-ele]	'add-IK-PFV'	p. 44, (6c)

Finally, if the word-final vowel is underlyingly mid, but the root vowel is not, then the word-final vowel raises to [+high] (11). In other words, Hyman contends that the perfective suffix is underlyingly /-ile/, although it never surfaces as such. In contexts where harmony obtains, this suffix surfaces with two mid vowels, while in contexts where harmony fails, it surfaces with two high vowels.[8]

(11) Mid suffixes without a mid root vowel (Hyman 1998)

a.	/√kin-ile/	[√kin-ini]	'dance-PFV'	p. 43, (3a)
b.	/√hit-ik-ile/	[√hit-ik-idi]	'send-IK-PFV'	p. 44, (6a)
c.	/√kab-ik-ile/	[√kab-ik-idi]	'spread.out-IK-PFV'	p. 44, (6a)

This particular type of non-myopic spreading pattern, where the spreading feature value is eliminated when spreading would otherwise be blocked along the path, is dubbed *'use it or lose it' harmony* by Mullin & Pater (2015). These authors claim the pattern to be unattested and pathological, but it is attested in Komo (Koman; Leduc & McCollum 2023).

Under Hyman's account, it is not only the surface quality of a target vowel, *U*, that depends on long-distance information, but also the quality of a trigger vowel, *T*. Hyman proposes that the word-final /e/ triggers harmony, but lowering to mid only obtains when the word-final trigger co-occurs with a root mid vowel *Z*. As shown in Table 4, the presence of a single trigger vowel, whether in the root or word-final, is insufficient to lower [+high] suffixes. When a word-final trigger occurs without a root mid vowel, the failure of harmony drives raising of the trigger. Only when both triggers are present does harmony obtain.

	Word-final V is mid	Word-final V is not mid
Root V is mid	✓[√keb-ele] (10a)	✗[√bet-idik-a] (9b)
Root V is not mid	✗[√kin-ini] (11a)	✗[√kik-il-a] (9a)

Table 4 Conditions on height harmony in Yaka

The data in Hyman (1998) derive almost entirely from Ruttenberg (1971/2000), which explicitly notes the vowel harmony pattern, listing 1,353 tokens of /-ile/ and its surface alternants: 453 tokens of [-ele], 378 tokens with [-ene], 419 tokens of [-idi], and 103 tokens of [-ini]. In tandem with these suffix allomorph counts,

[8]See Hyman (1995) for an analysis of the three-way [d]~[l]~[n] alternation observed in the perfective suffix.

Hyman (1998) demonstrates the generality of the pattern with evidence from root-internal co-occurrence patterns, loan words, as well as other facts about Bantu verbal morphology.

5 Liko

Liko is a Bantu language described extensively by de Wit (2015); our representation of the vowel harmony pattern in Liko is based primarily on pp. 66–107 of de Wit's grammar. Liko has a nine-vowel inventory, /i ɪ e ɛ a ɔ o ʊ u/. Tongue root harmony is dominant-recessive but typically root-controlled, targeting the root-adjacent prefix vowel leftward (bounded) and suffix and enclitic vowels rightward (unbounded, and our focus here). The [+low, −ATR] vowel [a] alternates with the [−low, +ATR] vowel [o] due to the lack of a [+low, +ATR] counterpart, a re-pairing alternation similar to the one between [a] and [e] in Tutrugbu and Tafi (recall §3).

Typically, affix vowels agree with the root for [±ATR]: [−ATR] roots are flanked by [−ATR] vowels (12a–d), and [+ATR] roots are flanked by [+ATR] vowels (12e–h). For clarity, enclitics are indicated with a preceding '='.

(12) Liko ATR harmony (de Wit 2015)

a.	/na-√jɪɓ-ag-a/	[ná-√jɪ̀ɓ-ág-á]	'1S-tear-PLUR-FV'	p. 136, (4.26)
b.	/ka-√ɓɪt-an-ag-a/	[ká-√ɓɪ́t-án-ág-á]	'9B-slap-ASSOC-PLUR-FV'	p. 82, (3.38a)
c.	/ta-mʊ-√dʊnd-a/	[ta-mʊ-√dʊnd-a]	'1P-2P.O-touch-FV'	p. 77, (3.28b)
d.	/a-√sɪɪ-ɪ=tɔ/	[a-√sj-ɪ́=tɔ]	'3S-stay-FV=INS'	p. 62, (2.69e)
e.	/na-√ɓin-ag-a/	[nó-√ɓi̋n-óg-ó]	'1S-dance-PLUR-FV'	p. 96, (3.69a)
f.	/ka-√lut-an-ag-a/	[kó-√lut-ón-óg-ó]	'9B-pull-ASSOC-PLUR-FV'	p. 82, (3.38b)
g.	/ɓa-√lub-ag-ɪ/	[ɓó-√lub-ŏg-i̋]	'3P-2P.O-plunge-PL-FV'	p. 275, (6.71)
h.	/na-√ɓin-ɪ=tɔ/	[nó-√ɓi̋n-i=tó]	'1S-dance-FV=INS'	p. 83, (3.40c)

There are several enclitics in Liko that resist the spread of [+ATR]. The data in (13) show that the negative, supplicative, and time adverbial (which de Wit glosses as 'P.3') enclitics fail to undergo spreading from a [+ATR] root vowel (13a–e) or from a dominant [+ATR] suffix vowel (13d–f). To distinguish them from alternating enclitics, these resistant enclitics are indicated with a preceding '≐'.

(13) Resistant enclitics (de Wit 2015))[9]

a.	/na-ka-√ɓin-ɪ≐gʊ/	[ná-kó-√ɓi̋n-i≐gʊ̆]	'1S-NEG-dance-FV≐NEG'
b.	/a-√pup-ɪ≐nɔ/	[ó-√pup-i̋≐nɔ]	'3S-leave-FV.SUBJ≐SUPP'
c.	/ɓa-ka-√sil-ɪ-an-ag-ɪ≐gʊ/		
		[ɓá-kó-√sil-j-on-og-i≐gʊ̆]	'3P-NEG-arrive-APPL-ASSOC-PLUR-FV≐NEG'
d.	/∅-ka-√tigol-ɔ-ku-≐gʊ/	[∅-kó-√tigol-o-ku-≐gʊ]	'3S-NEG-stay-FV-DIR≐NEG'
e.	/a-√dim-a-ni≐$^{\text{n}}$dɪ/	[ó-√dim-ó-ni̋≐$^{\text{n}}$dɪ]	'3S-clear-FV.PST-PFV≐P3'
f.	/tɪ-√pa-a-ku≐nɔ/	[ti̋-√pó-kú≐nɔ]	'1P.O-give-FV.IMP-DIR≐SUPP'

Observe in (14) that resistant enclitics cause immediately preceding sequences of [−high] vowels to surface as [−ATR] even when preceded by a root/dominant [+ATR] vowel. In (14a–c), each resistant enclitic prevents the preceding [−high] suffix vowel from surfacing as [+ATR]. In (14d–e), the same blocking effect

[9]Page and example/line numbers: (13a) – p. 94, (3.63a); (13b) – p. 94, (3.63b); (13c) – p. 383, (7.211a); (13d) – p. 481, line 20; (13e) – p. 95, (3.68a); (13f) – p. 94, (3.65b).

is shown to affect longer, uninterrupted sequences of [−high] suffix vowels. As de Wit (2015: 96) succinctly puts it, “anticipatory assimilation to the following [−ATR] value prevails over [+ATR] spreading.”

(14) Non-high suffixes before resistant enclitics (de Wit 2015, p.c.)[10]

a.	/√ɓin-a≐nɔ/	[√ɓín-á≐nɔ]	‘dance-FV.IMP≐SUPP’
b.	/∅-ka-√sil-a≐gʊ/	[∅-kó-√sil-á≐gʊ]	‘3S-NEG-arrive-FV≐NEG’
c.	/a-√dim-is-a≐ⁿdɪ/	[ó-√dim-ís-á≐ⁿdɪ]	‘3S-clear-CAUS-FV≐P.3’
d.	/na-ka-√ɓin-ag-a≐gʊ/	[ná-kó-√ɓín-ág-á≐gʊ]	‘1S-NEG-dance-PLUR-FV≐NEG’
e.	/na-ka-√koŋ-ag-a≐gʊ/	[ná-kó-√kóŋ-ág-á≐gʊ]	‘1S-NEG-roast-PLUR-FV≐NEG’

To appreciate why these blocking sequences of [−high] vowels must *immediately* precede resistant enclitics, compare the examples in (14) with those in (13c–f). In (13c–f), a [+high] vowel intervenes between the resistant enclitic and a preceding [−high] vowel. Regardless of whether that [+high] vowel is dominant (13d–f) or alternating (13c), the preceding sequence of [−high] vowels undergoes harmony. Thus, when /a/ (= ***U***) occurs between a [+ATR] root vowel (= ***T***) and a resistant [−ATR] enclitic (= ***Z***), spreading of [+ATR] from ***T*** to ***U*** is blocked in non-myopic fashion — except when a [+high] suffix vowel intervenes between the /a/ and the resistant enclitic, as in (13c–f).

In addition to /a/, /ɔ/ may also occur between a [+ATR] root and a resistant enclitic. Like /a/, /ɔ/ is output faithfully in this context, as shown for the alternating insistive enclitic in (15). When the resistant negative enclitic is absent, the alternating insistive enclitic vowel /ɔ/ assimilates to the [+ATR] value of any preceding [+ATR] vowels, including root vowels (15b–c) and dominant [+ATR] suffix vowels (15c). In (15d), though, the alternating insistive enclitic vowel fails to harmonize with the preceding dominant suffix due to the following resistant enclitic.

(15) The insistive enclitic (de Wit 2015)

a.	/a-√sɪɪ-ɪ=tɔ/	[a-√sj-í=tɔ]	‘3S-stay-FV=INS’	(repeated from (12d))
b.	/na-√ɓin-ɪ=tɔ/	[nó-√ɓín-i=tó]	‘1S-dance-FV=INS’	(repeated from (12h))
c.	/na-√do-a-ku=tɔ/	[nó-√do-kú=tó]	‘1S-come-FV-DIR=INS’	p. 97, (3.72b)
d.	/wa-ka-√ɓin-a-ni=tɔ≐gʊ/		‘2S-NEG-dance-FV-NEG.SUB=INS≐NEG’	
		[wa-ko-√ɓín-o-ní=tɔ́≐gʊ]		p. 100, (3.80b)

The behavior of [−high] vowels in Liko can be summarized using the PL suffix /ag/, shown in Table 5. The PLUR suffix surfaces as [+ATR] when there is a preceding [+ATR] vowel and no following resistant enclitic, the leftmost column in Table 5, or when a [+high] vowel intervenes between the [−high] vowel of the PLUR suffix and a following resistant enclitic, i.e., the bottom-right cell of Table 5. In all other circumstances, [−high] suffix vowels, e.g., the PLUR suffix, are output faithfully. Spreading of [+ATR] to [−high] vowels depends in part on whether there is a resistant enclitic further downstream — that is, rightward spreading to [−high] vowels is non-myopic. The full set of conditions on ATR harmony in Liko are summarized in Table 5.

	No resistant enclitic	Resistant enclitic is present
All suffix Vs are [−high]	✓[nó-√ɓín-óg-ó] (12e)	✗[ná-kó-√ɓín-ág-á≐gʊ] (14d)
(Intervening) suffix V is [+high]	✓[ɓó-√lub-ŏg-í] (12g)	✓[ɓá-kó-√sil-j-on-og-i≐gʊ̆] (13c)

Table 5 Conditions on ATR harmony in Liko

[10]Page and example numbers: (14a) – p. 95, (3.66b); (14b) – p. 95, (3.67); (14c) – p. 95, (3.68b); (14d) – p. 96, (3.69b); (14e) – p.c.

de Wit (2015: 66–107) devotes over forty pages to the ATR harmony, including nine pages on the role of the resistant enclitics just discussed. de Wit's fieldwork, like the data presented in his grammar, is extensive, including data from elicitation and text collection. Each of the morphemes discussed above is robustly attested throughout the grammar, including the sequences where [+ATR] spreading is blocked, as summarized quantitatively in Table 6.

	=INS≐NEG	-FV≐NEG	-FV≐SUPP	-FV≐P.3
[+ATR] spreading	0/29	0/10	0/3	5/38

Table 6 [+ATR] spreading counts with resistant enclitics in Liko

In most morphological contexts, the presence of a resistant enclitic inhibits the spread of [+ATR] to [−high] vowels. However, when the final vowel /a/ is followed by the time adverbial enclitic (-FV≐P.3), [+ATR] spreading to the final vowel obtains in a minority of cases. In four of the 33 instances in which the final vowel fails to undergo [+ATR] spreading, a preceding [−high] vowel *does* undergo spreading, yielding forms like [ɓó-kw-óg-á≐^{n}dɪ] '3P-die-PLUR-FV≐P.3' (de Wit 2015: 301, (7.207a)). These facts all support the reliability of the Liko data presented in de Wit (2015) and its relevance to our discussion.

6 Discussion

Having established the existence of non-myopic patterns of vowel harmony, we address here their virtual inevitability from the point of view of phonological theory. We offer three possible analyses of the Liko pattern, all of which consist of some subset of elements commonly found in analyses of vowel harmony, elements which are in fact staples of phonological analysis generally. The point is to demonstrate that certain combinations of common theoretical assumptions straightforwardly produce non-myopic spreading patterns, challenging any effort to maintain the myopia generalization in (1).

Setting aside the bounded leftward spreading and the re-pairing of /a/ to [o], all three analyses of Liko call for the two unbounded spreading rules shown in simplified form in Figure 1. One rule ('$\overrightarrow{\textbf{LR}}$', for left-to-right spreading) spreads [+ATR] rightward from root/dominant vowels to all following vowels up to resistant enclitics, and the other ('$\overleftarrow{\textbf{RL}}$', for right-to-left spreading) spreads [−ATR] leftward from resistant enclitic vowels to preceding [−high] vowels up to the root.

Figure 1 Rules for the non-myopic ATR harmony pattern of Liko. $\overrightarrow{\textbf{LR}}$ spreads [+ATR] rightward to all vowels up to resistant enclitics; $\overleftarrow{\textbf{RL}}$ spreads [−ATR] leftward to [−high] vowels up to the root.

These rules, when both are applicable to the same form, make conflicting demands on alternating vowels: $\overrightarrow{\textbf{LR}}$ demands that they be [+ATR], and $\overleftarrow{\textbf{RL}}$ demands that they be [−ATR]. Central to each of the analyses discussed below is the adjudication of this conflict via serial ordering. This accords with Meinhardt et al.'s (2024) computational characterization of unbounded circumambient patterns generally: such patterns require the expressivity of the class of non-deterministic regular functions, which can be decomposed into an interacting pair of contradirectional subsequential functions. $\overrightarrow{\textbf{LR}}$ and $\overleftarrow{\textbf{RL}}$ are just such a pair of functions.

Several strategies may ensure that resistant enclitic vowels are not affected by $\overrightarrow{\textbf{LR}}$ while root vowels are not affected by $\overleftarrow{\textbf{RL}}$. Each of the analyses below involves a combination of these strategies, illustrated with sample derivations of two key examples: /na-√ɓin-ag-a/ ⟶ [no-√ɓíń-óg-ó] '1S-dance-PLUR-FV' (12e), exemplifying the success of [+ATR] spreading due to the absence of a resistant enclitic, and /na-ka-√kóŋ-ag-a≐gʊ/ ⟶ [ná-kó-√kóŋ-ág-á≐gʊ] '1S-NEG-roast-PLUR-FV≐NEG' (14e), exemplifying the failure of [+ATR] spreading due to the presence of a resistant enclitic.[11]

In one analysis, dominant root vowels are underlyingly specified as [+ATR], resistant enclitic vowels are underlyingly specified as [−ATR], all alternating vowels are underlyingly unspecified for [±ATR], the two spreading rules are feature-filling, and $\overleftarrow{\textbf{RL}}$ is ordered before $\overrightarrow{\textbf{LR}}$. The ordered operation of these rules is illustrated in Figure 2. In the first derivation, there is no resistant enclitic. $\overleftarrow{\textbf{RL}}$ thus does not apply; $\overrightarrow{\textbf{LR}}$ does, creating low [+ATR] vowels (transcribed |ɐ|) before eventually being re-paired to [o]. There is a resistant enclitic in the second derivation, so $\overleftarrow{\textbf{RL}}$ does apply in this case, specifying alternating vowels as [−ATR], bleeding $\overrightarrow{\textbf{LR}}$. In this case, the non-myopic pattern results from the bleeding interaction between these two rules. $\langle X \rhd Y \rangle$ means 'X applies before Y'.

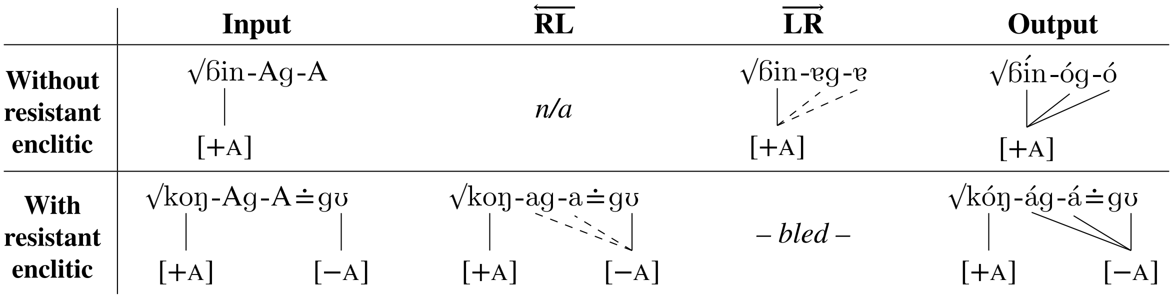

Figure 2 Liko analysis 1: $\langle \overleftarrow{\textbf{RL}} \rhd \overrightarrow{\textbf{LR}} \rangle$; both rules are feature-filling.

Another strategy for ensuring that $\overleftarrow{\textbf{RL}}$ does not affect root vowels would be to specify the root as a left domain boundary for the rule. This allows for a minimally different second analysis, one in which feature-filling $\overrightarrow{\textbf{LR}}$ applies before feature-changing $\overleftarrow{\textbf{RL}}$. Relevant derivations are provided in Figure 3. In this case, the non-myopic pattern results from the fact that the second function undoes the changes introduced by the first — a 'Duke of York' derivation (Pullum 1976).

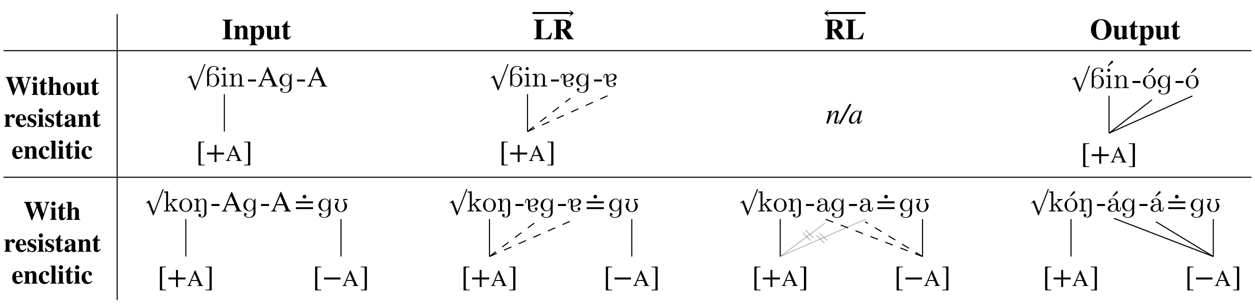

Figure 3 Liko analysis 2: $\langle \overrightarrow{\textbf{LR}} \rhd \overleftarrow{\textbf{RL}} \rangle$; $\overrightarrow{\textbf{LR}}$ is feature-filling; $\overleftarrow{\textbf{RL}}$ is feature-changing but blocked by roots.

Because dominant suffix vowels would also be underlyingly specified as [+ATR] in these analyses, the two make slightly different predictions. The analysis illustrated in Figure 2 predicts that a [−high] dominant suffix vowel would behave just like the root vowel in (14e) and not undergo [−ATR] spreading, because $\overleftarrow{\textbf{RL}}$ is feature-filling. The analysis illustrated in Figure 3 predicts that a [−high] dominant suffix vowel *would* undergo [−ATR] spreading, because only roots delimit the domain of that process. This difference in prediction

[11] Since we are setting aside the bounded leftward spread of [+ATR] to the root-adjacent prefix vowel, our illustrations of these analyses eschew all prefixal material.

can unfortunately not be tested, however, because "[t]he only vowels in [+ATR] dominant suffixes are the high vowels /i u/" (de Wit 2015: 107), and high vowels are independently not subject to $\overleftarrow{\textbf{RL}}$.

The analysis illustrated in Figure 3 is highly similar to Noske's (1996) analysis of a comparable pair of spreading processes in Turkana (Nilotic; Dimmendaal 1983, Meinhardt et al. 2024). The basic pattern in Turkana is roughly the same as that in Liko, [12] except that (a) roots do not block $\overleftarrow{\textbf{RL}}$, and (b) $\overrightarrow{\textbf{LR}}$ leads to re-pairing of /a/ to [o] *before* the application of $\overleftarrow{\textbf{RL}}$, such that an /a/ flanked by a root/dominant [+ATR] vowel to the left and a resistant [−ATR] vowel to the right ultimately surfaces as [ɔ]. This /a/ → |o| → [ɔ] derivation makes it clear that the application of $\overrightarrow{\textbf{LR}}$ is successful even when it is otherwise undone by the necessarily subsequent application of $\overleftarrow{\textbf{RL}}$. The alternative analysis of the Liko pattern in Figure 2, where both rules are feature-filling and $\overleftarrow{\textbf{RL}}$ effectively bleeds $\overrightarrow{\textbf{LR}}$, is thus unsuitable for the Turkana pattern.[13]

A third analysis for Liko (and also for Turkana) places $\overrightarrow{\textbf{LR}}$ in a morphophonological stratum prior to the attachment of resistant enclitics, which are always at the right edge of the word. $\overleftarrow{\textbf{RL}}$ would then apply subsequent to their attachment, again with the root as a left domain boundary. Both rules in this case could be feature-changing. The derivations would otherwise be similar to those shown in Figure 3, except that the resistant enclitic in the second derivation would not be attached until after the application of $\overrightarrow{\textbf{LR}}$ and before the application of $\overleftarrow{\textbf{RL}}$. The availability of this kind of analysis is perhaps critical for those who may object either to underspecification or to the essentially rule-based character of the other two analyses. It still requires ordering, but between morphophonological strata rather than rules.[14]

As noted at the outset of this section, all three of these analyses consist of common elements of phonological theory and analysis: underspecification of alternating vowels, feature-filling vs. feature-changing spreading rules, directional spreading rules and rule ordering, morphological domain delimitation, and/or interleaving of morphology and phonology. The availability of one or more of these analyses thus challenges the claim that a non-myopic spreading pattern like the one in Liko should not be possible. Short of an *ad hoc* stipulation of some kind, it is difficult to imagine what would have to be said of phonological theory in order to rule out the possibility of such analyses. Even from the perspective of theories that reject rules and ordering, such as Optimality Theory, some mechanism for the interleaving of morphology and phonology seems necessary, which means that at least the third analysis is still available. The fact that this analysis is also compatible with full specification is an added advantage, if one is skeptical of underspecification (Steriade 1995).

7 Conclusion

The existence of the non-myopic spreading patterns discussed in §§3–5 make it necessary to reject the strong claim in (1; Wilson 2003, 2006, Mascaró 2019) that all unbounded feature spreading is myopic. Rejecting this claim is furthermore warranted by the fact that non-myopic patterns can be straightforwardly described with various combinations of common elements of phonological analysis, seen in §6. The claim itself was justified by an imbalance in empirical attestation: myopic spreading patterns appear to be (far) more common than non-myopic spreading patterns. A more moderate claim would be that myopia is a strong tendency rather than axiomatic of unbounded feature spreading. This shifts the issue from what a specific generative theory does and does not predict to be possible to the more general problem of whether and how to account for typological tendencies vs. absolutes (Bickel 2007, Piantadosi & Gibson 2014, McCollum et al. 2020: 247ff).

Assuming this more moderate claim is true, how might it be formally accounted for? Consider two hypothetical scenarios that might lead to the emergence of a non-myopic spreading pattern like that in Liko. The first is that the pattern could emerge *ex nihilo*, or as the result of some mutation of a single pre-existing

[12]In Dimmendaal's (1983) description of Turkana, all vowels are targets of $\overleftarrow{\textbf{RL}}$, unlike in Noske (1996, 2000), which describes $\overleftarrow{\textbf{RL}}$ applying only to [−high] vowels, as in Liko.

[13]That is, unless the re-pairing rule simply raises all low vowels following a [+ATR] vowel, completely independently of whether $\overrightarrow{\textbf{LR}}$ ultimately applies. $\overleftarrow{\textbf{RL}}$ would then apply after raising, ensuring that the raised vowels are [ɔ] and bleeding $\overrightarrow{\textbf{LR}}$ just as in Figure 2.

[14]See Baković (2000) for an OT account of the Turkana pattern.

spreading rule. This scenario requires positing a single iterative spreading rule with a two-sided context, unbounded on both sides. This scenario should be unlikely, *ceteris paribus*, given the growing body of work finding a strong preference for computationally and formally simpler patterns (e.g. Moreton 2008; Moreton & Pater 2012a, b; Heinz & Lai 2013; Heinz 2018, Durvasula & Liter 2020).

The second scenario is that a non-myopic pattern could emerge in the way envisioned above, as the interaction of contradirectional myopic spreading processes. This scenario would require (i) at least two myopic spreading rules that (ii) apply contradirectionally, (iii) spread the same feature, and (iv) interact, by virtue of spreading *different values* of that same feature.[15] The set of languages with at least two spreading rules is a strict subset of the set of languages with any spreading at all. The set of languages with at least two rules spreading in opposite directions is in turn a stricter subset; the set of languages in which those two rules spread the same feature is an even stricter subset. The set of languages in which those two rules interact is a stricter subset still. The likelihood of the coincidence of all four of these requirements is thus strikingly low. In at least some cases (e.g. Tutrugbu and Tafi; McCollum et al. 2020), one of the two rules needed for the description of a non-myopic pattern may lack motivation independent of the non-myopic nature of the overall pattern itself — yet another reason to expect that such patterns will be rare, given the significance of independent motivation for the establishment (and learning) of phonological generalizations (Zwicky 1986).

Computationally, the interaction of two contradirectional and unbounded spreading rules results in an overall pattern whereby the realization of some vowel depends on information a potentially unbounded distance in both directions (Jardine 2016, Meinhardt et al. 2024). Such unbounded circumambient patterns require the increased expressivity of the non-deterministic regular functions. This leap in overall expressivity also contributes to the rarity of such patterns: the greater the computational expressivity required, the more challenging a pattern is to learn. Since the computational classes discussed in §2 concern the entire input-output mapping, the strong preference for computationally simpler input-output mappings (e.g. Lai 2015, Heinz 2018) means that even the compositional scenario just sketched is subject to the same dispreference as the first, *ex nihilo* emergence scenario. Meinhardt et al. (2024) demonstrates that the interaction requirement in the second, compositional scenario is precisely what results in the increased complexity of the pattern. In both the *ex nihilo* and compositional cases, the emergence of a non-myopic pattern — regardless of exactly how it emerges — is strongly disfavored because it requires a strictly more expressive class of functions to describe it.

These computational factors go hand in hand with the overall learnability of the Liko pattern specifically and phonological grammars more generally. While input strictly local, output strictly local, and subsequential functions are learnable from positive data (Chandlee 2014, Chandlee et al. 2015, Oncina et al. 1993), the full class of regular functions likely isn't (Gold 1967). This means that the probability of either the *ex nihilo* or compositional cases for the existence of a Liko-like spreading pattern is further restricted by the learnable region of the fully regular functions. This restriction likely also holds for phonological grammars as a whole: Although individual UR-SR maps may be subregular, their composition into grammars likely isn't (Elgot & Mezei 1965). From this perspective, non-myopic spreading patterns provide evidence critical to understanding the learnable region of regular languages, and although single fully regular UR-SR maps may be rare, they have broader implications for the learnable space of full phonological grammars.

Returning to the issue of non-myopia of metaphony patterns discussed in §2, the significance of potential cases of look-ahead is contingent on whether metaphony is bounded or unbounded. If metaphony is intrinsically bounded, then non-myopic look-ahead doesn't actually affect the computational complexity of the functions necessary to describe these patterns since they are all input strictly local (Chandlee 2014). However, if metaphony is intrinsically unbounded, then the myopia question bears on the computational expressivity of the grammar in the same way that it does for unbounded spreading generally. Thus, to the extent that one

[15] At least the first of the two rules must also leave at least some triggers of the second rule intact, else the resulting grammar would be indistinguishable form one without the second rule at all. This was evident in our three analyses of Liko, where neither of the rules is permitted to efface all triggers of the other: $\overrightarrow{\mathbf{LR}}$ does not affect resistant enclitics and $\overleftarrow{\mathbf{RL}}$ does not affect root/dominant vowels.

accepts the arguments in Anderson (1980), Calabrese (2011), and Mascaró (2019, 2024) that metaphony involves the same unbounded spreading mechanisms as other vowel harmony patterns, the data and discussion above indicate no reason to reject the ontological possibility of non-myopic metaphony patterns.

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