Anticyclic Mutation

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Abstract

A major argument for process-based approaches to nonconcatenative morphology is the observation that mutation morphology (morphological categories expressed by changes in tone, stress, segmental quality or quantity) seem to exhibit a systematic asymmetry: Affixal morphology cyclically triggers changes in the bases to which it attaches, but bases don't trigger comparable 'anticyclic' changes in affixes (Inkelas 1998, Alderete 2001, Rolle 2018). Intuitively, processes (morphology) can affect objects (stems), but objects cannot affect processes. Alderete (2001) calls this generalization 'Strict Base Mutation'. Inkelas (1998) argues that it follows from approaches where mutation is the effect of morphophonological constraints but is unexpected in item-and-arrangement models where mutation is the effect of defective floating material (Lieber 1992, Wolf 2007, Bye & Svenonius 2012), in the terms of Bermúdez-Otero (2012) 'Generalized Nonlinear Affixation'. This paper has three goals: *First,* we provide extensive typological evidence that Strict Base Mutation is empirically wrong presupposing a standard lexicalist cophonology approach: Anticyclic mutation exists for all major phonological modalities. *Second,* we demonstrate that the attested types of anticyclic mutation directly follow from a standard Generalized Nonlinear Affixation approach to cyclic mutation couched in the formal framework of Colored Containment Theory (van Oostendorp 2008, Trommer 2011, Zimmermann 2017). *Third,* we show that recent reformulations of the SBM in non-lexicalist models such as Cophonologies by Phase (Sande et al. 2020), and the model developed in Rolle (2018), while solving some of the problems raised by the Strict Base Mutation hypothesis in standard cophonology theory, still make problematic empirical predictions.

1 Introduction

There are two major types of theoretical approaches to nonconcatenative morphology. *Generalized Phonology* approaches basically treat nonconcatenative morphology with formal mechanisms also capturing phonological processes but triggered directly by morphological features. This holds true for derivational Item-and-Process accounts such as Amorphous Morphology (Anderson 1992) where processes such as the vowel fronting ('umlaut') in German diminutives (e.g., [valt] 'forest' and [vɛlt-çən] 'small forest') are achieved by rules like V → [-back] /__ [+diminutive]. Such rules are formally of the same format as classical SPE rules (modulo the morphological conditioning). But the same is true for many OT-based approaches such as Cophonology Theory where mutation follows from construction-specific constraint rankings. In contrast, *Generalized Affixation* accounts extend the classical Item-and-Arrangement approach and maintain that mutation is the effect of affixing subsegmental or suprasegmental material. Thus German diminutive umlaut can be captured by suffixing a floating [-back] feature to the final vowel in addition to the segmental affix which leads then to overwriting of the underlying [+back] specification of the base by general phonological processes. This approach has been highly influential in the autosegmental literature on morphological length and tone, and has seen a recent revival under the heading 'Generalized Nonlinear Affixation' (GNA, Bermúdez-Otero 2012).

While arguments against an Item-and-Arrangement approach traditionally highlight on the claim that it is too restricted to account for the full complexity of attested nonconcatenative processes (Anderson 1992), Inkelas (1998), Alderete (2001), and, more recently, Rolle (2018) identify an important formal difference between the two approaches where a GNA account actually predicts the *richer* typology. Under the GNA approach, mutation follows simply from the possibility that one morpheme (e.g., the affix) contains an incomplete piece of phonology which is realized on another morpheme (e.g., the root) by general phonological processes. In this account, there is no inherent root-affix asymmetry. The affix as well as the root could contain defective phonological structure that happens to be realized on an adjacent morpheme (say an affix). We would hence expect a process such as 'anti-umlaut', where specific roots

(or complex bases of affixation) trigger segmental changes on affixes. In an amorphous system eschewing the autosegmental apparatus of GNA, there is no obvious way to model anti-umlaut: Morphological processes cyclically change the underlying forms of stems (either simplex roots or morphologically complex stems) but stems have no symmetric means to influence the output of morphological processes in an anticyclic way. Alderete (2001) calls this prediction the principle of 'Strict Base Mutation' (SBM) which we cite in (1) in the formulation of Rolle (2018).

(1) *Strict Base Mutation Hypothesis (SBM, Rolle 2018:93)*
Alternations triggered by morphophonological operations are found exclusively in the stem
(simplex or complex) which serves as the base of a morphological process.

We will focus our discussion of the SBM on the original version of Cophonology Theory (variably also called 'Sign-Based Phonology' or 'Construction Phonology') as developed by Orgun (1996), Inkelas (1998), Inkelas & Zoll (2005), Inkelas (2014) because it embraces the most explicit claim that nonconcatenative morphology is generally process-based (see especially Inkelas 2008). However, most of our arguments extend mutatis mutandis to other Generalized Phonology approaches (see section 5 for some discussion).

Crucially, in Cophonology Theory, the SBM follows from the two assumptions in (2):

(2) *Theoretical Assumptions deriving SBM in Cophonology Theory*

(i) Roots are phonological objects, but morphology consists of morphophonological processes
(ii) Phonological evaluation is cyclic, i.e., recursively triggered by morphological constructions

Assumption (2-i) directly captures the asymmetry imposed by the SBM for roots (indicated here and in the following by "√") and affixes under simple affixation.[1] Only the pattern in (3-a), but not the one in (3-b) should be attested according to Strict Base Mutation:

(3) *Root-affix interactions in mutation*

a. *SBM-compliant Affix-to-Root mutation*

b. *SBM-violating Root-to-Affix mutation*

However, the SBM as formulated in (1) is not restricted to roots, but applies to all bases. The cyclicity assumption in (2-ii) generalizes the claim to complex bases as in (4). Since morphological structure-building in Cophonology Theory is incremental and applies in tandem with phonology, mutation cannot affect affixes added on later cycles (4-b) and applies strictly to inner morphological material which has been added on previous cycles (4-a):

(4) *Affix-affix interactions in mutation*

a. *SBM-compliant Affix-to-Affix mutation*

b. *SBM-violating Affix-to-Affix mutation*

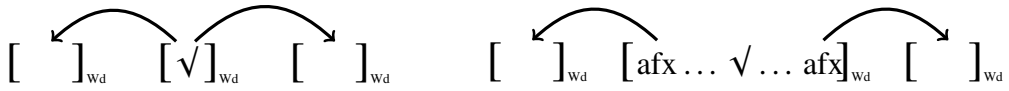
If we understand selection of a root morpheme as the initial cycle of a morphophonological derivation, what singles out the mutation patterns in (4-a) and (3-a) as conforming to the SBM is that mutation triggered by a morphological process in a given cycle applies strictly to material

[1] The traditional notion of cyclicity, as employed in Lexical Phonology is derivational interleaving of morphological and phonological operations. A process-based formalism which uses this approach is the Amorphous Phonology framework of Anderson (1992). However, as shown by Orgun (1996), this notion of cyclicity can also be captured in a declarative constraint-based framework. This underlies the notion of cyclicity in Cophonology Theory, but also Antifaithfulness Theory (Alderete 1999), and most other current work in process-based morphology such as Paradigm Function Morphology (Stump 2001).

introduced by previous cycles. In this sense, we will call mutation compliant with the SBM *cyclic*, and the patterns where roots or affixes trigger mutation on outer material (i.e., on material added in the current or later cyles) *anticyclic*.

The nature of cycles of course depends crucially on the overall architecture of the grammar and the interface between morphology, syntax, and phonology. Cophonology Theory presupposes the classical lexicalist architecture also found in Lexical Phonology (Kiparsky 1982) and Stratal OT (Bermúdez-Otero 2018): cycles are restricted to a morphology component which strictly precedes phrasal syntax and phonology. On the other hand, the interaction of morphosyntax and phonology in phrasal phonology is non-cyclic (or, put differently, is restricted to a single cycle of phonology following all syntactic structure building). Accordingly, the formulation of SBM in (1) implies that roots and affixes should not be able to trigger mutation processes in phrasal phonology. We call these patterns excluded by the SBM *Root-to-Word mutation* and *Affix-to-Word mutation* shown schematically in (5-a) and (5-b):[2]

(5) *a. Anticyclic Root-to-Word mutation* *b. Anticyclic Affix-to-Word mutation*



Whereas SBM seems to be a central means to distinguish Generalized Phonology and GNA accounts, this claim has to the best of our knowledge never been investigated systematically. We aim to fill this gap with this paper by (1) presenting extensive empirical crosslinguistic evidence against the SBM hypothesis establishing a systematic typology of attested anticyclic mutation and (2) developing analyses for representative cases of anticyclic mutation in Colored Containment Theory, a major recent framework embracing an item-and–arrangement approach (Zimmermann & Trommer 2014, Paschen 2018). These theoretical accounts demonstrate that a GNA account is not only in principle compatible with anticyclic morphology but parsimoniously derives all attested types of the phenomenon by the same constraints previously motivated for cyclic mutation.

Further below (in section 5), we will also address the predictions of cophonology approaches which embrace SBM, but assume a non-lexicalist approach to cyclicity without a strict separation of word-internal and phrasal grammar, and notions of the phonological cycle which also extends to phrases. Thus Rolle (2018) suggests that SBM applies in a model where cycles are defined over asymmetric c-command relations in a Distributed-Morphology architecture. Sande et al. (2020) propose that a version of the SBM holds in a Cophonology model where cycles are defined by Minimalist phases ('Cophonologies by Phase'). These variants of the SBM will be discussed in section 5.1. Finally, we will argue that the GNA approach, while inherently incapable to capture SBM, still imposes substantial restrictions on mutation phenomena due to general restrictions on possible affixation patterns and phonological representations. Thus in section 5.3 we will show that the generalization in (6) holds true for our language sample:

(6) *Phonological Locality Generalization on Anticyclic Mutation:*
Anticyclic mutation is phonologically adjacent to the position of its segmental anchor (modulo general phonological alternations).

The paper is structured as follows: In sections 2 and 3, we provide extensive empirical evidence that anticyclic mutation is attested in natural languages. Section 2 focusses on different basic patterns of anticyclic mutation, and section 3 extends the argument to more complex cases where anticyclic patterns alternate among each other or with cyclic mutation. In section 4.1, we present our theoretical background assumptions for a containment-based GNA account of

[2]Note that the structures in (5) don't have a cyclic counterpart simply because under a strictly lexical architecture there are no morphological operations in syntax. Word-constituting constructions cannot have an effect on other words because they are part of morphology, not of syntax.

cyclic mutation. Finally, in section 4.2, we show that this analysis directly transfers to anticyclic mutation. A critical discussion of construction approaches to mutation relating to the SBM is given in section 5 where we argue that the GNA approach is closer to the typological facts than recent non-lexicalist modifications of the cophonology approach (Rolle 2018, Sande et al. 2020). We conclude in section 6.

2 Basic Types of Non-Base Mutation

Following Wolf (2007), we subsume under 'mutation' all types of non-concatenative morphology where morphological contrasts are expressed by modifying phonological features; i.e., segmental quality (7-a+b), length (7-c+d), tone (7-e), and stress (7-f). These are illustrated in (7) with standard cases of cyclic non-concatenative morphology. The examples in (8) show that exactly the same types of mutation also cooccurr with segmental affixation. [3]

(7) *Types of cyclic mutation: non-concatenative morphology without concomitant segmental affixation*

a.	*V Quality*	(German)	bʀuːdɐ	'brother'	→	bʀyːdɐ	'brothers'
b.	*C Quality*	(Texistepec Popoluca)	dastah	'to dig'	→	nastah	'I dig'
c.	*V Length*	(Hausa)	gudù	'walk'	→	gudùː	'walking'
d.	*C Length*	(Shizuoka Japanese)	katai	'hard'	→	katːai	'hard!'
e.	*Tone*	(Ngbandi)	gwè	'swam' (sg.)	→	gwé	'swam' (pl.)
f.	*Stress*	(Upriver Halkomelem)	ts'ɛtɛ́ːm	'crawl'	→	ts'ɛ́təm	'crawling'

(a. Helbig & Buscha 2001:241, b. Reilly 2002:23), c. Schuh 1989:38, d. Davis & Ueda 2002:2, e. Nida 1949:63-64, f. Galloway 1993:56)

(8) *Types of cyclic mutation: mutation with segmental affixation*

a.	*V Quality*	(German)	huːt	'hat'	→	hyːt-ə	'hats'
b.	*C Quality*	(Fula)	reː-du	'belly'	→	deː-di	'bellies'
c.	*V Length*	(Tarahumara)	to	'take'	→	toː-ru	'take' (pass.)
d.	*C Length*	(Päri)	cam	'eat' (tr.)	→	camː-o	'eat' (intr.)
e.	*Tone*	(Kanuri)	tádà	'boy'	→	tàdà-á	'boys'
f.	*Stress*	(Modern Greek)	ˈanθrop-os	'man'-NOM.SG	→	anˈθrop-u	'man'-GEN.SG

(a. Helbig & Buscha 2001:241, b. Laughlin 2015:422, c. Caballero 2008:154, d. Andersen 1988:91, e. Cyffer 1998, f. Revithiadou 1999:19)

Accordingly, we will show in this section that anticyclic mutation effects are attested for all modalities listed in (7) and (8). To do this, we will first outline basic properties of our language sample (section 2.1), and then go step-by-step through different anticyclic configurations exhibiting anticyclic mutation: Root-to-Affix Mutation (section 2.2), Affix-to-Affix Mutation (section 2.3), Affix-to-Word Mutation (section 2.4), and Root-to-Word Mutation (section 2.5).

2.1 The Sample

The data in this paper are from a sample of anticyclic mutation data that we have collected, containing 138 distinct mutation patterns from 70 languages across linguistic macroareas and language families. See appendix A and B on the structure of the sample and basic statistics, and appendix C for schematic classification of all languages in the sample for anticyclic mutation and documentation of the data not explicitly discussed in the main text. In this section, we focus on representative examples of anticyclic mutation to illustrate the major structural types of the phenomenon across different phonological modalities.

[3] Abbreviations and glosses follow the Leipzig Glossing Rules wherever possible. Additional abbreviations are listed in appendix D.

Note that our data are based on two types of sources. On the one hand, we draw on theoretical work, especially from the classical autosegmental literature. These sources typically provide detailed arguments for an analysis in terms of defective phonological structure (e.g., Clements 1990 on Kikuyu, Noske 1996 on vowel features in Turkana, and Remijsen & Ayoker 2020 on lengthening in Shilluk), which effectively anticipates our interpretation as anticyclic mutation. Adding to this body of work, our sample also contains many cases of anticyclic mutation we have identified in descriptive sources on specific languages. This part of our sample is more subject to the inherent limitations of typological research. Language sources are of very different detail and quality, and it is not possible to show in detail for every data set that the categorization of a given pattern (in our case as anticyclic mutation) is preferable to possible alternative interpretations. To mitigate these limitations we have added an extensive online appendix which provides further information on all languages in our sample, our specific categorization, and in many cases, additional data. The appendix entries also specify if the interpretation on the data in the sample is building on previous theoretical work by other scholars. For a few patterns in our sample, there is also a broader theoretical literature including alternative interpretations of the data (most prominently postaccenting in Russian). We could have omitted these from the sample, but have considered it more informative for the reader to include them and to explicitly indicate published alternative analyses in the text and in the single language entries of the appendix.

The most systematic analytic alternative to the data in our sample is of course allomorphy. Virtually all cases of mutation (whether cyclic or anticyclic) could in principle also be captured by positing different allomorphs for the targets of mutation. To minimize the possibility of an interpretation as allomorphy, we have only included patterns in our sample, where anticyclic according to our sources mutation applies to *all* eligible target morphemes of a given type. Moreover, in the big majority of our data, mutation applies to multiple different targets. Thus Greek postaccenting puts stress on all following inflectional suffixes, and Kipsigis Causative morphology lengthens all short prefix vowels preceding it (see section 2.2). This point is especially clear in the cases of anticyclic mutation targeting independent words (see sections 2.4 and 2.5), where the set of mutation targets is an open class of items including nouns and verbs.

2.2 Root-to-Affix Mutation

We start our survey with anticyclic Root-to-Affix mutation since this is basically the mirror image to the cyclic cases of mutation discussed in the literature. The pattern is schematically summarized in (9).

(9) *Anticyclic Root-to-Affix mutation, abstract*

Consonant Quality: Several examples of anticyclic Root-to-Affix mutation for consonantal features are found in Korean where specific vowel- and sonorant-final roots trigger aspiration or glottalization of following obstruent-initial suffixes often leading to minimal pairs of roots differing according to their mutation behavior. (10) illustrates this with two suffixes, the declension marker /-ta/ and the coordinating suffix /-ko/, but, as Gleim & Lee (p.c.) confirm, the same effects are also found with all other obstruent-initial suffixes such as negative /-ci/, subordinative/gerundive /-ke/ and /-tolok/ 'in order to'. Here and in the following we indicate target morphemes (or target words) of mutation by boxes and mutation triggers by underlining (hence by the pure underscore "_" in cases where the trigger morpheme doesn't have segmental

content). sg and cg abbreviate the features [spread glottis] and [constricted glottis] respectively.[4]

(10) *Consonantal Root-to-Affix mutation in Korean (Gleim & Lee 2019)*

a. *Aspiration*

/na^{sg}-ta/	→	na-[t^{h}a]	give.birth-DEC	/na^{sg}-ko/	→	na-[k^{h}o]	give.birth-COOR
/co^{sg}-ta/	→	co-[t^{h}a]	good-DEC	/co^{sg}-ko/	→	co-[k^{h}o]	good-COOR
/al^{sg} -ta/	→	al-[t^{h}a]	suffer-DEC	/al^{sg}-ko/	→	al-[k^{h}o]	suffer-COOR

b. *Glottalization*

/na^{cg}-ta/	→	na-[t^{ʔ}a]	get.better-DEC	/na^{cg}-ko/	→	na-[k^{ʔ}o]	get.better-COOR
/i^{cg}-ta/	→	i-[t^{ʔ}a]	tie-DEC	i^{cg}-ko/	→	i-[k^{ʔ}o]	tie-COOR
/nam^{cg}-ta/	→	nam-[t^{ʔ}a]	remain-DEC	nam^{cg}-ko	→	nam-[k^{ʔ}o]	remain-COOR

c. *No Mutation*

/na-ta/	→	nata	occur-DEC	/na-ko/	→	nako	occur-COOR
/p^{h}i-ta/	→	p^{h}ita	blossom-DEC	/p^{h}i-ko/	→	p^{h}iko	blossom-COOR
/al-ko/	→	alko	know-DEC				

See appendix C for more consonantal Root-to-Affix mutation from Fula, Tauya and Acoma.

Vowel Quality: As far as we know, the earliest evidence in the literature for floating vocalic features on roots has been identified by Kenstowicz (1979) for Chukchee where roots containing only consonants may have a lowering or raising effect on affixes (e.g., the lowering root /-rw-/ 'to split' in [ɣa-rw-ə-len] PRF-split-Ø-PRF 'he has split' vs. the non-lowering root /-rw-/ 'to dig/scratch' in [ɣe-rɣ-ə-lin] PRF-dug/scratch-Ø-PRF 'he has dug/scratched', Wolf 2007:51-52, Krause 1976:13). Similar cases are found in the Kordofanian language Moro (see appendix C). However, vocalic Root-to-Affix mutation is by no means restricted to defective vowel-less bases. In Turkana (Noske 1996), most suffix vowels harmonize with the vowel of the lexical root in [ATR] (e.g., the Allative suffix in [a-dɔk-ʊn] INF-climb-ALL 'to climb down' vs. [a-gol-un] INF-discover-ALL 'to close in', p. 67). As expected, the low [-ATR] vowel /a/ in roots triggers [-ATR] in most contexts (e.g., [a-rap-ʊn] INF-close-ALL 'to discover', p. 85), whereas /a/ in suffixes typically shifts to [+ATR] [o] after [+ATR] stems since the language doesn't have a low [+ATR] vowel (e.g., the singular suffix in [ɛ-tɪm-at] MSG-hair-SG 'hair of head' vs. [e-pipj-ot] MSG-firestick-SG 'firestick', p. 80). The same holds for nouns with the plural suffix /-(i)a/ after non-low vowels (11-a,b) and after most roots with final /a/ (11-c,d). However, for a number of noun roots with final /a/, the suffix appears in its [+ATR] form [-(j)o] (11-e,f).

(11) [+ATR] *Root-to-Suffix mutation in Turkana (Noske 1996:85,93,94)*

a. ŋi-rizj-o	b. ŋa-pɛdɪ-a	c. ŋɪ-malj-a	d. ŋɪ-qaːz-ɪa	e. ŋɪ-lap-[jo]	f. ŋa-xabat-[jo]
M.PL-N-PL	F.PL-N-PL	M.PL-N-PL	M.PL-N-PL	M.PL-N-PL	F.PL-N-PL
'leopards'	'piles'	'arrows'	'works'	'moons'	'cupboards'

Following Noske, we take this as evidence that the irregular /a/-vowel verbs are characterized by a final floating [+ATR] feature following the [-ATR] specification of the root vowel. Independent evidence for this interpretation comes from the fact that these roots while enforcing [+ATR] suffixes still trigger regular [-ATR] harmony on the high-vowel class prefix [ŋɪ-,ŋi-] (cf. (11-e) vs. (11-a) with non-low [+ATR] root). This makes it unlikely that the pattern results from an underlying [+ATR] low vowel in these roots which would then neutralize to [a]. Anticyclic vocalic mutation is found for virtually all basic vowel features: ATR as in Turkana,

[4]The phonetic nature of Korean laryngeal contrasts is controversial, but orthogonal to their role in mutation. We simply adopt here the phonetic characterization assumed by Gleim and Lee.

Yoruba and Ik, backness (Ainu), [+high] and [+round] (Bari), and [+low] (Hungarian, Neve'i, and Koryak), documented in appendix C.

Tone: Root-to-Affix mutation for tone is found in Kinande where specific verb roots impose a H-tone on preceding prefixes such as the Infinitive prefix /ri/- and the tense markers /ndi/- and /a/-. (12) shows this effect for the verb root /tum/ 'send' (12-a',b',c') in contrast to the minimally different root /hum/ 'hit' which doesn't trigger tonal mutation on prefixes (12-a,b,c):

(12) *Root-to-Prefix mutation for tone in Kinande (Black 1995:9)*

a. e-ri-hum-a IV-INF-hit-FV	'to hit'	a'. e-rí-tum-a IV-INF-send-FV	'to send'
b. tu-né-mu-ndi-hum-a S1PL-TNS-TNS-hit-FV	'we will hit'	b'. tu-né-mu-ndí-tum-a S1PL-TNS-TNS-send-FV	'we will send'
c. tú-li-a-hum-a-a S1PL-TNS-hit-PF-FV	'we hit'	c'. tú-li-á-tum-a-a S1PL-TNS-send-PF-FV	'we send'

Whereas in Kinande, tonal mutation adds a fixed tone on affixes, there are also cases where Root-to-Affix mutation leads to register changes for single tones. Thus in the Tibeto-Burman 4-tone language Tenyidie, many suffixes such as the Present Continuous affix /-bɑ/ show register harmony with the tone of the preceding verb base. If the root has a higher-register tone (i.e., Mid or Extra-high), the suffix is also higher, i.e., has an Extra-high tone (13-a,b). On the other hand, if the root has a lower register tone (High or Low), the suffix tone is High (13-c,d). In addition there is a small irregular class of High tone (i.e., Low-register) roots such as (13-e) which impose the high register on the suffix.

(13) *Subtonal root-to-suffix mutation in Tenyidie (Meyase 2015:67)*

a. pētắ	'drive'	pētắ-bắ	'drive'-PRS.CONT
b. rədī	'change'	rədī-bắ	'change'-PRS.CONT
c. rəlí	'rest'	rəlí-bá	'rest'-PRS.CONT
d. pēlè	'believe'	pēlè-bá	'believe'-PRS.CONT
e. kēlé	'heat'	kēlé-bắ	'heat'-PRS.CONT

		Register	
		low	high
Melody	High	V́	V̋
	Low	V̀	V̄

The same effects as for the Present Continuous /-ba/ are reported by Meyase for the Imperative suffix /-hie/, the Imperative Negative suffix /-bie/, the Progressive suffix /-ʒə/, and the Perfective suffix /-ta/ (Meyase 2015:66+67).

As argued by Meyase, this can be captured by assuming that /kēlé/ (13-e) has a final floating high register feature which associates to the tonal root node of /-bɑ/.

Length: In the Southern Nilotic language Kipsigis, specific verbs trigger the lengthening of preceding agreement prefixes as shown by the contrast between /tʃam/ 'like ' and /kat/ 'to greet' in (14).

(14) *Root-to-prefix lengthening in Kipsigis (Non-Past Imperfective forms, Kouneli 2022:6)*

	tʃám ‘to like’	kɑt ‘to greet’
1sg	á-tʃám-é	âː-kàt-í
2sg	í-tʃám-é	îː-kàt-í
3	Ø-tʃám-è	í-kàt-ì
1pl	kí-tʃám-é	kîː-kàt-í
2pl	ó-tʃám-é	ôː-kàt-í
	AGR-V-Tns	

Kouneli argues that this is the effect of a floating mora associated with the verb which either associates to a preceding vowel (if available), or is otherwise (in the 3sg) filled by epenthetic [i]. Independent evidence for this analysis comes from the fact that underlying /i/ in Kipsigis behaves phonologically in a different way. For example, it coalesces with /a/ resulting in [ɛː] (e.g., /kà-í-tʃám/ CURR.PST-2SG-like → [kéː-tʃám] ‘you liked’, Kouneli 2022:7). In contrast, the 1sg prefix /á-/ in (14) is simply lengthened without a change in vowel quality.

See appendix C for another case of vocalic Root-to-Affix lengthening in Cherokee and for examples of consonantal Root-to-Affix lengthening (gemination) in Finnish and Shoshoni.

Stress: Postaccentuation, i.e., Root-to-Affix mutation for stress has been diagnosed by many authors for Greek and Russian.[5] Thus in Modern Greek (Revithiadou 1999), there seem to be roots with fixed underlying accents in different positions (15-a,b) and accentless roots with variable accent (15-c). In contrast, nouns like /uranos/ according to Revithiadou are postaccentuating and cause stress to be realized on the following suffix (15-d).

[5]Alderete (2001) argues that post-stem accent in Russian is not the effect of root-specific post-accenting, but the default pattern of stress in Russian. We include Russian here as a (potential) case of postaccenting since Alderete’s arguments seem to be far from decisive (see, e.g., Dubina 2012 for detailed criticism, and Molczanow et al. 2019 of a summary of the literature showing that the theoretical and experimental arguments for different claims on Russian remain indecisive). Note also that Alderete’s argument doesn’t extend to Greek postaccentuation where there is broad evidence against a post-stem default (see Apoussidou 2003).

(15) *Modern Greek stress patterns (Revithiadou 1999:93+94)*

	Nominative Singular	*Genitive Singular*	*Accusative Singular*	*Nominative Plural*	*Genitive Plural*	*Accusative Plural*	
a. *Fixed* σ1 *stress:*	klívan-os	klívan-u	klívan-o	klívan-i	klívan-on	klívan-us	'kiln'
b. *Fixed* σ2 *stress:*	fantár-os	fantár-u	fantár-o	fantár-i	fantár-on	fantár-us	'soldier'
c. *Alternation penult/*σ1*:*	ánθrop-os	anθróp-u	ánθrop-o	ánθrop-i	anθróp-on	anθróp-us	'man'
d. *Postaccenting:*	uran-ós	uran-ú	uran-ó	uran-í	uran-ón	uran-ús	'sky'

See appendix C for more cases of postaccentuation and preaccentuation in Mayo, Tagalog, Aklan, and Russian.

Summary of Anticyclic Root-to-Affix Mutation: All cases of Root-to-Affix mutation in our sample are summarized in (16). Asterisks ('*') point to languages documented in appendix C. As the table shows, there are multiple examples for all mutation modalities introduced in (7).

(16) *Sample of Root-to-Affix mutation patterns*

Tone			*Vowel Quality*			*Consonant Quality*
Tenyidie	Kunama*	Kpelle (3.1)	Turkana	Moro*	Bari*	Korean
Bangime (3.3)	Mao*	Bari*	Chukchee	Ainu*		Tauya*
Barasana*	Korean*	Awa*	Hungarian*	Ik*		Fula*
Anywa*	Bari*	Cherokee*	Neve'i*	German*		Acoma*
Chichewa*	Kɔnnɪ*	Kinande	Yoruba*	Koryak*		Chimila*

Length		*Stress*	
Kipsigis (V)	Cherokee* (V)	Greek	Tagalog*
Finnish* (C)		Aklan*	Russian*
Shoshoni* (C)		Mayo*	

2.3 Affix-to-Affix Mutation

Whereas some cases of Root-to-Affix mutation have been discussed before as counterevidence against the SBM hypothesis (see Wolf 2007 on Chukchee, Apoussidou 2003 on Greek stress, and Rolle 2018 on tonal cases), there is a second major type of anticyclic mutation which has to our knowledge been so far ignored in the literature, namely a pattern where a more inwards affix triggers mutation on a more outwards affix, instantiating the structure in (17), repeated from (4).

(17) *Anticyclic affix-affix mutation, abstract*

Vowel Quality: Affix-to-Affix mutation for [±ATR] is found in the Kuliak language Ik, where several suffixes shift all more peripheral suffix vowels to [+ATR] while not affecting preceding vowels. An example is the Realis suffix /-a/ triggering a change in the Past tense suffix /-nɔkɔ/ (18). As in Turkana, the effect is unidirectional to the right. In line with the otherwise general [ATR] harmony of the language, all preceding vowels remain [-ATR] in agreement with the low vowel of the Realis suffix.

(18) *[+ATR] Affix-to-Affix mutation: Ik Realis /-a/ (Schrock 2014:90)*

a. bɛr-a-nok^{o}	'he built'	bɛr-ʊkɔ́ː-nɔkᵓ	'he built with it'
b. ƙɔ́ɗ-a-nok^{o}	'he cried'	ƙɔ́ɗ-ʊkɔ́ː-nɔkᵓ	'he cried from it'
c. dʊ́b-a-nok^{o}	'he caught'	dʊ́b-ʊkɔ́ː-nɔkᵓ	'he caught with it'

The [+ATR] mutation not only extends to both vowels of the Past suffix, but also to multiple more peripheral suffixes. This is shown for another outwards mutating suffix, Distributive /-aːk/ in (19) which turns the Intransitive Infinitive suffix /-ɔn/ (cf. [ʃɛɓ-ɔn] 'to fly away', p.320) and the Andative suffix /-ʊƙɔt/ (cf. [bʊr-ɔn-ʊƙɔt] 'to fly away', p.332) into [+ATR].

(19) *[+ATR] Affix-to-Affix mutation: Ik Distributive /-aːk/ (Schrock 2014:90)*

a. cɪ-aːk-ón-uƙot 'to become full (of multiple people)'

b. ɗɔƙ-aːk--ón-uƙot 'to become wet (of multiple entities)'

c. ɪlíɓ-aːk-ón-uƙot 'to become green (of multiple entities)'

A more complex Affix-to-Affix mutation pattern is found in the Papuan language Nimboran (Anceaux 1965, Inkelas 1993). Several suffixes such as the derivational particle suffix /-N/ trigger fronting of back affix vowels with concomitant raising and unrounding of these vowels, as shown in (20). In (20-a) the Locative suffix /-bá/ 'above' and the final 1st-person agreement suffix /-ú/ surface in their underlying forms. In (20-b), /-N/ triggers fronting of /-ba/ to [be] and unrounding for /-u/. Example (20-c) shows that vowels other than /u/ are raised to [i] in this position (and may be followed by word-final consonants). In (20-d), only the last vowel undergoes mutation because it immediately follows /-N/. Finally, (20-e,f) show that neither front vowels in general nor the subject plural suffix /-i/ trigger fronting or raising/unrounding.

(20) *Vocalic Affix-to-Affix mutation in Nimboran (Inkelas 1993:369,574,576,562,564)*

a. ŋgua-bá-k-u → ŋguábáku (p. 562)
bite-LOC-PST-1 'I bit above'

b. sá-i-N-bá-r-u → sáim-béɨ (p. 576)
drive.away.PL-SPL-PART-LOC-FUT-1 'we will drive away from above'

c. sá-N-maN-d-ám → sám-endím (p. 575)
drive.away-PART-INCL.SDU-FUT-INCL 'you and I will drive away (from here)'

d. sá-N-d-u → sán-dɨ (p. 564)
drive.away.SG-PART-FUT-1 'I will drive away from here'

e. ŋgedóu-k-se-p-am → ŋgedóukesepám (p. 563)
draw-SDU-LOC-R.PST-3.M 'they two (m.) drew recently from here to there'

f. ŋgedói-i-rár-d-u → ŋgedóiráru (p. 569)
draw.PL-SPL-LOC-FUT-1 'We (pl.) will draw them' from here to above'

Affix-to-Affix mutation for multiple vocalic features is also found in Koryak (see appendix C).

Tone: Anticyclic Affix-to-Affix mutation is also attested for tone. An example can be found in the suffix system of Margi in one of its possessive constructions (see the Chichewa and Bakweri data in appendix C for mirror image patterns with prefixes). The pronominal suffixes in point are used in different constructions, especially in predicative forms as in (21-a). In this context, the pronouns reveal an underlying tonal contrast: 1sg /-jú/ and 3sg /-ʤá/ have a consistent H-tone whereas the other suffixes show tone polarity (a H after a preceding L, and

a L after a preceding H), plausibly because they underlyingly lack a tonal specification. The /a/-possession construction is formed by attaching the suffix /-á/ to a noun and adding the same set of pronominal suffixes (21-b). The central difference is that the tone of these suffixes is now uniformly L-toned. While this might be expected for the polar set of agreement affixes (they show L after the suffix-H), it neutralizes the underlying specification of the H-tone affixes. Thus /-á/ triggers tone lowering on more peripheral affixes.

(21) *Affix-to-Affix-tone: Margi Predicative forms (Hoffmann 1963:74+78)*

	a. *Predicative forms*			b. *a-Possessive*	
	H-final base		*L-final base*		
1sg	Màrɟí-jú̩	‘I am Margi’	Həɟì -jú̩	kór-á- jù̩	‘my head’
2sg	Màrɟí-gù̩	‘you (sg) are Margi’	Həɟì-gú̩	kór-á- gù̩	‘your (sg) head ’
3sg	Màrɟí-ʤá	‘he is Margi’	Həɟì-ʤá	kór-á- ʤà	‘his head’
1du	Màrɟí-mà	‘we (du) are Margi’	Həɟì-má	kór-á- mà	‘our (du) head’

An example of Affix-to-Affix mutation *without* a concomitant segmental affix is described for the Ghanaian Kwa language Gã in Paster (2000, 2003). As can be seen in (22), tense-aspect marking is structurally inside subject agreement. For example, the 1SG-prefix /mi-/ precedes the progressive prefix /n-/ in (22-a) and the 3SG-prefix /e-/ precedes the future prefix /baá-/ in (22-b).

(22) *Verb inflection in Gã (Paster 2000, 8+10)*

a. mí-n-cha 1SG-PROG-dig ‘I’m digging’ b. e-baá-cha 3SG-FUT-dig ‘he will dig’

Gã has various constructions where morpho-syntactic features are only expressed by changing the tonal melody of the base. Interestingly, this includes some tense-aspect markers as can be seen in (23) where partial paradigms for three verbs inflected for different person and tense categories are given. The forms for Habitual, Perfective, and Simple Past only differ in the tone realized on the subject prefixes /mi-/ and /o-/. These have different tone specifications in the Habitual but are both H-toned in the Perfective, and L-toned in the Simple Past. These facts according to Paster follow straightforwardly from assuming that the Perfective is marked by realizing an additional H and the Simple Past by realizing an additional L. The different tone specifications for the subject prefixes in the habitual then simply show the underlying tone specification for these prefixes. Crucially now, if we recall that tense-aspect marking is morphologically more inwards than subject agreement (22), this is an anticyclic mutation: the tense inflection triggers a (tonal) mutation on a morphologically more outwards marking for agreement (we notate vowel nasalization here by a tilde below vowels to keep it from interfering with tone diacritics).

(23) *Gã: Affix-to-Affix tone overwriting (Paster 2003, 28-30)*

	Habitual (‘sing’) *Underlying H/L*	*Perfective* (‘dig’) *Grammatical H*	*Simple Past* (‘cultivate’) *Grammatical L*
1SG	mí-ˈlá-a	mí-_-cha	mì-_-dú
2SG	ò-lá-a	ó-_-cha	ò-_-dú
3SG	è-lá-a	é-_-cha	ò-_-dú
1PL	wɔ̀-lá-a	wɔ́-_-cha	wɔ̀-_-dú
2PL	ɲɛ̀-lá-a	ɲɛ́-_-cha	ɲɛ̀-_-dú
3PL	àmɛ̀-lá-a	àmɛ́-_-cha	àmɛ̀-_-dú
	SAGR- √-HAB	SAGR-PFV- √	SAGR-SPST- √

See appendix C for a similar though more restricted case in Gaahmg.

Consonant Quality: Anticyclic Affix-to-Affix mutation for consonantal quality is found in the Ethiopian-Semitic language Chaha. Chaha Malefactive and Benefactive object agreement markers are summarized in (24), subsegmented into a consonantal part marking case and a remainder marking person and number of the object. These object suffixes now crucially surface in one of two versions, the choice being dependent on the preceding subject marking. The so-called ‘heavy’ form surfaces after verbs with plural subject affixes, the 2.Sg.f, or the impersonal (Rose 2007, 38) and the ‘light’ form elsewhere. These forms are systematically related phonologically. Thus the Malefactive markers differ only on their feature values for [±voice] and [±cont]. The difference between the heavy and the light form of the object markers can easily be derived from assuming that the trigger suffix impose the features [-continuant-voiced] on an obstruent following them, partially ignoring intervening sonorants for which these features are non-distinctive (see Rose 2000 for evidence that [β] in Chaha is a sonorant). For example, the subject 3pl suffix /-o/ triggers hardening in the following Malefactive suffix /-β/ in [jɨ-rəxɨβ-o̲-p-a] S3-find-S3MPL-MAL-O3F ‘they find (something) to her detriment’ (cf. [jɨ-rəxɨβ-β-a] S3-find-MAL-O3F ‘he finds (something) to her detriment’ Rose 2007:40).

(24) *Consonantal suffix-to-suffix mutation: object marking in Chaha (Rose 2007, 39)*

	Malefactive		*Benefactive*	
	Light	*Heavy*	*Light*	*Heavy*
1.SG	-β-i	-p-i	-n-i	-n-i
1.PL	-β-ndə	-p-ndə	-n-ndə	-n-ndə
2.SG.F	-β-x^{j}	-β-k^{j}	-n-x^{j}	-n-k^{j}
2.PL.F	-β-xma	-β-kma	-n-xma	-n-kma
3.SG.F	-β-a	-p-a	-r-a	-r-a
3.PL.F	-β-əma	-p-əma	-r-əma	-r-əma

Consonantal Affix-to-Affix mutation also occurs for multiple features in Acoma (appendix C).

Length: In addition to the cases cited in section 2.2, where lexically specified verbs trigger lengthening, Kouneli (2022) also discusses a morphological derivation which changes intransitive verbs into causative verbs, and in turn triggers the same lengthening effect. In effect, a causative mora anticyclicliclally triggers lengthening on more peripheral agreement affixes. Since Kouneli doesn’t provide minimal pairs, we give here examples from the closely related language Nandi, which exhibits exactly the same alternations:

(25) *Nandi Causative lengthening (Creider & Creider 1989:93)*

a. kiː-á-ŋêːt áneː ‘I woke up’
PST-1SG-wake I
b. kiː-aː-_-ŋeːt kipet ‘I woke Kibet up’
PST-1SG-wake I

Stress: In parallel to postaccenting roots (cf. 2.2), Modern Greek according to Revithiadou (1999) also has a postaccentuating suffix. As can be seen in (26) the derivational suffix /-ik/ causes stress to be realized on a following suffix.

(26) *Modern Greek postaccenting suffixation (Revithiadou 1999:204)*

a. ɣál-os	‘Frenchman’	ɣal-ik-ós	‘French’
b. elvet-ós	‘Swiss’	elvet-ik-ós	‘Swiss’
√-NOM.SG		√-DER-NOM.SG	

Summary of Anticyclic Affix-to-Affix Mutation: Table (27) summarizes our sample of anticyclic Affix-to-Affix mutation. Although rarer than anticyclic Root-to-Affix mutation, there are again examples for all phonological mutation modalities introduced in (7).

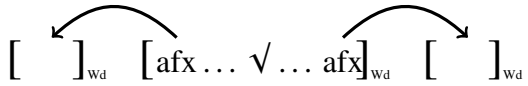
(27) *Sample of Affix-to-Affix mutation patterns*

Tone		*Vowel Quality*	*Consonant Quality*	*Length*	*Stress*
Margi	Gã	Ik *Ket	Chaha	Tamil (C)	Greek
Bakweri*	Chichewa*	Nimboran	Acoma*	Kipsigis* (V)	
Gaahmg*	Tetsǫ́t’iné*	Koryak*	Kashaya*		
Uspanteko*					

2.4 Affix-to-Word Mutation

The constitutive axiom of lexicalist approaches to morphophonology is that Phrase-level phonology strictly follows all cyclic word-internal phonology. Words are only concatenated after the application of all word-level morphology and phonology, and subsequently subject to a single joint cycle of phonology. A theorem of this architecture is that word-internal phonology cannot apply across words. Since standard Cophonology Theory adopts this strict separation and equates mutation with (construction-specific) word-internal phonology, it follows that mutation triggered by morphology inside a word $Word_1$ should never apply to any other word $Word_2$. We will call this pattern, schematically shown in (28) *Affix-to-Word mutation*. Again, we will provide crosslinguistic evidence that this type of mutation is actually attested across different phonological modalities.

(28) *Anticyclic Affix-to-Word mutation, abstract*



Paster & Kim (2011) describe different cases of this phenomenon in the Bantu language Tiriki. Several inflectional prefixes impose a High tone, not on their bases, but on the last syllable of a preceding word (29) (with concomitant insertion of a downstep triggered by the adjacent High tones). (29) illustrates this with two noun class prefixes: /à/- which marks verb-subject-agreement on verbs(29-a), and /và/- marking concord of modifiers with nouns (29-b). In both cases, the H-tone triggered by the prefix shows up on the preceding noun:

(29) *Affix-to-Word mutation in Tiriki (Paster & Kim 2011:80+85)*

a. mú-línà ‘friend’ ^{H}à-rhumúl-â: ‘(s)he is hitting’ → mú-lí$^{\downarrow}$ná à-rhumúl-â: ‘a friend is hitting’
CLS-friend CLS-hit-FV CLS-friend CLS-hit-FV

b. vá-línà ‘friends’ ^{H}và-rhá:nô ‘five’ → vá-lí$^{\downarrow}$ná và-rhá:nô ‘five friends’
CLS-friend CLS-five CLS-friend CLS-five

A near mirror image of the Tiriki pattern is found with definiteness affixes in Supyire (30) that impose a Low tone on a following word. While the segmental part of definitess marking consistently shows up as a suffix on the head noun of a DP, the L tone it triggers may appear on any right-adjacent word, a separate noun (30-a), a verb (30-b), a conjunction (30-c), or a preposition (30-d):

(30) *Affix-to-Word mutation in Supyire (Carlson 1994:59+60)*

a. ⇝ *possessed noun:* nà-ŋīⓁ ŋwɔ̄-ɔ̄-ní → nà-ŋī ŋwɔ̀-ɔ̀-ní
man-DEF knife-3SG-DEF ‘the man’s knife’

b. ⇝ *verb* cī-réⓁ pá:n → cī-ré pà:n
tree-DEF chop ‘chop a tree’

c. ⇝ *conjunction* cēè-ŋīⓁ ná ū pjà-ŋī → cēè-ŋī nà ū pjà-ŋī
woman-DEF and her child-DEF ‘the woman and her child’

d. ⇝ *postposition* ná cēè-ŋīⓁ ī → ná cēè-ŋī ì
with woman-DEF with ‘with the woman’

See appendix C for similar cases in Miya, Ciyao and Mao. That Affix-to-Word mutation is not restricted to tone is exemplified by recent work of Remijsen & Ayoker (2020) on Shilluk. Remijsen & Ayoker show that several nominal inflectional categories in the language are expressed by lengthening of the initial vowel in a right-adjacent word. The examples in (31) demonstrate this pattern for the plural. (31-a,b,c) show verb forms and a nominal modifier in their default form with an initial short vowel (the prefix /á-/ in (31-c) derives cardinal numbers from ordinal ones). Following plural nouns, these vowels become long (31-a’,b’,c’):

(31) *Shilluk Plural Affix-to-Word lengthening (Remijsen & Ayoker 2020:141-142,145, Remijsen & Ayoker 2019:7)*

a. kùl á-lîːḍà
warthog IPFV-look
‘I looked at the warthog’

b. kùl ʊ́-lîːḍɔ̀
warthog NEVP-look
‘Sb. apparently looked at the warthog’

c. á-dʌ̀k
CRD-third
‘three’

a’. tùl-_ ăː-lîːḍà
edge-PL IPFV-look
‘I looked at the foreheads’

b’. tɔ̀k-_ ʊ̆ː-lîːḍɔ̀
edge-PL NEVP-look
‘Sb. apparently looked at the edges’

c’. tɔ̂ŋ-_ áː-dʌ̀k
spear-PL CRD-third
‘three spears’

Remijsen & Ayoker argue that lengthening is morphologically a mora which functions as a plural suffix on the noun, but is phonologically realized on the first syllable of the following word. See appendix C for more Shilluk data and additional examples of Affix-to-Word gemination from Finnish and Afar. The appendix also describes Table (32) summarizes all the Affix-to-Word mutations in our sample.

(32) *Sample of Affix-to-Word mutation patterns*

Tone				*Length*	
Supyire	Tiriki	Kisi (3.2)	Miya*	Shilluk	Afar*
Kuria (3.2)	Ciyao*	Mao*		Finnish*	

2.5 Root-to-Word Mutation

In the lexicalist approach of Standard Cophonology theory, there is one further logical possibility that would violate the SBM, mutation triggered by a root in Word_1 on a different Word_2, as shown in (33):

(33) *Anticyclic Root-to-Word mutation, abstract*

Intuitively, this is the least expected mutation effect under the SBM in a Cophonology approach. Roots should not trigger mutation (since they are phonological objects, not constructions), and the lexicalist architecture of Cophonology Theory predicts that phonological processes triggered inside of words should never apply to material of other words. Again there are well-documented counterexamples to this prediction.

Probably the most detailed and prominent case of Root-to-Word mutation in the literature is tone in the Bantu language Kikuyu, introduced by the classical work of Clements and Ford (see Gjersøe 2015 for recent instrumental confirmation of Clements and Ford's fieldwork). In Kikuyu, specific nouns such as /βìrìβìrì/ 'chillies' (34-c) or /mwàɣáhìŋá/ 'weakling' (34-d) trigger downstep on the first syllable of a following word, whereas other words of similar tonal shape do not. Thus /mòβàkè/ in (34-a) has only Low tones like /βìrìβìrì/, but doesn't trigger downstep. Similarly, both /βàŋgírí/ (34-c) and /mwàɣáhìŋá/ (34-d) end in a H-toned syllable but only the latter triggers downstep. The glossing here reflects the proposal of Clements (1984) already implicit in Clements & Ford (1981) that downstep is triggered by a floating L:

(34) *Kikuyu downstep in subject + verb (Clements & Ford 1981:321)*

a.	mòβàkè tobacco.plant	né COP	mòɛ̀ɣá good	'the tobacco plant is good'
b.	βàŋgírí bangles	né COP	ɲɟɛ̀ɣá good	'bangles are good'
c.	βìrìβìrì chillies	↓né COP	ɲɟɛ̀ɣá good	'chillies are good'
d.	mwàɣáhìŋá weakling	↓né COP	mòɛ̀ɣá good	'the weakling is good'

Similar lexeme-specific Root-to-Word mutation is also extensively documented for Otomanguean languages where it is described as "tonal perturbation" (see also Cahill 2011:18 for similar data in a Papuan language, Gadsup). McKendry (2013) gives a survey of the broad literature on the phenomenon in Mixtec. We illustrate it here with data from San Miguel el Grande Mixtec (Pike 1944, 1948, Mak 1953, 1958, McKendry 2013). The examples in (35) contrast two homophonous verbs where only the one in (35-b) causes an additional H-tone on the initial TBU of the following word. The data in (36-b) and (37)-b) show that tonal perturbation is also triggered

by specific determiners and nouns. The minimally different examples in (36-a) and (37)-a) illustrate again that this is a lexeme-specific effect, not a construction-specific or phonologically predictable process. Thus both /βɛ̄ʔɛ̄/ 'house' and /nāʔā/ 'hand' are bisyllabic Mid-tone nouns preceding a possessor, but only the latter imposes a H-tone on the following noun.

(35) Verb^{H} Noun: ML → HL (Pike 1948:81)

a.	kēē	kōò	kēē kōò	Verb_{MM} Noun_{ML}
	'will go away'	'snake'	'the snake will go away'	
b.	kēē	kōò	kēē kóò	$\text{Verb}_{\text{MM (H)}}$ Noun_{ML}
	'will eat'	'snake'	'the snake will eat'	

(36) Det^{H} Noun: LH → HH (Pike 1948:80)

a.	tàká	sùčí	tàká sùčí	Det_{LH} Noun_{LH}
	'all'	'child'	'all the children'	
b.	máá	sùčí	máá súčí	$\text{Det}_{\text{HH (H)}}$ Noun_{LH}
	'that'	'child'	'that child'	

(37) Noun^{H} Noun: ML → HL (McKendry 2013:134-136)

a.	βɛ̄ʔɛ̄	jājàn	βɛ̄ʔɛ̄ jājàn	Noun_{MM} Noun_{ML}	
	‘house’	‘coyote’	‘house of coyote’		p.80
b.	nāʔā	jājàn	nāʔā jájàn	$\text{Noun}_{\text{MM (H)}}$ Noun_{ML}	
	‘hand’	‘coyote’	‘hand of coyote’		p.80

What seems to be characteristic to both Kikuyu and Otomanguean is that mutation is largely insensitive to the morphosyntactic relation between trigger and target. Thus a downstep-triggering noun in Kikuyu will induce downstepping not only on copulas as in (34), but also on full verbs (38-a), conjunctions (38-b), other nouns (38-c) and prepositions (38-d).

(38) *Kikuyu downstep (Clements & Ford 1981:315+321+322)*

a. *Noun + verb*

mwànèkì	ˡɔ̀-nír-ɛ́	‘Mwaneki saw’
Mwaneki	saw	

b. *Noun + conj (+noun)*

mwànèkì	ˡnà	njòɣóná-ɛ́	‘Mwaneki and Njuguna’
Mwaneki	and	Njuguna	

c. *object noun + object noun*

áhɛ̀irɛ́	mwàɣáhìŋá	ˡŋɟátá	‘he gave the weakling a star’
he-gave	weakling(L)	star	

d. *object noun + preposition (+noun)*

ndjɔ̀níˡrɛ́	mwàɣáhìŋá	ˡðéínè	wá	ŋómbà	‘I didn’t see the weakling inside the house’
I-didn’t-see	weakling(L)	inside	ASSOC	house	

Note that the data in (38) would be problematic for cophonology theory even if it were to abandon the assumption that postlexical phonology is non-cyclic. A central axiom of the framework is that domains of cophonologies are basically constructions corresponding to units of morphosyntax. But it is far from obvious why the occurrence of a specific noun would define a construction. In none of the cases in (38), the trigger is the head of its mutation target. Moreover in (38-c,d) the trigger and the target of downstepping don’t form an exclusive constituent. Thus even if we assume that the prepositional phrase in (38-d) is attached to the object NP, the minimal domain containing both [mwàɣáhìŋá] and [ðéínè] would comprise the noun and the complete PP (hence: [mwàɣáhìŋá ˡðéínè wá ŋómbà], roughly [[weakling]$_{\text{N}}$ [inside of [house]$_{\text{NP}}$]$_{\text{PP}}$]$_{\text{NP}}$. This would incorrectly predict that downstepping should apply to all words of this domain, not just to [ðéínè].

This makes it highly unlikely that downstepping in Kikuyu could be modeled by a rule or a cophonology applied to a specific syntactic domain in parallel to word-internal mutation. On the other hand, in an autosegmental GNA approach, downstep-triggering nouns can be modeled in just the same way as affixes triggering downsteps on their bases: by floating tones. See appendix C on more Kikuyu data, and further cases of tonal Root-to-Word mutation in Lango, Kɔnnɪ, and Awa, and section 3.1 on Kpelle.

Root-to-Word mutation also occurs for length. A well-known example is *Radoppiamento Fonosintattico* in Italian dialects, word-initial gemination which is partially triggered by phonological factors, but in many cases also by an arbitrary set of function words.[6] Thus in Tuscan, the preposition /a/ triggers gemination on following nouns (39-d) whereas neither the preposi-

[6]Phonological Radoppiamento occurs predictably after word-final stressed vowels, whereas idiosyncratic Radoppiamento is triggered by items with final unstressed vowels and cannot be predicted by phonological factors (compare, e.g., /a/ and /la/ in the examples).

tion /in/ (39-b) nor the minimally different definite article /la/ (39-c) do. Note that initial /k/ undergoes intervocalic lenition in (39-c) as other singleton plosives do.

(39) *Root-to-Word length mutation: Italian Radoppiamento Fonosintattico (Amato 2019)*

a. kasa	→	ˈkaːsa	'house'	c. la kasa	→	laˈxaːsa	'the house'
b. in kasa	→	iŋ ˈkaːsa	'in the house'	d. a kasa	→	a ˈkːaːsa	'at home'

See appendix C for additional cases of Root-to-Word lengthening in Finnish and Shilluk.

Extensive patterns of Root-to-Word consonant mutation for segmental features have been reported for Celtic languages. Thus in Welsh, the possessive pronoun /i/ triggers lenition (here: voicing) on a following word (40-b) such as the noun for 'dog', which is [ki] in isolation, whereas the numeral /tri/ triggers spirantization (40-c). Crucially, if both are combined every mutating item triggers mutation on the right-adjacent word as in (40-d).[7]

(40) *Root-to-Word consonant mutation: Welsh (Pyatt 2004:1)*

a. ki	'dog'	b. i gi	'his dog'
c. tri xi	'three dogs'	d. i dri xi	'his three dogs'

See appendix C for a case of Root-to-Word postaccentuation in Kashaya.

Just as affixes triggering mutation might lack segmental content or not, there seem to be syntactically independent triggers of mutation without a segmental component. Thus the Vocative in Shilluk is marked by a High tone at the right edge of noun phrases. That this is not an affix, but a syntactically independent element is evident from the fact that it surfaces as the last tone of whatever word is rightmost in the phrase, whether it is the head noun (41-a). an adjective (41-b), or a verb (41-c) (note that the HL falling contour in (41-b) is simplified to Mid before the morphological H, resulting in a MH contour).

(41) *Shilluk Vocative H (Remijsen & Ayoker 2019:16)*

NP final Constituent	*Noun phrase without vocative*	*Noun phrase (vocative)*	*Translation*
a. Noun	ɟùr	ɟǔr _	'Woman!'
b. Adjective	ɟùr à tɛ̂ːk	ɟùr à tɛ̄ˊk _	'Strong woman!'
c. Verb	ɟùr à nèːnɔ̀	ɟùr à nèːnɔ̌ː _	'Woman who is watching!'

A similar pattern involving tone has been recently established with meticulous empirical scrutiny for an otherwise non-tonal language, Samoan, by Yu (2021). In Samoan, Absolutive case is encoded by a High tone on the syllable immediately preceding the marked DP, regardless of the morphosyntactic affiliation of the host word (e.g., the subject in (42-a) but the finite verb in (42-b)).

(42) *Samoan Absolutive H (Yu 2021:6)*

a.	na	tala	e	le	tamá	[_	le	faitotoʔa].
	PST	open	ERG	DET	boy	ABS	DET	door

'The boy opened the door'

[7]Celtic consonant mutation is a highly complex and controversial area. Our interpretation of Celtic consonant mutation here follows the work of Wolf (2005, 2007) and especially Iosad (2012, 2014), who argues that different types of consonant mutation require substantially different analyses. Some cases are fully phonological, some instantiate cyclic mutation via featural affixes, and some are triggered by floating features on lexical items in phrasal phonology, as we assume here for the Welsh case at hand. See section 5.3 for more discussion.

b. na talá [_ le faitotoʔa] e le tama .
PST open ABS DET door ERG DET boy
'The boy opened the door'

See Yu (2021:19ff) for extensive data which show that the Absolutive-H is not tied to any specific trigger word, but appears before any determiner, (proper) noun, or pronoun which starts an absolutive DP.

A straightforward concatenativist interpretation of these cases is that the Shilluk Vocative and the Samoan Absolutive tones are morphosyntactically independent words which are phonologically defective, and hence associated to the preceding TBU by general phrase-level phonology. They might be called 'clitics', but only in the sense that their underlying form is defective by lacking segments. See Remijsen (2021) for a similar case involving length in Shilluk Associative plurals and section 3 for more tonal examples. Segmental examples might involve cases of syntactically conditioned consonant mutation in Celtic which lack an overt trigger (see, e.g., Borsley & Tallerman 1996).

Root-to-Word mutation is hence attested for all four major modalities, tone, length, segmental quality, and stress, as summarized in (43).

(43) *Sample of Root-to-Word mutation patterns*

Tone				*Consonantal Quality*	*Length*	*Stress*
Kikuyu	Mixtec	Mao*	Izon	Welsh	Shilluk (V)	Kashaya*
Samoan	Supyire (3.3)	Kpelle (3.1)	Guébie*		Italian (C)	
Seenku*	Gadsup*	Awa*	Igbo*		Finnish* (C)	
Aghem*	Lango*	Urarina*	Kɔnnɪ*		Shoshoni* (C)	
Makaa*						

What is the significance of this result for the SBM hypothesis? A possible reaction by proponents of the SBM might be to consider it a hypothesis which is strictly limited to lexical (word-level) morphophonology, but this would imply that root-to-Word mutation must be achieved by a substantially different formal mechanism from the one triggering morphological mutation. This provides effectively a parsimony argument for a concatenativist approach to mutation which would extend straightforwardly to phrasal phonology.

Alternatively, a proponent of SBM might assume an extension of the SBM to syntactic constructions, where cyclicity is generalized to phrasal phonology. Thus we might assume that functional projections play a similar role in syntax as morphological constructions including affixation in morphology. This would fit cases where functional elements such as prepositions and numerals trigger mutation on their complements (cf. the examples from Italian and Welsh above). However, there are also clear examples of root-to-Word-mutation which do not fall under this generalization. Thus the Italian wh-word /ke/ 'what' triggers Radoppiamento Fonosintattico (gemination) on a following verb as in [ke fːaj] 'what are you doing?' (Passino 2013:315), /ke/ is a function word, but in no obvious sense a functional modifier of the verb. It is rather a complement of the verb which appears in a preverbal position only in virtue of its wh-feature.[8] In fact, Kikuyu and Shilluk seem to provide near mirror-images to the Welsh and Italian cases where lexical (nominal) arguments trigger mutation on their head. In Kikuyu, as we have seen, a noun triggers downstep on a preposition and moreover on one modifying a different noun. In Shilluk, in addition to the lengthening pattern discussed in section 2.4 there is a second pattern of morphological lengthening, where specific nouns induce lengthening on a modifying numeral (see appendix C). Also root-to-Word mutation without segmental morphemes seems to exhibit this kind of symmetry: where the Shilluk Vocative-H is realized on the DP it modifies, the Samoan Absolutive-H surfaces on material preceding the Absolutive DP.

A further obvious possibility to introduce cyclicity into phrasal phonology would simply assume that phonological cycles apply generally bottom-up, where syntactic material which is embedded deeper is evaluated first. This amounts to a notion of cyclicity originally proposed in Chomsky & Halle (1968).

Counterevidence against this assumption is provided by Rolle (2018) based on data from Izon, where specific overwriting patterns are triggered not by affixes or constructions, but by arbitrary classes of lexical words, In particular, nouns and nominal modifiers (e.g., adjectives). In specific domains, only the leftmost element keeps its lexical tones, whereas it imposes an overwriting pattern on lexical material to its right. (44) shows this for the combination of attributive nominal modifiers and nouns, where the floating melody of the (leftmost) modifier replaces the underlyingly associated tones of the head nouns. Low, High, and Low-High are the only tonal overwriting melodies employed in the language.

(44) *Modifiers overwriting nouns (Rolle 2018:214)*

[8]Note that gemination is not a general feature of wh-words in Italian. Besides /ke/, also /dove/ ('where') and /kome/ ('how') trigger it. However, /kwando/ ('when'), /kosa/ ('what') and /ki/ ('who') fail to trigger gemination (Irene Amato, p.c.)

			N(L)(H)		N(H)		N(L)	
			bùrù	'yam'	námá	'meat'	wárì	'house'
Mod(L)(H)	èbì	'good'	èbì	bùrú	èbì	nàmá	èbì	wàrí
Mod(H)	ɛ̀ndì	'that'	ɛ̀ndì	búrú	ɛ̀ndì	námá	ɛ̀ndì	wárí
Mod(L)	kálá	'small'	kálá	bùrù	kálá	nàmà	kálá	wàrì

The nouns overwritten in (44) also have floating tones which in turn can overwrite when the nouns are leftmost in the appropriate phrasal context, for example if they function as objects preceding verbs:

(45) *Object noun overwriting verb (Rolle 2018:226)*

a.	N(L)(H)	bùrù	'yam'	+ fɛ́	'buy'	→	bùrù	fɛ̌	'buy a yam'
b.	N(H)	námá	'meat'	+ fɛ́	'buy'	→	námá	fɛ́	'buy a meat'
c.	N(L)	òró	'mat'	+ fɛ́	'buy'	→	òró	fɛ̀	'buy a mat'

Complex noun phrases show that in bigger domains, it is systematically the leftmost element which imposes its floating tones on the following words:

(46) *Overwriting by left-most modifier (Rolle 2018:217)*

a.

ìnè	tàrà	díbá	búrú
ìnè(L)(H)	tárá(H)	dìbà(L)(H)	bùrù(L)(H)
my	three	big	yam

'my three big yams'

b.

béí	mà꞉	bùrù
béí(L)	mà꞉(L)(H)	bùrù(L)(H)
this	two	yam

'these two yams'

Crucially, in a constellation where a modified noun precedes a verb, the tone imposed by the modifier extends to the verb:

(47) *Non-scopal overwriting of noun+verb by adjective (Rolle 2018:226)*

				N(L)(H) 'yam'	V 'plant'	
a.	Mod(L)(H)	'big'	òpù	bùrù	gbóró	'plant a big yam'
b.	Mod(L)	'small'	kálá	bùrù	gbòrò	'plant a small yam'

Under the standard assumption that nominal modifiers form a constituent with their noun ([[Adj Noun] Verb]), the prediction of Strict Base Mutation is that neither the adjective nor the noun should be able to trigger overwriting on the verb, counter to fact.

The same point can again be made with Samoan which also shows that it is not generally the syntactically less embedded words which trigger mutation on other words. Recall that it is the absolutive marker of the object which triggers mutation on a preceding subject. However, in standard analyses of VSO languages, whether they employ movement of the verb or of a VP, the object is embedded deeper than verb and subject, i.e., the structure is roughly [Verb . . . [Subject . . . [Abs-Object]]]) (see Collins 2017 for recent discussion on Samoan syntax).

In section 3, we will also see evidence for phonologically predictable alternations in the attachment of non-segmental clitics, providing further evidence against a version of the SBM generalized to syntactic constructions. The topic will be taken up more systematically in section 5 where we discuss the recent proposal by Rolle (2018) who proposes to subsume word-internal and external mutation by a general SBM requirement based on asymmetric c-command relations.

3 Alternations between Mutation Types

Under a concatenativist approach, the mutation types we have discussed so far are just descriptive categories. An affix tone attaches to another affix, not because there is any explicit,

construction-specific imperative to do so but simply as a result of concatenating floating affixal structure under adjacency to other affix material and independent phonological constraints (e.g., the requirement to associate to the left as in Gã). For this reason, we also expect cases where mutation crosscuts these categorizations and affects different targets (e.g., other words vs. other affixes) depending on the phonological context. In the following, we show that this prediction is borne out and virtually all conceivable types of such alternations are found across languages. Section 3.1 discusses alternations between different types of anticyclic mutation, section 3.2 cases where anticyclic mutation alternates with cyclic mutation. Finally, in section 3.3 we turn to a type of anticyclic mutation which is otherwise difficult to diagnose – mutation on the trigger morpheme itself – in alternation with cyclic mutation. All these alternations provide important evidence that mutation is not just allomorphy of single morphemes since it involves different target morphemes. They also demonstrate that anticyclic mutation cannot be conceptually separated from cyclic mutation. This constitutes a further variant of the empirical problem for the SBM hypothesis which assigns a special theoretical status to cyclic mutation.[9]

3.1 Alternations between different Types of Anticyclic Mutation

Root-to-Affix ~ Root-to-Word Mutation The simplest type of anticyclic mutation alternations is found with roots comprising floating features which attach to affixes or adjacent words on a first-come-first served basis. A straightforward example for this pattern is the Mande language Kpelle which has two types of low-toned nouns (48-a,b), one of which (48-b) triggers raising of low-toned suffixes to a Fall. The same effect is regularly observed after H-toned nouns (48-c) while all other nouns ending in L (or Fall, i.e., HL) (48-a,d) don't affect suffix tone. This distribution is naturally captured by assuming that nouns like /jàlà/ carry a final floating H as indicated in (48-b). Crucially, the same effect obtains if the singular (suffixless) noun is followed by a low-toned independent word such as the verb /kàà/ 'see'.

(48) *Noun classes in Kpelle (Konoshenko 2008, 24)*

		Singular	*Plural*	'I saw a . . . '	
a.	L.L	gbònò	gbònò-ɣàà	ŋ́ **gbònò kàà**	'ring'
b.	L.L^{H}	jàlà	jàlà-ɣáà	ŋ́ jàlà káà	'lion'
c.	H.H	wúlú	wúlú-ɣáà	ŋ́ wúlú káà	'tree'
d.	L.HL	yɔ̀wɔ̂	yɔ̀wɔ́-ɣàà	ŋ́ yɔ̀wɔ́ kàà	'axe'

This is an expected state of affairs in a floating-feature approach since it simply requires that the phrasal phonology treats lexical floating H's in the same way as the lexical phonology. However, it remains surprising in an amorphous account where mutation is the effect of constructions.

Alternations between Different Word Targets: Purely featural syntactic formatives, as the Shilluk Vocative discussed in section 2.5 might also alternate in the directionality of their attachment, in parallel to featural affixes. Under the lexicalist approach we presuppose here, where all mutation in phrasal phonology is anticyclic (see section 1), this is also a case of alternation between different anticyclic targets. But even if this assumption were to be abandoned, these patterns would be particularly interesting: In syntactic constructions, it is often unclear or theory-dependent what relations would count as cyclic or anticyclic (see section 5 on different proposals). Here cases of alternation are revealing since at least one of the cases will be typically anticyclic, independently of the definition of phrase-level cyclicity.

[9]Note that our use of *alternation* here is a slight extension of its standard use in theoretical linguistics. In its textbook use, *alternation* designates the fact that an abstract category (like a morpheme) has different realizations in its specific form which are predictable from its context. Here we talk about different realizations with respect to the position of a morpheme.

Tonal examples of this pattern can be found in cases of tonal associative marking. Associative (possessive) constructions in African languages are often marked by partially or purely tonal means either on the possessor or the possessum, as documented in the comprehensive typological survey of Cahill (2000). Crucially, two of the languages discussed by Cahill show a positional alternation. In Igbo (Goldsmith 1976:180ff., Clark 1990:ch.7), the possessive linking element is a High tone which shows up on the second (possessor) noun if this is LH (49-a,b), but not if it is all-L (49-c,d) and on the first noun if it ends in a low-toned syllable (49-b,d). If this syllable is already High (49-a,c), there is no overt change on the first noun. In effect, the associative tone might be realized overtly on the first (49-d) or second noun (49-a), on both nouns (49-b), or on none of them (49-c) (see appendix C for similar data from Makaa).

(49) *Igbo Associative construction (Clark 1990:253-254)*

a.	ísí	+	òké	→	ísí _ ˡóké	b.	ɔ́ðù	+	òké	→	ɔ́ˡðɔ́ _ ˡóké
	tail		rat		‘tail of a rat’		head		rat		‘head of a rat’
c.	ísí	+	èŋwò	→	ísí èŋwò	d.	ɔ́ðù	+	èŋwò	→	ɔ́ ˡðé _ èŋwò
	head		monkey		‘head of a monkey’		tail		monkey		‘tail of a monkey’

A case of alternating different word-target mutation outside of the DP domain is identified in work by Sande (2018) and Trommer (to appear) for Guébie where tonal change alternates between verbs and subjects. A similar case is again found in Igbo (see appendix C).

3.2 Alternations between Cyclic and Anticyclic Mutation

Affix-to-Base ~ Affix-to-Affix Mutation: The formation of Intransitive verbs from Transitive ones in Tamil (Dravidian) is achieved by consonant gemination either on the verb root or a following verbal suffix (Schiffman 1999, Sundaresan & McFadden 2014). The forms in (50) contrast the bare stem and the Past tense form for Transitive–Intransitive pairs. Note that the final [-u] in the bare stems in (50-a,b) is an epenthetic segment regularly found in consonant-final words. The alternations in (50-a,b) involve gemination of the root-final consonant in the Intransitive form and the allomorph [in] as Past marker. Note that there are no voiced geminates in Tamil, gemination hence involves devoicing for some sounds, as in (50-a). In (50-b), since there is nor geminated [r] in Tamil, [tː] surfaces instead. In the forms in (50-c,d), a different allomorph for the Past – /-ndʒ/ – can be found and gemination now affects the tense suffix, not a stem consonant, resulting in [ʧː]. As pointed out by Sundaresan & McFadden, in such forms, gemination always affects the first suffix directly adjacent to the stem (aspect or tense), not only the past tense suffix.

The Intransitive morpheme in Tamil hence triggers either cyclic mutation on the morphologically more inward stem or anticyclic mutation on a morphologically more outwards affix. Note that in contrast to the epenthetic [u], the underlying final stem vowels /æ/ and /i/ in (50-c,d) block gemination of the root consonant. If gemination is attributed to mora affixation, this plausibly follows from intervention of the vocalic mora.

(50) *Gemination in Tamil (Sundaresan & McFadden 2014, 2+3)*

	Transitive			*Intransitive*		
	Bare stem	*Past*		*Bare stem*	*Past*	
a.	aːg-u	aː(g-i)n-	‘become’	aːkː-_-u	aːkː–_-in-	‘make’
b.	uːr-u	uːr-in-	‘ooze’	uːtː-_-u	utː-_-in-	‘pour’
c.	oɖæ	oɖæ-ndʒ-	‘break’	oɖæ–_-	oɖæ -_-ʧː-	‘break’
d.	veɖi	veɖi-ndʒ-	‘burst’	veɖi–_-	veɖi–_-ʧː-	‘burst’

See appendix C on a tonal example of Affix-to-Base mutation alternating with Affix-to-Affix Mutation from the Mayan language Uspanteko.

Affix-to-Base ~ Affix-to-Word Mutation: In Kisi (Childs 2011), proper nouns are marked by a suffixal High. If a proper noun with an underlying final Low such as /tàmbà/ is in preverbal subject position, this H docks on the following verb, as shown by the contrast in (51).

(51) *Kisi: Raising on verb after proper noun (Childs 2011:94)*

a.	ò	kpè:ŋíá	lìá	'She shook off the bees'
	she	shake.off	bees	
b.	tàmbà-_	kpé:ŋíá	lìá	'Tamba shook off the bees'
	Tamba	shake.off	bees	

Whereas the pattern in (51) instantiates anticyclic Affix-to-Word mutation, proper noun formation in other contexts results in cyclic Affix-to-Base mutation. In isolation, utterance-finally, and in other syntactic environments, the suffix-H is realized on the proper noun itself, as can be seen in (52-a,b), where both /tàmbà/ and /sàà/ show a final H in non-subject position (the underlying tone of /sàà/ emerges in (52-c)).

(52) *Kisi: Raising of proper noun in other positions (Childs 2011:97)*

a.	hàlí	cúkál	sàá	tàmbá-_	'Hali pricked Tamba for Saa'
	Hali	prick	Saa	Tamba	
b.	hàlí	cúkál	tàmbá-_	sàá	'Hali pricked Saa for Tamba'
	Hali	prick	Tamba	Saa	
c.	sàà	cúkál	hàlí	á jùɛ̀ì	'Saa pricked Hali with a thorn'
	Saa	prick	Hali	with thorn	
d.	ɲùmá	cò	jɔ̀mndé	kìlìó	'Njuma is cutting wood'
	Njuma	AUX	wood	cut	

The examples in (52) also show that lexically H-final proper nouns such as /hàlí/ and /ɲùmá/ don't participate in the alternation. /hàlí/ does not appear with a final L in non-subject position (52-c), and /ɲùmá/ doesn't trigger raising on the following auxiliary (52-d). Childs explains this fact by the natural assumption that the suffix-H is absorbed by the final H of the base before it can be associated to a following word. Absorption (to the right) also accounts for the fact that /sàà/ doesn't host the floating H in (52-c).

In the examples so far, a non-segmental affix alternates between full realization on one morpheme (e.g., the root) and full realization on another morpheme. However, with morphological tone melodies comprising several tones, we expect that part of the alternation could also extend to more than one morpheme simultaneously. In fact, such a pattern seems to be attested in a notoriously challenging case of tonal morphology in the Bantu language Kuria. As can be seen in (53), Kuria expresses the remote future by a High tone on the third mora of the stem (which spreads to the penultimate mora by an independent phrase-level process).

(53) *Kuria Remote Future 'we will . . . ' (Marlo et al. 2015:254)*

a. 3μ-*Stems*:	n-to-re-[_ saamb-á]	'burn'	c. 5μ-Stems:	n-to-re-[_ koondókór-a]	'uncover'
b. 4μ-*Stems*:	n-to-re-[_ heetók-a]	'remember'	d. 6μ-Stems:	n-to-re-[_ hootóótér-a]	'reassure'
	FOC-1PL- √-FV			FOC-1PL- √-FV	

A natural interpretation for this distribution is given by Trommer (2022): the remote future affix is a Low Low High melody which is mapped one-by-one from left-to-right to the stem moras,

as in (54).

(54) *Autosegmental analysis of Kuria tone morphology*

L	L	H			L	L	H	
	+				¦	¦	¦	
he	e	to	ka	→	he	e	to	ka

That the tonal formative is an affix, not some type of clitic is evidenced by the fact that it applies to the stem constituent (indicated by square brackets in (53)) excluding subject agreement and tense prefixes. If the stem is too short to accommodate three tones (55), one or two of the affix tones are lost if the tensed verb isn't followed by other morphosyntactic material.

(55) *Kuria Remote Future – short stems 'we will . . . ' (Marlo et al. 2015:254)*

a. *2μ-Stems:* n-to-re-[_ romă] 'bite' b. *1μ-Stems:* n-to-re-[rj-a] 'eat'
FOC-1PL- √-FV FOC-1PL- √-FV

However, surprisingly, the LLH melody can be fully realized if the short verb is followed by additional material in the same clause (56).

(56) *Kuria Remote Future 'we will . . . ' (Marlo et al. 2015:254)*

a. *2μ-Stem:* n-to-re-[_rom-a] éɣétɔ́ɔ́ke 'bite a banana'

b. *1μ-Stem:* n-to-re-[_rj-a] eɣétɔ́ɔ́ke 'eat a banana'
FOC-1PL- √-FV banana

This set of data has been taken by Sande et al. (2020) as evidence that morphosyntactic domains must straddle the boundaries between morphology and syntax. However, as shown in a detailed reanalysis by Trommer (2022), in a concatenativist approach there is a simple more conservative approach based on an alternation between affix-base mutation and partial affix-base/affix word mutation. This is based on the assumption that in the lexical phonology, there is one-by-one left-to-right mapping (57-a) such that surplus tones remain until the phrasal phonology where they are then associated to following TBUs (57-b). Under this approach, Kuria is just minimally different from the Kisi case discussed above.

(57) *Reanalysis of Kuria phrase straddling*

a. *Word Level:* b. *Phrase Level:*

Ⓛ	Ⓛ	Ⓗ			L	Ⓛ	Ⓗ				L	Ⓛ	Ⓗ				L	L	H	
					¦												¦	¦	¦	
rja			→		rja				rja	e	ɣe	tɔ	→		rja	e	ɣe	tɔ	

3.3 Alternations Involving Tautomorphemic Mutation

There is one further type of non-base mutation. Floating material may overwrite the specification of tautomorphemic segmental material. Thus imagine an underlying root /^{H}bà/ (i.e., a segmental morpheme associated to a Low tone with a preceding floating High tone) in a language where H tones overwrite right-adjacent L-syllables. Thus the hypothetical root would consistently surface as [bá] – with a High tone. The problematic aspect about this non-alternating type of tautomorphemic docking is that there is no obvious way to distinguish it from the result of unaltered underlying representations as in our case an underlying suffix already associated to a High tone (/bá/). However, given the possibility of alternating mutation, i.e., floating material

surfacing on different morphemes contingent on phonological context, we expect to find cases where tautomorphemic mutation can be diagnosed and in fact such cases are also attested.

Root-to-Affix ~ Tautomorphemic Root Mutation: The language isolate Bangime has productive plural inflection for nouns with a suffix showing tone polarity: It bears H if the immediately preceding base tone is L and bears L if the preceding tone is H, as in (58).

(58) *Bangime Plurals (regular polarity, Hantgan 2009:77)*

	Singular	*Plural*			*Singular*	*Plural*	
a.	bʷɛ̀	bʷɛ̀-ndɛ́	'mosquito'	c.	kɛ́	kɛ́-ndɛ̀	'thing'
b.	gíjɔ̀ⁿ	gíjɔ̀ⁿ-ndɛ́	'shadow'	d.	dúːgú	dúːgú-ndɛ̀	'forest'

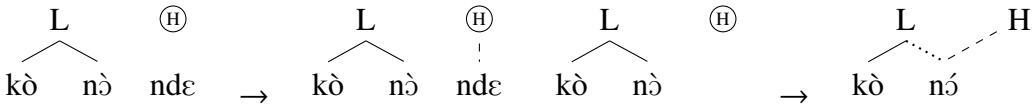
In a special class of nouns, the plural also involves a change of the final root tone. Thus /kònɔ́/ in (59-b) becomes [kònɔ̀-ndɛ́], not *[kònɔ́-ndɛ̀] (as in [kùwó] → [kùwó-ndɛ̀]).

(59) *Bangime Plurals (alternating polarity, Hantgan 2009:77)*

	Singular	*Plural*			*Singular*	*Plural*	
a.	pínà	píná-ndɛ̀	'fear'	b.	kònɔ́	kònɔ̀-ndɛ́	'doorway'
c.	dɔ́ɔ̀	dɔ́ɔ́-ndɛ̀	'paper'	d.	bẁó	bẁò-ndɛ́	'field'

As shown by Hantgan, the most natural categorization of these nouns is as carrying a final floating tone. In the plural (60-a), this tone attaches to the tonally unspecified plural affix, but in the singular the floating tone can only be realized by incestuous association to the root itself (60-b).

(60) a. *Plural* b. *Singular*



See appendix C on more tonal examples where Root-to-Affix mutation alternates with tautomorphemic root mutation in Anywa, South Kyungsang Korean, Bari, and Chichewa. Also cases of post- and preaccentuation typically involve alternations with tautomorphemic realizations (see appendix C on Aklan, Mayo, Russian and Tagalog).

Affix-to-Root ~ Tautomorphemic Affix Mutation: Under the description of Uchihara & Cano (2019), the 3pl agreement prefix in Tlapanec has a Mid tone followed by floating Low tone, which typically shows up on the following verb stem. This can be seen from comparing the 3pl form with an almost homophonous 3sg form where the prefix also has a Mid tone but no floating Low tone (61-a,b). However, with H.M roots there is free variation between realizing the L on the prefix (61-c).

(61) *Tlapanec L alternation (Uchihara & Cano 2019:33,42)*

	3sg	*3pl*	
a. *Ø.H-Root*	nī-rāhnjúːʔ	nī-ràhnjúːʔ	'feel spicy'
b. *H.Ø-Root*	nī-víjú	nī-vìjú	'whistle'
c. *H.M-Root*	nī-xpáthū	nī-xpàthū / nì-xpáthū	'hit'

This is plausibly a cumulative effect of the marked status of LH sequences in the language (unattested in underived verb stems) and the preference to maintain stem H's (which is achieved

in a simpler way in (61-a,b). See appendix C for a similar segmental case in German.

Root-to-Word ~ Tautomorphemic Root Mutation: Alternations with tautomorphemic root docking are also found for mutation across word boundaries. This is shown by mid-toned nouns in Supyire which have a floating final L overwriting the initial syllable of a following word in parallel to the floating L's of definiteness affixes discussed in section 2.4.

(62) *Supyire M◌̀ nouns: Root-to-Word mutation (Carlson 1994:57+58)*

a.	*Possessor noun*	sānɲcjɛ̄n◌̀	mɛ̄ː		→	sānɲcjɛ̄n mɛ̀ː
	⇝ possessed noun	bird	song			'bird's song'
b.	*Object noun*	cēwē◌̀	wíː		→	cēwē wìː
	⇝ verb	woman	look.at			'look at the woman'
c.	*Noun*	cēwē◌̀	ná	nɔ̀	→	cēwē nà nɔ̀
	⇝ conjunction	woman	and	man		'woman and man'
d.	*Noun*	ná	pwūn◌̀	ī	→	ná pwūn ì
	⇝ *postposition*	with	dog	with		'with a dog'

In isolation, the Low tone is unpronounced, but before a suffix with preassociated tone, it shows up on the noun root itself, either as part of a Mid-Low contour if the final syllable is stressed (63-a,c) or as a register Low supplanting the Mid on the final syllable if this is unstressed (63-b).

(63) *Supyire M◌̀ nouns: tautomorphemic ~ root mutation (Carlson 1994:54)*

	Bare noun	*+ def. suffix*			*Bare noun*	*+ def. suffix*	
a.	sīˈkā	sīˈkā̀-ŋī	'(the) goat'	b.	ˈkɛ̄rɛ̄gɛ̄	kɛ̄rɛ̄gɛ̀-ŋi	'(the) field'
c.	ˈpwūn	pwūǹ-ŋī	'(the) dog'				

A simple explanation for this pattern is that Supyire only allows floating tones at the right edge throughout the grammar. The final Low in a bare noun thus remains floating in lexical and postlexical phonology. However, the phonological systems diverge as to how they repair *non-final* floating tones. These are associated to the right in phrasal phonology but to the left in lexical phonology, resulting in tautomorphemic root docking. See appendix C for a similar non-tonal alternation involving nasalization in Seenku.

3.4 Summary

The anticyclic mutation data in our sample that involve alternation are summarized in (64).

(64) *Alternation data*

	Tone	*Length*	*Segmental*	*Stress*
Root-Affix ~ Root-Word:	Kpelle	Finnish* (C)		
	Awa*	Shoshoni* (C)		
Affix-Base ~ Affix-Affix:	Uspanteko*	Tamil (C, 2.3)	Koryak*	
Affix-Base ~ Affix-Word:	Kuria			
	Kisi			
	Ciyao*			
	Guébie			
Different Word targets:	Makaa*			
	Igbo(*)			
Root-to-Affix ~ Tautomorphemic Root:	Bangime			Aklan*
	Anywa*			Mayo*
	Chichewa*			Russian*
	Korean*			Tagalog*
	Bari*			
Affix-to-Root ~ Tautomorphemic Affix:	Tlapanec		German*	
			Koryak*	
Affix-to-Affix ~ Tautomorphemic Affix:			Nimboran(*)	
Word-Word ~ Tautomorphemic Root:	Supyire		Seenku*	

4 A Concatenative Analysis of Anticyclic Mutation

In this section, we show how anticyclic mutation can be straightforwardly captured in a concatenative approach to non-concatenative morphology. As background, we lay out in section 4.1 how the GNA approach that we adopt handles the better-known *cyclic* variant of mutation which will then be applied to anticyclic mutation in section 4.2.

4.1 A Concatenative Approach to Cyclic Mutation

Just as segmental affixation, many mutation patterns can be understood as addition of phonological material in parallel to segmental affixation. Thus the Eastern Sudanic language Gaahmg (Stirtz 2011) expresses subject agreement by suffixing (i.e., adding) tones at the right edge of the base tone, namely mid tone for non-third person, high tone for 3sg, and low tone for 3pl. This tonal addition is only obscured by general tonological alternations of the language, for example the lowering of M to L after another L (65-d). Tones affected by alternations are given in square boxes and brackets indicate phonetically vacuous repetition of tones, thus H(M)M is pronounced as HM.

(65) *Tone suffixation in Gaahmg (Incompletive) (Stirtz 2011:195)*

(Infinitive)		1sg + M	3sg + H	3pl + L	
a. fír	H	fíī̄ H-M	fír (H)-H	fîr H-L	'to smell'
b. bɛ́l̄	HM	bɛ́l̄ H(M)-M	bɛ́ĺ HM-H	bɛ̂l H(L)-L	'to name'
c. cɔ̄r	M	cɔ̄r (M)-M	cɔ̄r M-[M]	cɔ̄ȓ M-L	'to help'
d. d̰ùr	L	d̰ùr (L)-[L]	d̰ùr̄ L-[M]	d̰ūȓ [M]-L	'to bury'

Gaahmg person marking directly instantiates some of the classical arguments for the autosegmental representation of tone morphemes. The tone changes cannot be represented in a unified way by assuming tonal features such as [±rising] or [±falling], the resulting contours are simply a function of adding the tone for the person/number category to the one of the base. Similar

points can be made for other types of mutation. In Dinka, for example, 3sg is expressed by lengthening short vowels to long (e.g., [wèc] → [wèːc] '(s)he kicks'), and long vowels to super-long (e.g., [lèːr] → [lè̤ːːr] '(s)he rolls', Andersen 1992:16,28). This can be captured in a unified way by a mora affix as in (66).

(66) a. $we_{\mu}c + \mu \rightarrow we_{\mu\mu}c$ b. $le_{\mu\mu}r + \mu \rightarrow le_{\mu\mu\mu}r$

Additive mutation for segmental features can be found in Seenku where plural formation involves adding a suffixal [-back] at the right edge of the rightmost base vowel, as shown by McPherson (2017). This mutation does not trigger any change in front vowels that are already specified as [-back] (67-a,b) and results in diphthongal glide+full vowel sequences in the case of non-low back vowels (67-c,d).

(67) *Vocalic [-back] suffixation in Seenku (McPherson 2017:223+231)*

		Sg	*Pl*			*Sg*	*Pl*	
Front V stems:	a.	bi^{21}	bi^{3}	'goat(s) '	b .	$ke^{1}re^{1}$	$ke^{2}re^{2}$	'day(s) '
Back V stems:	c.	$ʃu^{3}$	$ʃwi^{3}$	'hare(s)'	d.	so^{21}	swe^{3}	'horse(s)'
Low V stems:	e.	ka^{21}	$kɛ^{3}$	'yam(s)'	f.	$kjə^{2}ba^{21}$	$kjə^{3}bɛ^{3}$	'orphan(s)'

In contrast, replacive mutation arises if featural affixation leads to phonotactically illicit feature combinations. Thus for low vowels, the Seenku [-back] affixation leads not to a glide+vowel sequence but to a [-back] monophthong as in (67-e+f). Similarly, the Irrealis prefix-H in San Miguel El Grande Mixtec (68) replaces the tone in the first syllable of the verb (McKendry 2013:45) since the language doesn't allow for contour tones.

(68) *Irrealis prefix-H in San Miguel El Grande Mixtec (McKendry 2013:45)*

	Irrealis		*Imperfective*				*Irrealis*		*Imperfective*		
a.	MM	kānī^{n}	HM	hánī^{n}	'hit'	c.	LM	kìkū	HM	kíkū	'sew'
b.	ML	kāʔà^{n}	HL	káʔà^{n}	'talk'	d.	LH	ʃìkó	HH	ʃíkó	'sell'

Since the goal of this paper is to show that anticyclic mutation can be captured under conservative theoretical assumptions (pace recent work in Cophonology Theory, Sande et al. 2020), we adopt a substantially restricted implementation of Optimality Theory – Colored Containment Theory – in line with much recent work on nonconcatenative morphology (e.g., Zimmermann 2017, Paschen 2018). See Wolf (2005, 2007) for a similar concatenativist approach to mutation couched in Correspondence Theory.

Colored Containment Theory is a conservative extension of the original implementation of OT in Prince & Smolensky (1993) with a more limited set of possible structural changes than Correspondence Theory – basically just insertion and marking for non-pronunciation – and principled modularity restrictions on the phonology-morphology interface.[10]

In the following, we provide representative analyses for the examples of replacive tone mutation in Mixtec and additive tone mutation in Gaahmg that illustrate both the Colored-Containment formalism and its application to mutation. The crucial constraints, all in substance standard constraints from the OT-literature on tone (cf. Yip 2002), are given in (69). Formally, they make use of a central distinguishing feature of Containment Theory: Markedness constraints may either refer to material marked as phonetically realized in a given candidate (indicated by underlining in constraint names as in (69-b)) or to all material in an output representation, whether marked as phonetically realized or not ('generalized' markedness constraints as (69-a)).

[10]We adopt here the autosegmental version of Colored Containment Theory (Trommer 2011), which is slightly more restrictive than versions based on Goldrick's 2001 Turbidity theory, as assumed in much early work in (Colored) Containment (see, e.g., Revithiadou 1999, Finley 2008, van Oostendorp 2007). All analyses developed here could also be implemented in a Turbidity-based version of Containment.

(69) *Constraints*

a. τ ▷ σ: Assign ∗ to every tone which is not associated to a syllable.

b. *Cont(our): Assign ∗ to every syllable associated phonetically with two different tones.

c. Max: | Assign ∗ to every morphological association line which is not phonetic.

The tableaux in (70) show how different rankings of these constraints derive additive and replacive tone mutation in Gaahmg and Mixtec. In both cases, τ ▷ σ guarantees association of a floating affix tone. Since in Gaahmg, Max | is ranked above *Contour, the affix tone is simply added to the underlying tone of the base, whereas higher ranking of *Contour in Mixtec leads to phonetic deassociation of the underlying M. Recall that under Containment, association lines cannot be literally deleted but just marked as phonetically invisible. Those are indicated here by dotted lines '. . . ' whereas inserted association lines are dashed '- - - ' and elements that are not integrated into the structure by phonetically visible lines are circled in all following depictions to ease readability. Since τ ▷ σ in contrast to *Contour is a generalized markedness constraint, it is not violated by 'deassociating' the lexical M because the association line is still present (though not pronounced), turning the floating tone's lack of association into a strategical advantage. The Containment approach thus directly derives the potential of floating features to 'dispossess' associated features, a fact which must be captured by specific constraints in Correspondence Theory (e.g., the constraints Max-Flt and *Float in Wolf (2007) and much more literature cited there).

(70) *Analyzing tone mutation*

i. *Additive mutation (Gaahmg)*

Input: = c.	τ ▷ σ	Max |	*Cont
a. fìr		*!	
☞ b. fîr			*
c. fír	*!		

ii. *Replacive mutation (Mixtec)*

Input: = c.	τ ▷ σ	*Cont	Max |
☞ a. ka ʔan			*
b. ka ʔan		*!	
c. ka ʔan	*!		

The tableaux in (70) also illustrate the second crucial ingredient of Colored Containment Theory, namely the representation of morpheme affiliation by color, a substantial restriction on the visibility of morphological structure in phonological computation. Thus the meaning or status as being a root or affix of the involved morphemes is invisible for phonology. The only information transferred from morphosyntax to phonology by colors is which phonological elements are part of the same morpheme or not (or – in the case of epenthetic material – are not part of any morpheme at all and hence colorless). Morphological color is thus broadly equivalent with the traditional notion of morpheme 'boundaries' but more adequate in an autosegmental context since it naturally allows to capture identical or different morpheme affiliation of elements on different tiers, which is difficult to represent with boundary symbols. Conceptually, colors provide a morpheme-level implementation of the Indirect Reference Hypothesis (Selkirk 1986, Nespor & Vogel 1986, Inkelas & Zoll 2005, Bermúdez-Otero 2012), which disallows direct reference to morphosyntactic information in phonological rules and constraints.

We will illustrate the use of color here with two other crucial aspects of our analysis of

mutation morphology. First, it has been often observed that floating features typically don't associate to segmental affix material that accompanies them. A simple example is tone mutation triggered by the indefinite plural suffix in Dzùùngoo (McPherson 2017, Solomiac 2014), shown in (70).

(71) *Dzùùngoo overwriting with segmental affix (McPherson 2017:222, Solomiac 2014)*

a. mòdzīn + ^{H} ì → [mòdzín]-ì̲/*mòdzìn-í 'people' b. vì + ^{H} ì → [ví]-ì̲/*vì-í 'dogs'

If, as argued by McPherson, raising is triggered by a floating High tone, it could in principle dock either to the suffix or the root, illustrated in (71). In both cases, it would overwrite a tone underlyingly associated to a TBU. This tie is naturally resolved by the constraint ALTERNATION developed by van Oostendorp (2007) to account for Derived Environment effects (see Trommer 2022 for discussion of this constraint in accounting for mutation), defined in (72).[11]

(72) ALTERNATION: Assign ∗ to every epenthetic association line which connects two nodes of the same color.

The tableau in (73) shows how ALTERNATION determines directionality of association by penalizing association of the floating H to the tautomorphemic suffix (73-c) which shares the same color. Since contour tones are illicit in Dzùùngoo (73-b), stem overwriting emerges (73-a).

(73) *Heteromorphemic overwriting in Dzùùngoo*

Input: d.	τ ▷ σ	ALTERNATION	*CONTOUR	MAX |
☞ a. (L) H L | vi i				*
b. L H L | vi i			*!	
c. L H (L) | vi i		*!		*
d. L (H) L | vi i	*!			

Crucially, the preference for heteromorphemic feature association is not special to mutation. ALTERNATION also explains the often made observation that autosegmental material stranded by deletion relinks to the 'segment which triggered it' (Clements & Ford 1979, p.207/fn.18). As shown by van Oostendorp (2007), ALTERNATION captures a substantial part of what has been traditionally called *Nonderived Environment Blocking*. An example is the fact that tone spreading is often restricted to apply across morpheme or word boundaries (Myers 1997).

Morphological colors also allow for a simple account of different types of across-the-board mutation. Thus Trommer (2024) shows that the standard cases of tonal overwriting for entire stems and syntactic phrases by a single tonal melody can be directly captured by tonal circumfixes, a phenomenon also robustly attested outside of overwriting (see, e.g., Pulleyblank 1986 on Tiv, Clark 1990 on Igbo, Hyman & Ngunga 1994 on Ciyao, and Trommer 2024 on Asante Twi). In tandem with a high-ranked CONTIGUITY constraint penalizing phonetically realized tones of

[11] In contrast to the ALTERNATION account, Wolf (2005, 2007) captures the ban on tautomorphemic docking by a specific constraint. NOTAUTOMORPHEMICDOCKING much in the spirit of Colored Containment Theory; NOTAUTOMORPHEMICDOCKING refers to both morphemic affiliation and underlying representations. In contrast to ALTERNATION, it doesn't generalize to Derived-Environment effects outside of mutation.

a different color between tautomorphemic tones, tonal circumfixes are effectively enforced on embedded constituents. While circumfixation seems to be the right approach for standard cases of tonal overwriting, it doesn't extend to anticyclic overwriting since circumfixation is inherently cyclic. Moreover, there are also cases of cyclic overwriting in segmental phonology which have a directional character that cannot be captured naturally by circumfixes.

Thus in Terena, 1sg possession or agreement is expressed by nasalizing the first segment of the base word. Crucially, the morphological nasal feature spreads up to a blocking oral stop (74-a,b), or, in absence of the latter, up to the end of the word (74-c,d) although the language otherwise doesn't have nasal harmony (Bendor-Samuel 1960, Akinlabi 1996).

(74) *Terena 1sg nasalization*

a. ituke	'his (pron.)'	_	ĩ^{n}duke	'my (pron.)'	c. ajo	'his brother'	_ ãjõ	'my brother'
b. owoku	'his house'	_	õwõ^{n}gu	'my house'	d. emoʔu	'his word'	_ ẽmõʔũ	'my word'

'Morphemic harmony' (Finley 2009) of this kind has been a major argument for positing morpheme-specific constraints as in the Terena analyses of Finley (2009) and Akinlabi (1996) . In contrast, the only additional constraint type we need to account for it is one against proper spreading of underlyingly associated features, formulated for [nasal] in (75). As Alternation, it refers to abstract color, not to particular morphemes or constructions.

(75) *Spread [nasal]: Assign ∗ to every [nasal] feature which is linked
to at least one segment by a colored (underlying association line
and to at least one segment by a colorless (epenthetic) association line.

With *Spread [nasal] ranked above the harmony-triggering constraint (here: Share [nasal]: 'Assign ∗ to every pair of adjacent segments not sharing a nasal feature', McCarthy 2011, Kimper 2011), nasal agreement is effectively restricted to mutation contexts as in (76-i) but excluded for underlyingly associated [nasal]-features (76-ii). n ▷• is defined absolutely parallel to τ ▷ σ and demands that every [nasal] is associated to a segmental root node (= •). Dep |, on the other hand, is the counterpart to Max | penalizing inserted association lines between underlying elements.

(76) *Terena*

i. *Spreading under mutation*

Input: = c.	n ▷ •	*Spr [n]	Shr [n]	Dep |
☞ a. n: ã j̃ õ				***
b. n: ã j o			*!	*
c. (n): a j o	*!			

ii. *No spreading for underlying nasal*

Input: = c.	n ▷ •	*Spr [n]	Shr [n]	Dep |
a. n: ũ n ã		*!		**
b. n: ũ n a		*!	*	*
☞ c. n: u n a			**	

After demonstrating how the GNA approach accounts for both additive and replacive cyclic mutation, the following section will show how it naturally predicts different types of anticyclic mutation and hence patterns that violate the SBM.

4.2 GNA-Analysis of Anticyclic Mutation

Crucially, anticyclic mutation in a GNA account follows from the same mechanisms as its cyclic counterpart. Tableau (77-a) illustrates this for the Kinande verb root /tum/ which imposes a H-tone on the preceding prefix (Root-to-Affix mutation) resulting in [e-rí-tum-a] 'to send' (cf. (12)) and (77-b) for the Margi form /kə́r-á-Ⓛjṵ́/ → [kə́r-á-jṳ̀] 'my head' (Affix-to-Affix mutation) where the possession affix /-a/ triggers overwriting of the underlying H on 1sg /-ju/ by L. The rankings achieving this are only minimal variants of the ones outlined for cyclic mutation in section 4.1.

(77) *Anticyclic heteromorphemic overwriting*

i. *Kinande*

Input: d.	τ ▷ σ	Alt	*Cont	Max |
Ⓛ H L L ☞ a. rí tùm à				*
L H L L b. rí tùm à			*!	
L H Ⓛ L c. rì túm à		*!		*
L Ⓗ L L d. rì tùm à	*!			

ii. *Margi*

Input: d.	τ ▷ σ	Alt	*Cont	Max |
H H L Ⓗ ☞ a. kər á jù				*
H H L H b. kər á jǔ			*!	
H Ⓗ L H c. kər à jú		*!		*
H H Ⓛ H d. kər á jú	*!			

Root-to-Word and Affix-to-Word mutation raise the question of how lexical and phrasal phonology interact. Recall from section 1 that we (as the Cophonology literature) adopt the conservative Lexical Phonology position that they form different subgrammars as in Stratal Optimality Theory. Hence the constraint rankings of lexical and phrasal phonology may differ, and the outputs of lexical phonology are fed into phrasal phonology (Kiparsky 2000, Bermúdez-Otero 2018, see also McCarthy & Prince 1993, Myers 1997 for the same assumption). Further, following Trommer (2011, 2024), Paschen (2021) we adopt the Colored-Containment equivalent of Bracket Erasure – Monochromization: At the transition from Word Level to Phrase Level all morphemes of a single word are assigned a common but unique new color. In effect, color at the Phrase Level does not distinguish roots and affixes, but (possibly complex) different words.

In (78-a), we illustrate this with Root-to-Word mutation in Mixtec. This takes place in the phrase-level phonology presupposing previous runs through the lexical phonology for the single involved words which has effectively preserved the floating features from their lexical entries. At the phrase level, Alt is ranked above τ ▷ σ to ensure that floating features are not associated to the same word in forms where the word is utterance-final , as shown here for nāʔāᴴ + jājàn 'the coyote's house' and nāʔāᴴ 'house' in isolation (78-b).

(78) *Mixtec floating tone*

i. *Heteromorphemic association*

ii. *Non-realization in 1-word utterance*

Input: d.	Alt	*Cont	τ ▷ σ	Max |
☞ a. nā ʔā ja jàn				*
b. nā ʔā ja jàn		*!		
c. nā ʔā ja jàn	*!			*
d. nā ʔā ja jàn			*!	

Input: b.	Alt	*Cont	τ ▷ σ	Max |
a. nā ʔā	*!			
☞ b. nā ʔā			*	

Whereas the direction of association in all examples so far has been fully determined by Alternation, it isn't sufficient for cases where a featural affix without segmental content is 'trapped' between two comparable hosts, as in Gã /mí-Ⓛ-dú/ → [mì-dú] 'I cultivated' (section 2.3). We assume that ties like this are resolved by constraints on linear directionality of docking such as the one in (79) deriving left-association of the tense-Ⓛ in (80).

(79) *Assoc-R: Assign ∗ for every pair of elements A and X that are associated in the output but not in the input if A precedes B and B is associated to X in the input.

(80) *Gã: Outwards mutation due to directionality*

Input: d.	Alt	*Cont	*Assoc-R	τ ▷ σ	Max |
☞ a. mì dú					*
b. mǐ dú		*!			
c. mí dù			*!		*
d. mí dú				*!	

In fact, floating material in Gã associates to the left more generally. Thus Paster (2003) shows that the floating negative H suffix always associates to the left (the root), not the right (the TAM suffix), e.g., negative perfective /é-kánè-Ⓗ-kɔ̀/ → [é-kán↓é-_-kɔ̀] 'he has not counted' (Paster 2003:34)

Also anticyclic across-the-board mutation can be modelled in parallel to its cyclic counterpart. We illustrate this point with Nimboran. The constraints and the ranking here are almost completely analogous to the Terena evaluations in section 4.1. Floating features result in multiple association, not available to underlyingly associated features due to the definition of *Spread constraints.

Tableau (81-i) is a simplified evaluation (omitting consonants and root vowels) for across-the-board mutation examples like ((20)-c) /sá-N-maN-d-am/ → [sá-m-endím]) where the floating [-b(ack)] affix fronts the penultimate and ultimate vowel. Association of [-b(ack)] to

a segmental root node is enforced by the constraint -b ▷ • (excluding (81-i-d)), which in turn activates the necessity for multiple linking by virtue of Sh(a)r(e) [-b(ack)] (excluding (81-i-c)). The only independent complication here is the additional raising of the ultimate vowel in Nimboran, which we capture as a phonological side effect of fronting. This fronting is triggered by the constraint Anchor$_R$ (-back,+high) which requires the rightmost segment of a [+back] span to also carry the feature specification [+high], violated by (81-i-b).[12] See Smolensky & Legendre (2006) for similar conditions on high vowels in [ATR]-harmony. Tableau (81-ii) is the schematic evaluation of examples such as ((20)-e) [ŋgedóukesepám] where underlying front vowels (i.e., preassociated [-back]) do *not* spread.

(81) *Nimboran apophony*

i. Multiple association of floating [-b(ack)]

Input: = d.	-b ▷ •	*Spr [-b]	Anch$_R$ (-b,+h)	Shr [-b]	Dep
☞a. -b (+h) e ɪ					**
b. -b e e			*!		**
c. -b e a				*!	*
d. (-b) a a	*!				

ii. No spreading of underlyingly associated [-b(ack)]

Input: = c.	-b ▷ •	*Spr [-b]	Anch$_R$ (-b,+h)	Shr [-b]	Dep
a. -b (+h) e ɪ		*!			*
b. -b e e		*!	*!		*
☞c. -b e a				*	

Again this is completely analogous to the corresponding Terena evaluation in section 4.1. *Spread [-back] blocks further association of a feature which already has an underlying association line (cf. the explicit definition of the analogous constraint *Spread [+nasel] in (75)).

Under our approach, also alternating patterns directly follow from the same constraints as consistent cyclic and anticyclic mutation. In fact, we assume that in many cases the absence of alternations is just a collateral effect of morphological and syntactic combinatorics. Thus (non-alternating) Root-to-Affix mutation in Korean is due to the fact that verbal roots in the language are generally bound – they are always followed by at least one suffix, i.e., a potential host for its floating features. The same picture also holds, although for slightly different morphological reasons, for the Margi possessive suffix and the Gã negation tone and of course for the bulk of cyclic Affix-to-Root mutation since bound affixes by definition require a host. On the other hand, alternating cases like Kisi exhibit morphosyntactic contexts, where the floating elements lacks a host (the floating H of noun roots associates to the root itself in absence of an affixal host).

The affix tone associates to the right if possible but leftwards in absence of an adequate host, it is crucial that τ ▷ σ outranks *Assoc-L (=*| L) so that association is rightwards if there is an appropriate segmental host (82-i), but otherwise to the left as a last resort (82-ii).

(82) (i) *Kisi anticyclic mutation* (ii) *Kisi cyclic mutation*

[12] A span is understood here as feature with epenthetic association lines plus all the segments to which it is associated.

Input: d.	*Cont τ ▷ σ	*| L	Max |
☞ a. L H Ⓛ H | | | tàm bà kpé: ŋjá			*
b. L H L H | | | tàm bà kpě: ŋjá	*!		
c. L H L H | | | tàm bà kpé: ŋjá		*!	*
d. L Ⓗ L H | | | tàm bà kpè: ŋjá	*!		

Input: c.	*Cont τ ▷ σ	*| L	Max |
☞ a. L H | | tàm bà		*	*
b. L H | | tàm bà	*!		
c. L Ⓗ | | tàm bà	*!		

In Kisi as in several other cases prosodic boundaries seem to play a role in alternations (see, e.g., Tebay 2019 on the claim that in Nimboran vocalic mutation doesn't extend to root morphemes since these constitute independent feet). Thus the fact that the Proper Noun-H doesn't spread to a right-adjacent object is plausibly due to an intervening phonological phrase boundary. We assume that blocking of association in these cases is due to high-ranked Crisp-Edge constraints (Ito & Mester 1999, Kaplan 2018) but won't go into any details here due to reasons of space.

Alternations between word-internal and -external mutation also follow under the assumption made here that they form consecutive OT-evaluations. We illustrate this with Supyire. Recall that in Supyire, roots with floating L-tones show additive heteromorphemic association if they are followed by a right-adjacent morpheme (an affix) word-internally (e.g., /pwūnⓁ-ŋi/ → [pwūǹ-ŋi] 'the dog', ((63)-c)), but overwriting rightwards association if they are followed by an independent word (/ná pwūnⓁ ī/ → [ná pwūn ì] 'with a dog (with)', ((62)-d)). Otherwise, if no other word follows the floating L is not overtly realized (/pwūnⓁ/ → [pwūn] 'dog', ((63)-c)). We capture this by different constraint rankings in the respective phonological grammars. Thus we assume that at the phrase level, Alt is undominated and hence above τ ▷ σ. This predicts rightwards association on a following word (83-i) and otherwise non-realization of the floating Ⓛ (83-ii).

(83) *Supyire phrase-level phonology*

(i) M Ⓛ M → M L

Input: c.	Alt	τ ▷ σ	Max |
☞ a. pwūn ì			*
b. pwùn ī	*!		*
c. pwūn ī		*!	

(ii) M Ⓛ → M

Input: c.	Alt	τ ▷ σ	Max |
a. pwūn	*!		*
b. pwūn	*!		*
☞ c. pwūn		*	

At the word level we face an apparent paradox: Word-final Ⓛ obviously remains unassociated at this stratum, hence τ ▷ σ must thus be ranked relatively low. This effect, however, cannot be due to Alt since homomorphemic self-association is obligatory in suffixed forms. Instead, this follows naturally from the constraint *Ⓣ τ ('Assign ∗ to every floating tone followed by a non-floating tone'), introduced by Trommer (2022) to capture autosegmental left-to-right association (Goldsmith 1976, Yip 2002). In conspiracy with high-ranked Max | and *Assoc-R, *Ⓣ τ leads to additive self-association (84-i). Crucially, *Ⓣ τ remains unviolated in the absence of a suffix, and hence Ⓛ stays afloat word-finally (84-ii).

(84) *Supyire word-level phonology*

(i) MⓁ-X → ML-X

Input: c.	*Ⓣ τ	Max |	*Assoc-R	Alt	τ ▷ σ
a. pwūn ŋ̀		*	*!		
☞ b. pw ū n ŋ̄		*		*	
c. pwūn ŋ̄	*!				*

(ii) MⓁ → MⓁ

Input: b.	*Ⓣ τ	Max |	*Assoc-R	Alt	τ ▷ σ
a. pwūn				*!	
☞ b. pwūn					*

5 Discussion: Concatenative vs. Construction Approaches to Mutation

In the preceding sections, we have shown that SBM is extensively violated crosslinguistically and across all relevant phonological modalities. There are not only cases of outright anticyclic mutation (section 2), but also alternations between the anticyclic and cyclic variant (section 3), indicating that they are not formally different phenomena. Maybe most strikingly, some cases of mutation just apply according to simple phonological directionality, regardless of hierarchical structure. Thus in Gã, tonal mutation applies always to the left whether it targets more internal or more peripheral material (see appendix C on Anywa tone which exhibits basically the mirror generalization to the left and Acoma which shows the same phenomenon for seg-

mental features). Analytically, we have shown that a simple autosegmental approach based on non-segmental affixation derives all the observed patterns in our language sample without any additional assumptions and fully in parallel to cyclic mutation.

Our data also strengthen an argument against optimality-theoretic construction-grammar approaches raised by Zimmermann (2017) against the claim of Inkelas (1998) where mutation is the effect of phonological markedness constraints: Many cases of anticyclic mutation are phonologically non-optimizing. For example, tone mutation as in Supyire leads to marked word-internal contour tones and Acoma and Korean mutations create marked (aspirated, palatalized, glottalized) consonants. Similarly, Ik and Turkana vowel mutation creates round mid vowels, which are arguably more complex than the otherwise expected low unround vowels and these patterns also break up the otherwise general pattern of ATR-harmony in the two languages. In Construction Phonology, all these patterns are unexpected since mutation is supposed to be derived by exactly the same phonological constraints which also capture regular phonological alternations. On the other hand, in a concatenativist setting, markedness increase and decrease should both be possible as long as they correspond to a possible underlying representation.

To complete our argument against SBM and construction-grammar approaches to mutation, we will now discuss recent proposals trying to salvage the SBM either by assuming a non-lexicalist notion of the cycle (section 5.1) and/or by the assumption that SBM is not an absolute restriction on all possible mutation processes but only limits a well-defined subset of mutation phenomena (5.2). We will consider several closely related versions of these claims and argue that they are also untenable given the empirical evidence presented in this paper.

5.1 Alternative Interpretations of the Cycle

In our discussion above, we have presupposed three of the classical premises of Lexical Phonology. (i) Word-level morphology strictly precedes syntax and Phrase-Level phonology (ii) Word-internal morphophonology is internally cyclic. Word-internal cycles are defined by affixes successively added to roots. (iii) Phrase-level phonology is non-cyclic. These hypotheses are adopted in the classical work on Cophonology Theory leading to the problems for the SBM identified above. However, recent work in Cophonology has argued that non-lexicalist notions of phonological cycles may obviate these problems.[13]

5.1.1 Phase-based Cycles: Sande et al. (2020)

The most recent variant of construction phonology, Cophonologies by Phase (Sande et al. 2020), provides a radical departure from earlier versions which embraced SBM. Sande et al. explicitly take the Kuria data discussed above (section 3.2) as evidence for a model where inner material *can* have effects on outer material – as long as they are introduced in the same syntactic phase. At the same time, they take these very data to show that domains of cophonologies may be nonisomorphic to the ones predicted by classical lexical architectures (words and phrases). This follows in the account from the combination of phases with the second – logically independent – assumption that words are not formed in the lexicon but in the syntax. There are thus syntactic phases contained inside of words and phases that are limited simultaneously by word-internal and phrasal boundaries, especially a phase triggered by the category-defining head 'v' ('little v', see Embick 2021 and references cited there), or Voice, which might include a verb root with lower affixes and complements but exclude affixes corresponding to higher functional structure in the clause

[13] We do not discuss here the possibility to formulate Strict Base Mutation in a version of Stratal OT where cycles coincide with strata (i.e., where there are no stratum-internal cycles, Bermúdez-Otero 2018). To our knowledge this has never been proposed as a general approach to mutation morphophonology in the literature, and it is unclear to us how it would look like in detail. However, it seems that this approach would incorrectly predict that Affix-to-Word mutation (section 2.4) and Root-to-Word mutation (section 2.5) should be impossible since word-internal phonology in Stratal OT cannot have an effect across word boundaries.

This is a special case of Sande et al.'s general claim on morphophonology in (85), which for anticyclic mutation amounts to the corollary in (86). This is in effect the phase-based residue of the SBM-hypothesis endorsed by Sande et al..

(85) *The Phase Containment Principle (Sande et al. 2020:19)*
Morphological operations conditioned internal to a phase
cannot affect the phonology of phases that are not yet spelled out.

(86) *Phase-based Locality Generalization on Anticyclic Mutation:*
Targets of anticyclic mutation must be part of the phase
where the mutation trigger is spelled out.

The data in our survey provide evidence that anticyclic mutation is not generally bound by phases. We illustrate this with the two types of phases invoked by Sande et al., which can be most easily identified empirically: major lexical categories and DP's.

Lexical Categories and Roots: In the grammatical architecture adopted by Sande et al., roots of major lexical categories (i.e., nouns, verbs, etc.) are assumed to be categoryless and receive a specific morphosyntactic category only by syntactic merge with a category-defining functional head (little n, little v, etc.). These category-defining heads according to Sande et al. trigger spellout (see their analysis of Hebrew nouns and verbs), hence induce phases including their roots before higher-level material is added. This directly implies that roots should not be able to trigger mutation effects outside of minimal stems. But, as we have seen in our survey (see section 2.2), roots have effects on a wide variety of affix types, which should be outside the category-defining heads. Examples include:

- Greek noun roots trigger stress on case suffixes
- Kipsigis verb roots trigger lengthening on agreement prefixes
- In Tenyidie, verb roots trigger subtonal changes on TAM suffixes
- Kɔnnɪ noun roots trigger tone mutation on nominal number suffixes (appendix C)
- Yoruba verb roots trigger [+ATR] on nominalizing prefixes (appendix C)

Noun Phrases (DP's): With much of the minimalist syntactic literature, Sande et al. posit that full nominal projections, DP's, are phases and should hence disallow DP-internal material to trigger mutation on outside material. Virtually all cases of Root-to-Word mutation in section 2.5 which are triggered by nouns or determiners are counterexamples to this prediction, e.g.:

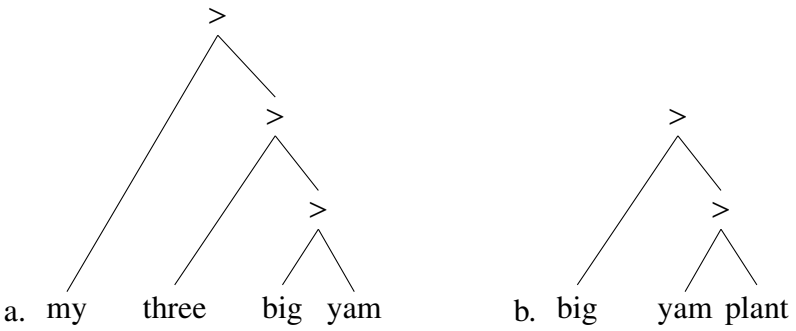
- In Supyire, determiners which are final in their DP trigger tone changes on following nouns, verbs or conjunctions, hence material clearly outside their DP's.
- The Italian case where a wh-pronoun, presumably also of the category D triggers gemination on a following verb, externally to its own, minimal, DP projection.
- In Kikuyu, the head noun of a DP triggers downstep on a following conjunction, preposition, or the head noun of a following independent DP, as discussed in detail above.
- In Kpelle, object nouns trigger alternations on following verbs.

Thus in many cases, Phases are apparently a too small domain for capturing anticyclic mutation. Complementarily, Trommer (2022) shows for one of Sande et al.'s major case studies of anticyclic mutation, verbal tone in Kuria, that the Cophonologies by Phase approach predicts a too wide domain (a CP, hence an entire clause) for the application of tonal mutation. Taken together, the phase-based version of the SBM while avoiding specific pitfalls of the lexicalist version seems to create new empirical problems for the hypothesis.

5.1.2 Cyclicity via postsyntactic C-command: Rolle (2018)

Rolle (2018) adopts a Distributed Morphology approach where phonological cyclicity is defined not on syntactic representations, but on a postsyntactic spellout tree encoding only the asymmetric c-command relations between vocabulary items (≈ the postsyntactically inserted morphemes). Thus the syntactic representation of Izon [ìnè tàrà díbá búrú] 'my three big yam' discussed in section 2.5 (see example (46)) is converted to the simplified structure in (87-a), where '>' indicates asymmetric c-command. Crucially, in the algorithm he proposes, vocabulary items corresponding to heads are higher than their complements, specifiers higher than the phrases to which they are adjoined. Also specifiers of specifiers are higher in the spellout tree than their complements (see Rolle 2018 on a detailed derivation by asymmetric c-command in the sense of Kayne 1994). Under this analysis, the Izon case discussed above [òpù bùrù gbóró]] 'plant a big yam' (47) has no longer the problematic cyclic structure [[big yam] plant] for the purposes of phonology, where the adjective /òpù/ 'big' imposes tone anticyclically on the verb /gbóró/. Under the plausible assumption that the adjective is a specifier of the noun and the NP comprising both is in a specifier position above the verb, this structure results in the representation in (87-b), where the effect of 'big' on 'plant' is in accordance with Strict Base Mutation:

(87) *Asymmetric c-command tree for Izon (Rolle 2018:218)*



Rolle's proposal elegantly solves the problem for SBM in the Izon case. Still we remain skeptical about postsyntactic spellout trees as a general approach to cyclicity since it implies that phrasal phonology is inherently cyclic. However, as decades of research in Lexical Phonology and Stratal OT have shown, there is only little prima facie evidence for cyclicity in Phrase Level phonology (see, e.g., Bermúdez-Otero 2018 for an overview).[14] Virtually all cases of putative phrase level cyclicity reported in the literature are tonal or at least prosodic, most of them cases of tonal overwriting triggered by morphosyntactic categories or specific lexical items (see, e.g., McPherson & Heath 2016 on Dogon and Harry & Hyman 2014 on Kalabari). Rolle's cyclic approach naturally predicts grammatical tone of this type. However, Trommer (2024) demonstrates that tonal overwriting can be captured fully in parallel in Colored Containment. Thus cyclic tonal overwriting per se doesn't provide clear evidence for cyclicity in phrasal phonology. On the other hand, there are no reported cases of fully general *segmental* sandhi processes in phrasal phonology which exhibit signs of cyclicity. Here there is a clear typological gap which is unexpected under phrasal cyclicity.

Even in tonal phonology, the most plausible cases for cyclic phrasal sandhi processes reported in the literature don't seem to fall in line with the c-command-based version of cyclicity proposed by Rolle. We will illustrate this with the best-established case for Phrase-Level cyclic-

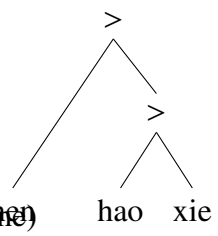
[14] The major argument in SPE (Chomsky & Halle 1968) for phrase level cyclicity is the fact that phrasal stress reflects syntactic constituency. Prosodic Phonology (see Selkirk 2011 for an overview) derives these effects without cyclicity from mapping syntactic structure to units of the prosodic hierarchy. Note also that the issue of phrasal cyclicity is in principle independent from recursivity. Thus the Match Theory version of Prosodic Phonology advocated by Selkirk (2011) embraces fully recursive prosodic representations which allow for phonetic sensitivity to recursive embedding (see, e.g., Wagner 2005), but the phonological evaluation of constraints applies in parallel.

ity, Mandarin tone-3 sandhi, where the tone of a tone-3 word is changed to tone 2 if immediately followed by another tone-3 word (e.g., *hao*3 *jiu*3 → *hao*2 *jiu*3 'good wine', all data from Chen 2021). This process apparently applies cyclically. However, structures with internally modified preverbal modifiers exhibit left-branching cycles, as expected by traditional constituent-based cyclicity. Thus in the example in (88), where the verb phrase should have essentially the same structure as in the Izon case in (87-b), sandhi applies first in the modifier phrase [*hen*3 *hao*3] (88-a), and only afterwards on the entire VP changing the tone of *hao*3 before *xie*3 (88-b) (*bi*3 keeps its tone because at this point the following word has tone 2). In contrast, under the c-command-based algorithm, we would expect that the relevant structure for cyclic evaluation is the tree in (88-c), since *hen* is presumably the specifier of the specifier of *xie* in parallel to ((87)-b). This incorrectly predicts that [hen3 > [*hao*3 > *xie*3] becomes *[hen3 > [*hao*2 > *xie*3] which is not further modified by sandhi because the only tone-3 word to its right ([*xie*3]) is separated from it by an intervening tone-2 syllable:

(88) *Cyclic application of Tone-3 Sandhi (Kaisse 1985:173)*

[[[zhei zhi] bi]$_{NP}$ [[hen hao] xie]$_{VP}$]						
this	CLAS	pen	very	good	writes	
Underlying tone:	4	1	3	3	3	3
a. Cycle 1:	4	1	3	[2	3]	3
b. Cycle 2:	4	1	3	[2	2	3]

(= output tone)



'This pen writes very well'

The same problem with left branching for a c-command-based approach to cyclicity also shows up in compounds. In left-branching compounds in Izon, the left-most noun imposes its tone pattern on the remainder of the compound.

(89) *Non-scopal overwriting of NP by embedded noun (Rolle 2018:219)*

[[òsǐ Ⓛ Ⓗ námá Ⓗ] wárì Ⓛ] → òsì nàmà wárí 'a snail-meat house'
snail meat house (a house/place where there is snail-meat)

Rolle derives this by the assumption that the non-head modifier of a compound is syntactically its specifier. Hence *snail* in (90) is the specifier of *meat* and the specifier of the specifier of *house*, resulting in the c-command tree ([snail > [meat > house]], ensuring overwriting by the tonal melody of snail. However, again, the cyclic structure of Mandarin tone-3 sandhi is markedly different, as shown by the example in (90), which follows standard cyclicity. Tone-3 sandhi is apparently first applied to the complex non-head constituent ([[water3 color3] and subsequently to the entire compound:[15]

[15]Note that the standard type of cyclicity apparent in (90) is also the one which is argued for by Duanmu (1999) for Shanghai in one of the most stringent arguments for systematic cyclicity in compounding found in the linguistic literature. The same version of cyclicity is also applied in SPE (Chomsky & Halle 1968) to account for compound (and phrasal) stress. Finally, this approach to cyclicity is also assumed in arguments that applications of the Rhythm Rule in English compounds and phrases are cyclic (Prince 1983, Kaisse 1985, Gussenhoven 1991).

(90) *Cyclic application of Tone-3 Sandhi in compounds (Kaisse 1985:170)*

	[[shui	cai]	bi]	'water color pen'
	water	color	pen	
Underlying tone:	3	3	3	
a. Cycle 1:	[2	3]	3	
b. Cycle 2:	[2	2	3]	(= output tone)

Under cyclicity based on post-syntactic c-command trees, we would incorrectly expect the tone sequence 3-2-3 ([water3 > [color3 > pen3]] → *[water3 > [color2 > pen3]).

In effect, the c-command-based trees extend the coverage of the SBM to the type of tonal overwriting found in Izon, but this seems to come at the cost of positing a new type of cyclicity not found elsewhere in grammar.

Empirically, Rolle's claim for Strict Base Mutation is much more restricted in scope than the one by Inkelas (1998) since he limits it to cases of across-the-board mutation, which we will discuss below in section 5.2. For simple mutation there are cases in our sample where mutation clearly violates syntactic c-command based SBM. In Samoan, as discussed in section 2.5, the case marking of object nouns triggers a H-tone on preceding subjects, which are arguably higher in the syntactic structure than objects (see Collins 2017). The same holds for Tense marking in Guébie (appendix C). Another example is Aghem, where specific nouns trigger downstep on following modifiers such as /wó/ 'hand' in (91-b'). This contrasts with /fú/ 'rat' which lacks the downstepping effect, but is otherwise tonally identical (91-b):

(91) *Root-to-Word downstepping in Aghem (Hyman 2001:3 Hyman 1979)*

a.	ká-fú		'rat'	a'.	ká-wó		'hand'	
	CLS-rat				CLS-hand			
b.	fú	kán	'this rat'	b'.	wó	↓kán	'this hand'	
	rat	DEM			hand	DEM		

The same holds for Root-to-Word length mutation in Shilluk (see appendix C).

5.2 SBM as a Restriction on Subtractive Mutation (Alderete 2001, Rolle 2018)

Both Alderete (2001) and Rolle (2018) claim that phonologically additive mutation might be anticyclic (≈ triggered by floating features), but that subtractive and replacive mutation is strictly cyclic (≈ triggered by construction-specific phonologies).

The data in our survey provide clear counterexamples against this typological claim. Virtually all cases of anticyclic mutation involving segmental features are descriptively replacive (e.g., Turkana) and the Gã data in section 2.3 instantiate the same point for tone: Structurally internal prefix tones completely replace tone on more outwards prefixes. Since both the overwriting tone and the tone of the target prefix may be H or L, this cannot be the result of tonal underspecification on the overwritten syllable. Our data from alternations between different mutation targets also show that there is no strict boundary between replacive and non-replacive mutation, as shown for example by Supyire (section 3.3) where L mutation triggered by roots is replacive if affecting following words but is additive if the tone associates tautomorphemically to a stressed syllable. A cyclic counterpart are the Seenku data in section 1 where the same vocalic features lead either to diphthongization or to overwriting depending on the quality of the base vowel.

A methodological problem with any typological claim on featural subtraction is that putative examples of non-replacive deletion as in Japanese (Alderete 2001, Rolle 2018) or Vedic (Halle & Vergnaud 1987, Inkelas 1998, Rolle 2018) are plausible in the theoretical contexts where

they have been formulated, but not surface-evident from the data. 'Accent deletion' in Vedic results not in accent-less outputs but in forms with *initial* accent. While this arguably is the default position for accentuation in the language, there is no principled reason to exclude an analysis where it is added by 'dominant' affixes. Tonal 'subtractive' affixes in Japanese lead to the same pitch realization as in underlyingly tone-less bases. However, the Word-Level tone of single words is made opaque by phrasal tonology. The clearest case of truly subtractive prosody would be affixes which render content words unstressable or affixes which transform lexical bases that have a fixed tonal target into items that are tonally unspecified in the sense that their pitch is linearly interpolated from their phonetic context. Whereas there have been convincing arguments for surface underspecification of tone in the phonetic interpretation of underlyingly tone-less morphemes (see, e.g., McPherson 2011 and Myers 1998 on Chichewa), there is to the best of our knowledge no documented case where the same effect is triggered by morphological processes.

Rolle (2018) makes an innovative proposal to circumvent the methodological problem to identify subtractive mutation by using across-the-board mutation as a litmus test for genuine subtraction. He argues that tonal overwriting where just a single TBU is affected (like Gã in our sample) may be amenable (as in our analysis above) to a different mechanism (phonology and floating features) not subject to the SBM, whereas overwriting of multiple syllables or words must be due to subtraction implemented by cyclic cophonologies.

In a thorough typological survey of similar tonal overwriting patterns, Rolle finds only one potential case of anticyclic across-the-board overwriting, the Mande language Jalkunan. With respect to tone, our results confirm Rolle's finding. All cases of anticyclic tonal overwriting in our sample affect single, not multiple tones. On the other hand, our sample contains clear counterevidence against Rolle's generalization for segmental features. Thus Moro (section 2.2), Nimboran, Ik (section 2.3) and Koryak (appendix C) all exhibit anticyclic across-the-board mutation in vocalic mutation. In the cases of Nimboran and Koryak this also applies in languages which otherwise do not exhibit vowel harmony.

Whereas much more systematic work is needed on the crosslinguistic distribution of across-the-board Mutation, we think that Rolle's generalization on *tonal* across-the-board mutation points to a significant typological bias. However, the fact that it doesn't extend to other phonological features seems to indicate that the typological gap for anticyclic tone mutation is not due to general formal properties of the morphosntax-phonology interface, but to differences in substance, i.e., to functionally grounded phonological preferences for tonal and segmental features. This would not be an unexpected result: As the typological literature shows (see e.g, Hyman 2008), tone and segmental features have typologically different preferences with respect to the directionality of spreading. Similarly there is an ongoing debate on long-distance effects in spreading which seems relatively frequent in tone, but rare (and possibly absent) for segmental harmony (see Jardine 2016, McCollum & Essegbey 2018 for controversial discussion). In fact, Trommer (2024) shows that Rolle's generalization can be implemented as an emergent 'soft' constraint in a concatenative account. If, as argued by Trommer, most cases of cyclic across-the-board overwriting for tone fall out from tonal circumfixes which do not tolerate heteromorphemic tones between their prefixal and suffixal portion, this would account for the lack of an anticyclic counterpart. The latter would "require a kind of circumfixal (discontinuous) root morpheme, a 'circum-root' or, conversely, a tonal infix. Such structures, if existing at all, would be extremely infrequent. It is well known that even segmental infixes are much rarer than prefixes and suffixes (Greenberg 1963), and the status of discontinuous segmental roots is at best marginal. Given that floating material in roots, while clearly attested, is also considerably less frequent than in affixes (the statistical basis of the SBM), a tonal circum-root (a tonally specified root with a discontinuous floating tone) would be the coincidence of several phenomena which are already independently rare typologically. Thus it is likely that greedy inside-out overwriting

is simply accidentally unattested" (Trommer 2024:52+53).

5.3 Locality of Mutation in a Concatenative Approach

In the preceding subsections, we have argued that Strict Base Mutation under a cyclic construction grammar approach imposes typologically problematic locality predictions on possible mutation patterns. We conclude that mutation is not generally restricted by morphosyntactic structure. In contrast, the concatenative approach predicts a different kind of locality restriction because mutation is an effect of defective phonological material evaluated in the phonological grammar. We summarize this prediction in (92):[16]

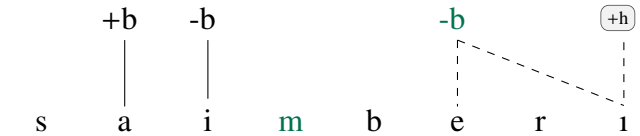
(92) *Phonological Locality Generalization on Anticyclic Mutation:*
Anticyclic mutation is phonologically adjacent to the position of its segmental anchor (modulo general phonological alternations).

By 'segmental anchor', we intend the segmental part of the morpheme inducing anticyclic mutation if there is one and otherwise the segmental position of the morpheme as it can be inferred from segmental affixes of the same morphological type. Thus the anchor location for the purely tonal tense prefix in Gã (section 2.3) would be the position between root and agreement morphemes where other segmental tense prefixes surface in the language. 'Anticyclic mutation' denotes the autosegmental melody (i.e., a string) of features on an autosegmental tier which is the output of the mutation process (in the case of foot structure: a foot node). Phonological adjacency is defined as in (93).

(93) *Phonological Adjacency:*
A segmental morpheme position *M* and a mutation pattern *P* on autosegmental tier *T* are phonologically adjacent iff there is no feature *F* on *T* which would intervene between *M* and *P*

Let us briefly illustrate the application of (92) and (93) with a non-trivial example from Nimboran apophony (section 2.3) In examples such as ((20)-b) /sá-i-N-bá-r-u/ → [sáim- béri] drive.away.PL-PL.SUBJ-PART-LOC-FUT-1 'we will drive away from above', the anticyclic mutation pattern is the feature [-back] on the vocalic [±back] tier (94). Although the vowel segments which undergo mutation are not string-adjacent to the triggering morpheme /-N/, the surfacing [-back] feature is not separated by any other [±back] feature from the affix vowels it associates to and thus adjacent to it in the sense of (93). The insertion of [+high] on the last vowel instantiates the phonological alternation clause in (92) since it is only indirectly triggered by the [-back] mutation pattern (see the analysis in section 4.2).

(94)



Similarly, in Kinande, no tone intervenes between roots like /tum/ and the High they trigger on preceding prefixes. And in Mayo, the accent of the accent-triggering roots is the only and thus closest accent to the root morpheme despite its dislocation to prefixes. The only case in our

[16]Note that we have formulated (92) cautiously as a generalization over *anti*cyclic mutation. It also seems to be true for the overwhelming majority of cyclic mutation patterns, but, as pointed out by an anonymous reviewer, there are some potentially problematic cases of cyclic mutation involving 'mobile' palatalization and labialization in Ethiopian Semitic languages, especially in Chaha (Akinlabi 1996, Rose 1997, Wolf 2007, see also Zoll 1996 for a number of other cases which however are much less dramatic). Addressing these cases in detail is beyond the scope of this paper. Note however that long-distance labialization and palatalization in Ethiosemitic is not a feature specific to mutation, but also occurs in vowel-consonant harmony (see, e.g., Rose 2004 on palatalization in Harari triggered by overt high front vowels. It thus seems to be in line with the intuition encoded by (92) that mutation is the effect of concatenative affixation and independent phonological processes.

sample which might seem prima facie problematic for phonological locality is vowel mutation in Koryak where [+low] mutation skips intervening high vowels. However, transparent vowels are also found in many productive vowel harmony systems (Rose & Walker 2011), we thus take this pattern as actually confirming the validity of the proposed locality generalization. Apart from Koryak, and a handful of cases in our survey which lack evidence for a segmental anchor (and hence cannot be evaluated for the hypothesis), the Phonological Locality Generalization holds without exception for all anticyclic mutation patterns in our sample.

This generalization follows directly under a GNA account because 'mutation' is simply the spellout of defective phonological material for a morpheme *M* in the very position where *M* is concatenated. If this material is salvaged phonologically by epenthesis, it will show up in situ. Otherwise, if it is associated to underlying lexical material by the force of phonological constraints, it is subject to the standard locality conditions of (autosegmental) phonology, which typically involve adjacency.

We know of only two potential exceptions to the Phonological Adjacency generalization in anticyclic mutation. *First*, in some varieties of Mixtec (see section 2.5), H-tone mutation affects the second syllable of the following target word if its first syllable is a Mid tone. However, Tranel (1995) shows that this can be captured by assuming that the intervening Mid tones are default tones, hence underlyingly absent. This correctly predicts that for targets with initial L and H-tones it is the first syllable which shows the mutation tone. Moreover, even Mid-initial target words show phonological locality effects: if the second syllable of the target word starts with a glottal stop it blocks association of the mutation tone to the second syllable which instead shows up on the word-initial syllable.

Second, cases of anticyclic mutation under non-adjacency have been reported for Celtic consonant mutation (see Stump 1988, Green 2006). (95) shows a representative case from Breton based on the description of Stump (1988). The possessive pronoun /va/ triggers spirantization on the following noun (95-b), whereas the quantor /holl/ triggers voicing (95-c)). However if the noun is modified by both morphemes, spirantization triggered by /holl/ seems to apply across the intervening /va/ (95-d):

(95) *Breton consonant mutation under non-adjacency (Stump 1988)*

a.	tud			'people'
b.	va	zud		'my people'
	my	people		
c.	holl	dud		'all people'
	all	people		
d.	va	holl	zud (*dud)	'all my people'
	my	all	people	

Strikingly, like in (95), the strongest cases of apparent non-adjacency between overt words reported in the literature on Celtic instantiate relations between nouns (as target) and modifiers of nouns (as triggers). We hence follow the detailed arguments in Wolf (2005, 2007), Iosad (2012, 2014) and Laoide-Kemp (2024) that these patterns do not instantiate anticyclic mutation across words at all, but rather morphological marking of head constituents: nouns (or non-maximal projections of nouns) show agreement with modifiers by prefixes which cyclically trigger mutation on their host constituents. Thus the morphological formative triggering lenition in (95-b,d) would not be [va], but a prefix consisting solely of floating consonantal features, attached to [tud], and encoding agreement with the 1sg possessor. Since agreement is not a phonological, but a syntactic relation, this naturally explains that it can skip NP-internal material and that the non-adjacency effects are limited to these constructions.

Note finally that Cophonology approaches don't predict any form of phonological locality between segmental affixes and mutation. In pure Cophonology approaches, a segmental prefix or suffix is only connected to mutation (i.e., in cophonological terms: construction-specific phonology) by being part of a specific construction introducing both. But phonological computation in Cophonology Theory is completely independent from morphology, and in fact barred from accessing morphological boundaries or the affiliation of phonological material to specific morphemes (see Orgun & Inkelas (2002) for detailed elaboration). Thus we do not expect any systematic correlations between the position of affixes and the position of mutation effects they trigger. Overall, cophonologies predict tight morphosyntactic locality restrictions, and the lack of phonological locality restrictions. Our data suggest that the empirical situation is rather reversed.

6 Conclusions

In this paper, we have provided evidence that anticyclic mutation is a widespread and variegated phenomenon in the languages of the world: It is attested for all types of phonological modality and applies between roots and affixes as well as between affixes and more peripheral affixes, and roots or affixes across word boundaries. Moreover, anticyclic mutation alternates among different subtypes and with cyclic mutation which makes it unlikely that anticyclic mutation is a strictly morphological phenomenon substantially distinct from cyclic mutation. The sum of these data points constitutes a strong empirical argument against non-morphemic cyclic theories that are restricted by the SBM. On the theoretical side, we have shown that an analysis of mutation phenomena which combines autosegmental or prosodic affixation with purely phonological constraints avoids the limitations of strictly amorphous approaches and provides a unified account for the complex variety of its cyclic and anticyclic incarnations of mutation and their alternations. In a final step, we have demonstrated that the concatenativist approach also makes accurate typological predictions on the locality domains of anticyclic mutation, based on purely phonological restrictions which fit the data much better than existing variants of construction phonology, especially the recent Cophonologies-by-Phase approach. Where traditional cophonologies have too small domains to capture anticyclic mutation, phase-based cophonologies tend to have too big domains. On the other hand, we have argued that auto- and supra-segmental representations provide a direct way to solve apparent problems of a classical lexical – word-based – architecture since autosegmental material may naturally persist from the word level to the phrase level. Taken together, this accounts for the fact that regular phonological alternations are typically bounded to words or to phrasal contexts, whereas word-internally mutation might 'seep' into phrasal domains. The concatenativist account thus – we think, correctly – predicts a crucial distinction between phonological alternations and mutation which by definition cannot be captured in a cophonology approach equating mutation and productive phonology.

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