Countercyclic Process Interactions

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Abstract

Cyclic models of phonology make (explicitly or implicitly) assumptions on how processes that apply in a contained cycle φ_i may interact with processes that apply in a containing cycle φ_{i+x}. This dissertation examines the predictions of cyclic phonology regarding process interaction from a theoretical and empirical standpoint. These predictions are formalised as the NO-COUNTERCYCLICITY-HYPOTHESIS, which states that a process in an inner cycle must feed or bleed a process in an outer cycle, and that a process in an outer cycle must counterfeed or counterbleed a process in an inner cycle. This hypothesis is enforced by various mechanisms, such as bracket erasure, the strict cycle condition, restricted intermodular reference and intermodular interleaving. Empirically, the hypothesis is generally correct: Cyclic interaction abound, and countercyclic interactions, i.e. interaction incompatible with the hypothesis, are hardly attested. However, hardly does not mean not at all: There are some instances of countercyclic interactions, the present work gathers such interactions from 11 languages, from which it discusses 6 in detail. It is argued that a cyclic theory enriched with prosodic structure (Prosody and Cycles, PaC) can account for the attested cases. This is implemented with a Stratal OT version of PaC, which assumes the indirect reference hypothesis (IRH). This is demonstrated with six case studies from C'Lela, Akan, Hijazi Bedouin Arabic, Icelandic, Chamorro and Kimatuumbi: The first two derive apparent countercyclic feeding and bleeding interactions and demonstrate the core mechanism of how PaC derives apparent countercyclic interactions: A prosodic domain the size of a cyclic domain is built on some cycle; on a later cycle, two processes apply, one is bound to the current, bigger cyclic domain and the other to the smaller prosodic domain, given the illusion of countercyclicity. Combined with the assumption of OT-based computation, this derived that countercyclic process interactions are (mostly) transparent. The other countercyclic transparent cases follow the same pattern with some complications, whereas the opaque cases, Hijazi and one interaction in Kimatuumbi, require some reanalyse, in the former case phonological and in the latter morphological. Chamorro illustrates the one type of countercyclic opacity that PaC can derive. PaC and its predictions compare favourably to alternatives, notably Output-Output Correspondence, which undergenerates attested patterns, and a rule-based version of PaC, which can derive an array of unattested countercyclic interactions.

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List of symbols and abbreviations

Prosodic and skeletal elements and tones

π	Variable over prosodic domains
D	Indefinite specific prosodic domain
ϕ	Prosodic phrase
ω	Prosodic/phonological word
Ft	Foot
HdFt	Head foot
σ	Syllable
μ	Mora
•	Segmental root node
◦	Tonal root node
V	Vowel
C	Consonant
H	High tone
L	Low tone
!	Downstep

Other Abbreviations

φ	Cycle
☞	winning candidate in a OT tableau
✄	Desired, but not winning candidate in an OT tableau
IRH	Indirect Reference Hypothesis
ITI	Initial Tone Insertion
OCP	Obligatory contour principle
OOC	Output-Output Correspondence
OT	Optimality Theory
PaC	Prosody and Cycles
PaC-RB	Rule based PaC
PaC-OT	OT based PaC
UR	Underlying representation

Glosses

1	First person
2	Second person
3	Third person
ACC	Accusative
AGR	agreement
ANTIP	Antipassive
APPL	Applicative
CLx	Noun Class x
CMP	Comparative
COMP	Complementiser
DAT	Dative
DEF	Definite
DET	Determiner
DIM	Diminutive
DL	Dual
EQ	Equative
EXCL	Exclusive
EZ	Ezafe
F	Feminine
FOC	Focus
FREQ	Frequentative
FUT	Future
GEN	Genitive
HAB	Habitual
ICM	Incompletive
IMP	Imperative
INAL	Inalienable
INCL	Inclusive
INF	Infinitive
INFL	Inflection
INTENS	Intensifier
IPF	Imperfect
LINK	Linker
LOC	Locative
M	Masculine
MID	Middle
N	Neuter
NEG	Negation, negative
NMLZ	Nominaliser
NOM	Nominative
NUM	Numeral agreement
OBJ	Object
PFV	Perfective
PL	Plural
POSS	Possessive
PREP	Preposition
PRF	Perfect
PRFX	Prefix
PROG	Progressive
PRS	Present
PST	Past
PTCP	Participle
Q	Question marker
REAL	Realis
RECP	Reciprocal
REFL	Reflexive
REL	Relative
REM	Remote
RESP	Respectful imperative
SBJV	Subjunctive
SG	Singular
STRG	Strong
TC	Theme consonant
TOP	Topic
VEN	Ventive

Chapter 1

Introduction

1.1 Countercyclicity

A key property that distinguishes between competing architectures of phonology is whether phonology is assumed to be cyclic (Chomsky & Halle 1968; Brame 1974; Mascaró 1976; Kiparsky 1982, 2000; Orgun 1997; Bermúdez-Otero 1999; Sande, Jenks, & Inkelas 2020 among many others) or not cyclic (Benua 1997; Albright 2002; Kager 1999; McCarthy 2007b among others). Cyclic here means that phonological computation does not apply in one fell swoop, but in multiple cycles applying to morphosyntactic domains of increasing size. Cyclic process application is usually tied to the adoption of the cyclic principle (Chomsky, Halle, & Lukoff 1956), which states that a process that applies to a smaller domain applies before a process that applies in a larger domain. In addition, the no-look-ahead principle states that a process in a smaller cycle is completely oblivious to material that is external to it. These two principles together derive the NO-COUNTERCYCLICITY HYPOTHESIS, given in (1).

(1) NO-COUNTERCYCLICITY

a. If a process P applies in a cyclic domain D_i, it must transparently enable, block or influence (feed, bleed or shift) a process Q that applies in a cyclic domain D_{i+x}.

b. If a process Q applies in a cyclic domain D_i, it cannot transparently enable, block or influence (thus must counterfeed, counterbleed or countershift) a process P that applies in a cyclic domain D_{i-x}.

Countercyclic process interactions are thus interactions that violate the NO-COUNTERCYCLICITY HYPOTHESIS, i.e. either interactions where a process germane to a bigger domain feeds or bleeds a process bound to a smaller domain (transparent countercyclicity) or where a process bound to a smaller domain counterfeeds or counterbleeds a process with a larger morphosyntactic scope (opaque countercyclicity).

Consequently, the potential existence of countercyclic interactions is a very useful tool for evaluating the hypothesis that phonology is cyclic. Do countercyclic

Language	P	Q	Interaction
C'Lela	Vowel deletion	Vowel Preservation	Bleeding
Akan	Tone polarity	Tone spreading	Feeding
Hijazi Bedouin Arabic	a-Raising	i-Syncope	Counterfeeding
Icelandic	Epenthesis	Resyllabification	Bleeding
Chamorro	Stress insertion	Umlaut	Counterfeeding
	Stress deletion	Umlaut	Counterbleeding
Kimatuumbi	Gliding	ITI	Bleeding
	Gliding	Shortening	Counterfeeding
Kashaya	Foot-flipping	Resyllabification	Bleeding
Kinande	Vowel harmony	Vowel harmony	Feeding
Hausa	Tone raising	Shortening	Bleeding
Seenku	Tone docking	Sandhi	Shifting
Eton	Tone spreading	Tone polarity	Feeding

Table 1.1: Languages that show countercyclic process interactions
P = Process that applies in the smaller morphosyntactic domain; Q = Process that applies in the bigger morphosyntactic domain; ITI: Initial Tone Insertion; **Main sources:** C'Lela: Dettweiler 2015; Akan: Paster 2010; Hijazi Bedouin Arabic: Al-Mozainy 1981; Icelandic: Kiparsky 1984, 1985; Chamorro: Chung 1983; Kimatuumbi: Odden 1996; Kashaya: Buckley 1999, 2017; Kinande: Archangeli & Pulleyblank 2002; Hausa: Hayes 1990; Seenku: McPherson 2019; Eton: Van de Velde 2008.

interactions exist, and if so, do they refute cyclicity wholesale? After all, the cyclic programme can be considered quite successful, see Bermúdez-Otero (2011) for relevant summary of the virtues of cyclic phonology. However, countercyclic interactions are indeed attested, and some are a known problem for cyclic architectures. Still, the known and discussed cases are very few. Table 1.1 gives an overview over the attested cases that I am aware of, the first six in bold face are discussed in detail in this work.

It is striking that for most of these languages, process Q is phrasal whereas process P is applies in some lexical domain. The only exceptions to this are Icelandic and Kashaya. This is not surprising: The watershed between words (even if notoriously difficult to define) and phrases is almost universally recognised as a cyclic boundary, cyclic frameworks that have only two cycles have exactly those, compare Itô & Mester (2001), it is a cyclic boundary in Lexical phonology and morphology (Kiparsky 1982 *et seq.*) and its successor Stratal OT (Kiparsky 2000; Bermúdez-Otero 1999), but also in approaches that assume much more cycles, such as Distributed Morphology (DM, Halle & Marantz 1993 *et seq.*) with its m-word (Shwayder 2015). Other potential countercyclic interactions are arguably easier do reanalyse as cyclic, because there are more theories to chose adequate cyclic domains from.

1.2 Proposal

I propose a restrictive cyclic framework Stratal OT with conventional constraints enriched with prosodic structure, which I call Prosody and Cycles (PaC). The combination of cyclic and prosodic domains has been criticised, see e.g. Golston (1996), because it leads to a proliferation of ambiguity: For many processes, it is not clear whether they should be analysed as bound by a prosodic or cyclic domain. PaC can account for limited instances of countercyclic interactions, namely aligned (that is, the relevant prosodic structure is aligned at the crucial edge with the relevant cyclic domain) transparent Interactions. By transparent here I mean roughly derivable in parallel OT. This includes some interactions that are opaque, such as some instances of counterfeeding on focus and counterbleeding, compare McCarthy (2007b). The general gist of how PaC can account for a transparent aligned interaction is the following: At a first cyclic domain φ_1, a prosodic structure π is build that aligns with the edges of the cyclic domains. At a later cycle φ_{1+x}, this prosodic structure is intact. A process P and a process Q apply simultaneously, in OT that implies in a feeding or bleeding fashion if applicable. Process Q is general and applies indiscriminately in the domain φ_{1+x}. P, however, is restricted to apply within π. this gives the illusion that P is a process bound to the cyclic domain φ_1.

1.3 Results

In order for a attested countercyclic interaction to be reanalysed as cyclic under PaC, it must fulfil two conditions: A prosodic domain must be aligned with the relevant edge(s) and the interaction must be transparent. This basic analysis fits for Akan and C'Lela, and, with some caveats, for Icelandic and the interaction of Initial Tone Insertion (ITI) and Gliding in Kimatuumbi. Hijazi Bedouin Arabic requires a phonological reanalysis of the process Q, which I split into a lexical process that targets all high vowels, and a postlexical process that targets only vowels that are final in a prosodic word. The analysis does thus not follow the PaC scheme laid down above, but refers to prosodic structure that crucially (mis)aligns with smaller cyclic domains. The Chamorro interactions are opaque and thus not analysable with PaC without further amendments. If, however, the Umlaut triggering clitics are reanalysed as word level, and the relevant stress rules are shifted to the phrase level where they must crucially refer to prosodic structure, the interactions can be analysed with PaC. The opaque interaction of Kimatuumbi shortening and gliding, lastly, cannot be reanalysed with reference to prosodic structure. However, similar to Chamorro, it is possible to analyse shortening as a (morphologically induced) stem level process that is cyclically counterfed by word-level gliding. I conclude thus that the existing countercyclic patterns are compatible with a restrictive cyclic framework that is enriched in so far as that it has prosodic domains.

I also compare PaC to two competing approaches: a (restrictive version of) Output-Output Correspondence (OOC, Benua 1997; Burzio 1998; Kager 1999 and many others) and a rule based version of PaC. Both fare worse than the OT based version of PaC (PaC-OT), for opposite reasons. OOC cannot derive some of the attested patterns, namely Akan, C'Lela and the Kimatuumbi shortening and gliding interaction. C'Lela and Akan can be derived if prosodic structure is assumed in addition, but this cannot be extended to Kimatuumbi, which remains a severe problem. In principle, OOC behaves similar to PaC because both approaches are OT based: they can derive transparent interactions easily, whereas opaque interactions are difficult or impossible to derive. However, PaC ties the possibility of a transparent countercyclic interaction to aligned domain edges and restricts thus the set of predicted transparent countercyclic interactions. OOC cannot do anything like that and overgenerates transparent misaligned patterns. The most egregious case of undergeneration for OOC is that it cannot derive cyclic opacity between a phrasal process Q and a lexical process P: if Q applies in the phrasal base, it must transparently interact with P. Summarised, OOC overgenerates some patterns not generated by PaC (but the reverse is true, too) and it crucially undergenerates attested cyclic and countercyclic patterns. PaC with extrinsically ordered rules can derive all the interactions and languages derived in the case studies. It can also derive all the unattested patterns that PaC-OT can derive, but even more: whereas PaC excludes most cases of opacity, even if the prosodic structure is aligned, a system with extrinsically ordered rules derives opacity just as easily as transparency and has no problem with those patterns. It generally works by ordering Q before P at φ_1, if Q feeds or bleeds P, we get transparent countercyclicity, if P would feed or bleed Q if reordered, we get opaque countercyclicity. P can of course only refer to prosodic domains, and in a OT framework that means that it is sensitive to the prosodic boundaries in the output, which rules out misaligned transparent interactions. For the rule-based approach, the output is irrelevant and only the immediate input counts. If process P is ordered before reprosodification which misaligns the prosodic domain from the past cyclic domain, the rule based approach derives countercyclic misaligned patterns as well. This means that rule based PaC can generate basically all countercyclic interactions, it is virtually indistinguishable from a non-cyclic framework that has access to all morphosyntactic brackets.[1] The predictions can be restricted if we extend a recent proposal by Rusyanova & Rasin (2023) who suggest that on every cycle, stress rules precede melodic rules. If this proposal is extended from stress rules to include all prosodic rules, a thusly amended rule based PaC excludes misaligned opaque and transparent patterns. Table 1.2 gives an overview over which patterns are predicted by which theory.

1.4 Outline of the Dissertation

In chapter 2.5 I will elaborate the NO-COUNTERCYCLICITY hypothesis and examine with which mechanisms cyclic theories of phonology have derived the hypothesis,

[1]There are still some different predictions between rule based PaC and such a framework: Because the cyclic domain cannot be reconstructed after the aligned prosodic domain has been moved/destroyed, some marginal pattern will still be excluded.

	PaC-OT	PaC-RB1	PaC-RB2	OOC	Attested[†]
Cyclic opaque interaction					
Q applies in isolation form	✓	✓	✓	✗	✓
Transparent interactions					
aligned	✓	✓	✓	✓	✓
misaligned	✗	✓	✗	✓	✗
Opaque interactions derivable in OT[‡]					
chain shift	✓	✓	✓	✓	?[✣]
counterbleeding	✗	✓	✓	✓	✗
self-destructive feeding	✓	✓	✓	✗	✗
Opaque interactions not derivable in OT					
aligned	✗	✓	✓	✗	✗
misaligned	✗	✓	✗	✗	✗
3-Level-language	✓	✓	✓	✗	✓[✢]

Table 1.2: Comparison of approaches

PaC-RB1: rule based PaC without restrictions; **PaC-RB2**: rule based PaC with universal ordering of prosody rules before melodic rules on every cycle. [†] Attested here assumes that the countercyclic opaque interaction of Kimatuumbi are reanalysed as suggest in section 4.6.8. [‡] This includes only the instances of chain shift, counterbleeding and self-destructive feeding that *are* derivable in standard parallel OT, not these interactions in general. [✣]The potential case is Hijazi Bedouin Arabic, however it is analysed differently in chapter 4.3. [✢]The case is Chamorro. Chamorro is analysed along these lines in chapter 4.5, but whether it is truly an example needs further research, see footnote 35.

namely bracket erasure, the strict cycle condition, restrictions on intermodular reference and intermodular interleaving. I also discuss in how cyclic frameworks differ in the number and identification of phonological cycles, and how thus the countercyclic patterns that are excluded may be different between another. In 3 I introduce prosodic phonology and lay down the specific assumptions that I make for a cyclic framework with prosody (Prosody and Cycles, PaC) that is able to account for the attested data. In this chapter, I discuss the predictions that PaC makes: It can generate transparent countercyclic interactions, if a prosodic domain is aligned with a relevant cyclic domain, but it cannot (generally) account for opaque countercyclic interactions. In chapter 4, I discuss alleged or potential countercyclic interactions from six languages. The first case study in 4.1 examines the bleeding interaction of phrasal vowel preservation with lexical or cyclic vowel deletion in C'Lela. The second case study, in section 4.2, from Akan discusses a countercyclic feeding interaction, here, phrasal tone spread feeds polarity which is sensitive to interior brackets. Both interactions are reanalysed as cyclic with basic gist of PaC: A phrase level process feeds or bleeds a presumed lexical process, which is reanalysed as a phrasal process sensitive to internal prosodic boundaries. The third case study, in chapter 4.3 focuses on the famous case of Hijazi Bedouin Arabic, where allegedly a phrasal process of syncope is counterfed by a word-level process of low vowel raising. I argue that the phrasal instances of syncope should be reanalysed, so that they refer specifically to prosodic-word final vowels, a position where low vowel raising does not apply. This reanalysis does not follow the PaC scheme, but it crucially relies on prosodic domains nonetheless. The fourth case study in section 4.4 deals with the counterbleeding interaction of (potentially stem level) epenthesis and word level resyllabification in Icelandic, also a known problem for cyclicity. I argue for a novel generalisation over the data, namely that epenthesis is counterbled by resyllabification if the resyllabification happens with the masculine articles, but is bled by resyllabification if the article happens to be feminine or neuter. I then propose that the feminine and neuter articles are word level suffixes that bleed word level epenthesis, and that the masculine article is a phrasal affix that integrates into the prosodic word it attaches to at the phrase level. In the fifth case study, in section 4.5, I discuss the problem for cyclicity posed by Chamorro. Here, word stress seems to both apply before and after lexical and even postlexical processes. With a PaC approach, it is possible to postpone some aspects of the stress algorithm onto the phrase level, so that the interactions can be analysed as cyclic. The last case study in 4.6 deals with two countercyclic interactions from a single language, Kimatuumbi. In this language, a cyclic, lexical process of gliding is bled by a process of high tone insertion (ITI) that relies on the phrasal phonological context. I argue that some instances of gliding are phrasal, but that those phrasal instantiations are blocked by prosodic structure. It is exactly those instantiations that can be bled by ITI. In principle, this is analysable with the familiar approach for transparent interactions, but I argue on independent grounds that ITI should be analysed as phrasal allomorphy rather than a process. The second countercyclic interaction with gliding is between word level instantiations of gliding and shortening, a process that takes in phrasal information but is counterfed by word level gliding. However, shortening can be reanalysed as the reflex of a stem-level ezafe morpheme that marks lexical heads that are overtly modified. Under that approach, the interaction with gliding is fully cyclic. In chapter 5, I compare my approach in PaC with three competitors: First, with Output-Output Correspondence (OOC), a non cyclic alternative to account for cyclic effects. I find that OOC is comparable with respect to overgeneration, but fares worse than PaC with respect to undergeneration. After that I briefly discuss a system with relaxed bracket erasure and argue that this, while similar in many respects to PaC, accounts worse for the data. Lastly, I compare the OT based version to a rule based version of PaC, and find that it overgenerates massively compared to the OT implementation. In Chapter 6, I summarise the findings and look ahead to future research.

Chapter 2

The No-Countercyclicity Hypothesis

In phonology, cyclicity refers to the concept that phonological computation is serial, and that the cycles of phonological computation is (loosely) determined by morpho-syntactic structure. Since the beginning of theoretical phonology, cyclicity has been assumed, which makes it hard to impossible to determine its origin. The quote in (2) can be taken as one of the first formalisations of cyclicity.

(2) "[Rules] apply no more than once to each constituent, applying a rule to a constituent of order n only after having applied it to all constituents of order n+l; i.e. beginning with the smallest constituents and proceeding to larger and larger constituents" (Chomsky et al. 1956: 75)

If we replace 'rules' in (2) with something more theory neutral, such as 'phonological computations', this description is still useful for capturing cyclicity independent of whether a rule-based system is assumed.

The remainder of this chapter is structured as follows: First, I will discuss the empirical justification for cyclicity, namely cyclic effects. Cyclic effects fall into two categories, cyclic counterbleeding, which argues for cyclicity generally, and cyclic counterfeeding, which, in addition to cyclicity, is an argument for a phonological system with different rule blocks. After discussing cyclic effects, we will come to the central topic of this dissertation, countercyclic effects. In section 2.2, I will focus on hypothetical countercyclic patterns, the existing cases will be discussed later. For this chapter, the pretence is that it is desirable for a phonological theory to exclude countercyclic interactions (No-Countercyclicity hypothesis). However, if cyclicity is implemented just with the clause such as in (2), it remains a stipulation, or as Kiparsky (1983) put it more scathingly: 'some baroque ordering convention' (Kiparsky 1983: 6). There have been many proposals to derive cyclicity from (preferably) independently motivated principles, such as Bracket Erasure, discussed in section 2.3.1, the Strict Cycle Condition (SCC, section 2.3.2), restrictions on reference across modules (section 2.3.3) and (modular) interleaving (section 2.3.4). Cyclic theories do not only diverge on how they enforce cyclicity, but also on what they define as a phonological cycle, and whether (some) cycles have a proprietary phonological computation or not. In section 2.4 I will categorise current and historic cyclic frameworks along these lines. Given that NO-COUNTERCYCLICITY, while being true as a tendency, is not exceptionless, I will end this chapter with laying out three possible routes forward: abandoning cyclicity, weakening cyclicity, and redefining cycles.

2.1 Cyclic effects

In short, a cyclic effect is a pattern affecting a structure S that is opaque on the surface but can be derived if the structure S contains a (smaller) structure S′, and that application of phonology to this smaller structure S′ before application of phonology to S explains the opaque pattern. Take the data from Dutch in (3).[2] There is final devoicing syllable finally, but final devoicing does not apply if the consonant in question re-syllabifies. Now consider the data point in (4). here, final devoicing applies, *even though* the /v/ manages to re-syllabify. If re-syllabification precedes final devoicing, which it must in order to derive [bade], and apply the same rules to an input /xeːvər/, we wrongly predict an output *[xeː.vər].

(3) *Cyclic counterbleeding in Dutch (Grijzenhout & Krämer 2000)*

a. /xeːv/ → [xeːf] '(I) give'
b. /xeːv-ər/ → [xeː.vər] 'giver'
c. /xeːv#ər/ → [xeː.fər] '(I) give her'

Cyclicity come to the rescue here. If we split the derivation into two cycles, one encompassing the root, /xeːv/, and, if present, the suffix -ər, and the second the root plus the person affix, the correct result falls out, compare the derivation in (4). At the first cycle, the /v/ undergoes final devoicing, unless it has been moved into the onset of the syllable headed by the schwa. At the second cycle, the fricative can resyllabify again, but since it has already been devoiced, it surfaces as [f] even in an onset.

(4) *Derivation of Dutch cyclic counterbleeding*

cycle φ_1			
xeːv-ər	xeːv	xeːv	Input
xeː.vər	xeːv.	xeːv.	Syllabification
—	xeːf.	xeːf.	Final Devoicing
cycle φ_2			
xeː.vər	xeːf.-ər	xeːf.	Input
—	xeː.fər	—	Syllabification
—	—	—	Final Devoicing
xeː.vər	xeː.fər	xeːf.	Output

[2]For discussion of the Dutch counterbleeding, see next to Grijzenhout & Krämer (2000) also Booij (1985, 1995).

In this instance, we have a case of cyclic counterbleeding. If resyllabification with the affix would apply at an earlier cycle, it would bleed final devoicing, just as the syllabification with the cycle 1 suffix -ər bleeds it. Many arguments for cyclicity come from cyclic counterbleeding, including many stress patterns, among many others, stress and syncope in Arabic (Brame 1974; Kiparsky 2000), various stress assignments in Manam (Halle & Kenstowicz 1991), stress, and vowel lowering and umlaut in Chamorro (Chung 1983, see also case study in chapter 4.5); but also interactions without stress such as the Dutch case above, and, for example, the interaction of syllabification with l-velarisation and epenthesis in English (e.g. Mohanan 1986 and sources therein), or the interaction of epenthesis and syllabification in Turkish (Inkelas 2014).

A second argument comes from the situation where a process applies in a phonological context in a cyclic structure S, but not if the same context arise in a bigger cyclic structure S′. Take the examples form German in (5). The distribution of the uvular fricative [χ] and the palatal fricative [ç] is completely predictable: If the fricative is immediately right-adjacent to a back vowel, the dorsal fricative is uvular, elsewhere e.g. after a front vowel, a consonant, or word-initially, it is palatal.[3] As the data in (5c-d) shows, a single underlying dorsal fricative can map to the uvular and the palatal surface forms depending on context.

(5) *ç-Uvularisation in German*

a. kaˈzaχə '(male) Kazakh'
b. kaˈzaχɪn '(female) Kazakh'
c. dʁaχə '(male) dragon'
d. dʁɛçɪn '(female) dragon'
e. mɪlç 'milk'
f. mɔlç 'newt'
g. tɔχtɐ 'daughter'
h. zʏçtɪç 'addicted'
i. baldaˈχiːn 'tent gazebo'
j. çiːna 'China'

(6) *Counterfeeding of Uvularisation*
zaː ˈçiːna *zaː ˈχiːna '(I) saw China'

However, the fricative in (6) remains palatal, even though it follows a back vowel. Indeed, in the phonologically very similar case in (5i), we do find a uvular. In this case, backing of the fricative does not even interact with a rule, it is the simple presence of the vowel to which it is not sensitive. If we, however, assume that the verb [zaː] belongs to an outer cycle, we can derive the pattern, compare the derivation in (7). At the first cycle, the dorsal is uvularised in 'tent gazebo', but not in 'China'.

[3] Data is from the author, a native speaker of Standard German, compare Hall (1989) for a discussion and Hall (2022: 690) for a a conflicting opinion on this pattern.

At the second cycle, the verb and object are considered together, but the rule of uvularisation does not apply any more.

(7) *Derivation of German cyclic counterfeeding*

cycle φ_1			
çiːna	çiːna	baldaçiːn	Input
—	—	baldaχiːn	Fricative uvularisation
cycle φ_2			
zaː çiːna	çiːna	baldaχiːn	Input
—	—	—	other rules
zaː çiːna	çiːna	baldaχiːn	Output

This analysis thus derives cyclic counterfeeding: The juxtaposition applies to late to feed uvularisation. An analysis along this line requires an additional assumption in addition to cyclicity: The processes associated with each cycle may be different. In (7), uvularisation is a rule applying in cycle φ, but it simply does not apply in cycle φ 2. A mechanism that switches processes off is thus necessary for cyclic counterfeeding. In rule-based theories following the advent of Lexical Morphology and Phonology (LMP, Kiparsky 1982, 1984, 1985; Mohanan 1986; Booij & Rubach 1984), this is mainly the adoption of cycle-specific rule-blocks(compare e.g. (Mohanan 1986: 122) for an explicit defence of multiple rule blocks), in cyclic OT the equivalent is cycle specific constraint rankings (Bermúdez-Otero 1999; Kiparsky 2000).

Other cases of cyclic counterfeeding are for example found in the interaction of dentalisation and syllabification in Northern Irish English (Bermúdez-Otero & McMahon 2006), the interaction of r-vocalisation and ç-uvularisation in German (Itô & Mester 2001, very similar to the German case discussed here), the interaction of vowel lengthening or stress shift in Malayalam (Mohanan 1986).[4] Different rule blocks allow also for the derivation of another type of cyclic effect: cyclic counterbleeding where the structural description of the counterbleeding process is met in the first cycle – in contrast to the counterbleeding interactions discussed above–, but the process does not apply until later. A convincing example for this is the interaction of cluster simplification and post-obstruent tensing in Korean (Yun 2009). The former process counterbleeds the latter, and there is evidence that it cannot apply at the first cycle.

Some cases of cyclic counterfeeding can be re-analysed as cyclic bleeding, so that a single rule-block or ranking can be sufficient for those cases. In the German case discussed above, one can assume that the fricative is underlyingly unspecified, a feature filling rule is sensitive to the environment of the consonant, the same rule applies at the second cycle, but is bled by the previous instance of itself. It is not clear whether all instances of cyclic counterfeeding can be re-analysed as cyclic bleeding.

[4]In a system with extrinsically ordered rules, a distinct rule-block does not necessarily equate to a different set of rules, it can also mean a different ordering of the same set of rules. This is exactly what Mohanan suggests for this interaction in Malayalam.

For example, in Arapaho epenthesis applies between affixes and stems, where a CV syllable template is enforced, but not between stems and proclitics, where the syllable shape is more relaxed (Cowell & Moss 2008), there is no obvious feature filling rule that could apply early in order to bleed epenthesis at a later level. Similar, non-cohering metrical systems, see Benz (2018); Kaplan (2022) for case studies, pose a serious challenge for such proposals. For the purpose of this dissertation I will assume that different rule-blocks are a necessary feature of cyclic theories.

2.2 Countercyclic Interactions

As we have seen, a cyclic architecture where phonological processes apply to increasingly larger morphosyntactic domains can derive cyclic effects – cyclic counterbleeding in any case, and cyclic counterfeeding under the adoption of different rule blocks. However, cyclic frameworks are by no means the only way to derive cyclic effects.[5] Lets take the morphosyntactic structure in (8a), and the rules (8b) and (8c) without any ordering.

(8) *Scheme of cyclic bleeding*

a. $[[AB]_X C]_{XP}$
b. B→D / __C
c. B→A / A__
d. $[[AA]_X C]_{XP}$

In a cyclic framework, if X is a cyclic domain, rule (8b) bleeds (8a) because at the first cycle, C is not yet available, so that the first rule cannot apply. At the later cycle, it has been bled, yielding the output (8d). However, we can slightly reformulate the rules so that they derive the same pattern without any cycles, and order them so that the rule that is blocked by brackets applies before the rule that is not blocked by brackets, see (9).

(9) *Scheme of cyclic bleeding without cycles*

a. $[[AB]_X C]_{XP}$
b. B→A / A__
c. B→D / __$(]_X)$C
d. $[[AA]_X C]_{XP}$

Unlike the cyclic approach, the approach in (9) can derive also the reverse pattern, where the the second process, B→D, is counterbled by AB-Assimilation, if we assume the reverse ordering of rules, as in (10).

[5]The most important competitor is Output-Output Correspondence (Benua 1997 *et seq*). The very unrestricted approach presented here for comparison's sake has to my knowledge not been proposed seriously.

(10) *Scheme of countercyclic counterbleeding*

a. $[[AB]_X C]_{XP}$

b. B→D / __($]_X$)C

c. B→A / A__

d. $[[AD]_X C]_{XP}$

This interaction is derivable in a non-cyclic framework, but not in a framework that adopts the cyclic hypothesis. This is actually something that follows from the cyclic hypothesis only by stipulation, but this stipulation has been technically implemented with various means, discussed in section 2.3. In the remainder of this section, I will categorise countercyclic effects and in the end briefly discuss whether countercyclic effects have been attested. The short answer is yes, but barely.

2.2.1 Countercyclic effects: categorisation

The observation that cyclicity precludes certain interactions is by no means new, compare e.g. Pak (2008: 37), Kiparsky (2000), Gleim & Rasin (to appear), but has, to my knowledge, never been systematically evaluated. It can be summarised as in (11).

(11) Cyclic prediction: In a context where Cyclicity can derive a cyclic effect, it must derive a cyclic effect.

More fleshed out, this gives us the NO-COUNTERCYCLICITY hypothesis in (12).[6]

(12) NO-COUNTERCYCLICITY

a. If a process P applies in a cyclic domain D_i, it must transparently enable, block or influence (feed, bleed or shift) a process Q that applies in a cyclic domain D_{i+x}.

b. If a process Q applies in a cyclic domain D_i, it cannot transparently enable, block or influence (thus must counterfeed, counterbleed or countershift) a process P that applies in a cyclic domain D_{i-x}.

We have a countercyclic interaction, if one of the two clauses in (12) does not hold. This gives us in consequence two types of countercyclic interactions: The reverse of (12a) are opaque countercyclic interactions; the reverse of (12b) are transparent countercyclic interactions. If we imagine a process P that can feed a process Q, P applying in a earlier cycle with respect to Q, and P feeds Q, this is a transparent

[6]For the typology and terminology of process interactions, see Kiparsky (1973); McCarthy (1999, 2007b); Baković (2007, 2011); Rasin (2022); Baković & Blumenfeld (2024). For the NO-COUNTERCYCLICITY hypothesis, the characterisation from Baković (2007) is especially illustrative: If a process P at domain D_i creates an input for Q, Q must apply (feeding), if P takes away an input for Q, Q must not apply (bleeding), and if P meaningfully alters the input for Q, Q must apply to the altered input (shifting). Reversely, if Q creates an input for P, P cannot apply (counterfeeding), if Q takes away an input for P, P applies nonetheless (counterbleeding), and if Q alters the input P, P applies to the non-altered input (Countershifting).

and cyclic interaction. If P does not feed Q, this is an opaque and countercyclic interaction. If, on the other hand, P can be fed by Q, and is fed by Q, the interaction is still transparent, but countercyclic. With the cyclic hypothesis, we would expects Q to counterfeed P. (13) gives an overview over the interaction patterns regarding feeding/counterfeeding between to cyclically ordered processes P and Q. The same relationships hold for (counter)bleeding and (counter)shifting.

(13) *Cross-classification of cyclicity and opacity*

	P can feed Q	Q can feed P
Transparent	cyclic	countercyclic
Opaque	countercyclic	cyclic

The name ‘countercyclic’ is adequate for this interactions, because if the process would counter-factually apply in the reverse order, the interaction would be cyclic, compare Baković (2007). The language we have seen above in (10) was very abstract. How could a countercyclic effect look like in a more naturalistic language? Let us construct an example. Imagine a language that has word bound vowel harmony, which is triggered by an affix. In (14), it is the feature [+ATR] that spreads leftward. Such systems are attested, e.g. from Assamese (Mahanta 2008, 2012). Now imagine that the language also has a type of vowel assimilation that crosses word boundaries, but is distinct from the word-level harmony in being bounded, like in (15). This type of vowel harmony is rarer, but still abundantly attested (compare e.g. Kügler 2015a, 2022; Kiparsky 2023).

(14) *Hypothetical language with word bound vowel harmony*

a. tʊ-ku → tuku
b. pʊtʊ-ku → putuku

(15) *Hypothetical language with phrasal vowel harmony*

a. tʊ mutʊ → tu mutʊ
b. lʊtʊ mutʊ → lʊtu mutʊ

If a language has both processes, cyclicity makes a clear prediction: The word-bound process must feed the phrasal process. If we find an interaction pattern like (16), this data is compatible with cyclicity. If we find however the interaction pattern in (17), this language is at odds with the cyclic prediction. (17) instantiates counter-cyclic counterfeeding, word bound harmony counterfeeds cross-word harmony.

(16) *Hypothetical language with cyclic feeding*
lʊtʊ pʊtʊ-ku → lʊtu putuku

(17) *Hypothetical language with countercyclic counterfeeding*
lʊtʊ pʊtʊ-ku → lʊt**ʊ** putuku

Another hypothetical language, one that shows countercyclic transparency, is discussed in Gleim & Rasin (to appear), given here in (18). Here, a word bound process palatalises /t/ to [c]. Such a process can be found, amongst many others, in Korean (Ahn 1997). In addition, there is a purely phrasal process of epenthesis, which inserts a vowel into a three consonant cluster or a final two consonant cluster. Such a process of epenthesis is also attested, for example in Palestinian Arabic (e.g., Kiparsky 2000).

(18) *Hypothetical language with word-bound palatalisation and phrasal epenthsis*

	#	/-i/	/#ima/	
a. /at/	at	a.ci	a.t i.ma	PAL is word-bound
b. /apn/	a.pin	ap.ni	ap.n i.ma	EPEN is phrasal

The cyclic prediction, again, is clear: word bound palatalisation cannot be fed by phrasal epenthesis, (19b). If, on the other hand, we find feeding, as in (19a), we have a transparent but countercyclic interaction.

(19) *Countercyclic transparent and cyclic opaque interactions*

	#	/-i/	/#ima/	
a. /atn/	a.cin	at.ni	at.n i.ma	EPEN feeds PAL
b. /atn/	a.tin	at.ni	at.n i.ma	EPEN counterfeeds PAL

For the time being, we will treat these predictions as correct and cyclicity on the right track. However, there are counterexamples to the NO-COUNTERCYCLICITY hypothesis, which will be discussed in Chapter 4. I want to stress that even though a number of counterexamples has been claimed, the overwhelming number of cases of process interactions are compatible with NO-COUNTERCYCLICITY, and the claimed cases are barely more than the ones discussed in this thesis. Cases of potential countercyclicity not discussed in the present work include Hausa verb-final shortening (Hayes 1990), Kashaya Foot-flipping (Buckley 1999, 2017), Eton tone polarity (Van de Velde 2008), the interaction of two types of vowel harmony in Kinande (Archangeli & Pulleyblank 2002) and the interaction of Sandhi and morphological plural tone in Seenku (McPherson 2019). While more investigation is needed, I contend for now that they do not pose a severe problem for cyclicity and follow from the framework proposed in the present work. The Hausa case is amenable to the analysis that I propose for Kimatuumbi shortening in chapter 4.6.8, and it has been reanalysed on similar lines by Crysmann (2004). Buckley (2017) gives a tentative analysis of the Kashaya pattern that is compatible with the cyclic hypothesis, and the data seems to be to be derivable to the framework I propose in chapter 3. The Data for Eton is unfortunately not conclusive enough to attempt to make substantial claims, and Kinande, as briefly discussed in chapter 3 is an expected pattern. Seenku was analysed by McPherson (2019) cyclically, however, with a very unusual cycles and a novel morphology-phonology interface. Whether this can be transferred to a more standard architecture remains to be investigated.

No-Countercyclicity, however, can either fall out from the definition of cyclicity by stipulation (e.g., Inkelas 1996), or be enforced by independent means. Most endeavours in cyclic phonology take the latter route, the chief mechanisms that enforce cyclic predictions are Bracket erasure (Chomsky & Halle 1968; Mascaró 1976; Pesetsky 1979; Kiparsky 1982 and many more), the strict cycle condition (Kean 1974; Mascaró 1976; Kiparsky 1982, 1985) and other conditions on rule formalisation (Brame 1974), restrictions on intermodular reference (Scheer 2010; Bermúdez-Otero 2012) and modular interleaving (Kiparsky 1982; Mohanan 1986). The first three are a means to exclude look-back effects, by prohibiting a process in an outer cycle from being restricted to an inner cycle, while interleaving prevents look-ahead effects. Both look back and look ahead can be used to model countercyclic interactions. Recall the opaque contercyclic pattern in (17). If we do not have a prohibition of look-ahead, the second process, vowel harmony across word boundaries, can be re-interpreted as belonging to the word-sized cycle, for example modelled as the rules in (20), where rule (20a) is allowed to cross brackets, but (20b) is not. This rule then is counterfed by a subsequent rule in the same domain that is responsible for word-bound vowel harmony.

(20) *Look-ahead rules*

a. $ʊ \rightarrow u$ __(][)C_0u

b. $ʊ \rightarrow u$ __C_0u (iterative)

Countercyclic approaches that employ look-ahead in this way have been proposed by Odden (1990, 1993, 1996)[7] to account for Kimatuumbi and by Andersson (2020) to derive Hijazi respectively. An approach that has look-back is virtually very similar, with the difference that the rule block in (20) would only apply after the two words form a cycle together. This shows that the adoption of either look-back or look-ahead weaken the restrictiveness of cyclicity massively.

In the next section, I will discuss the chief mechanisms that enforce the No Countercyclicity hypothesis in different cyclic models of phonology.

2.3 Enforcement strategies

2.3.1 Bracket erasure

Bracket erasure is the most traditional means to block a rule in an outer cyclic domain to behave like a rule in a previous cycle in a non stipulative way. It is, in fact, almost

[7] The substantial loss of restrictiveness of Odden's framework has been pointed out by Pak (2008: 241).

as old as cyclic phonology itself and was introduced in SPE (Chomsky & Halle 1968) with the definition in (21).

(21) Chomsky-Hallean Bracket Erasure
Given the nested constituents
$[\ldots[\ldots]_{n\text{-}1}\ldots]_n$
the first rule of cycle j is: Erase brackets j-1.
(Pesetsky 1979 based on Chomsky & Halle 1968: 15)

Under this definition, a process can only be sensitive to the outermost brackets, which are concomitant with the edges of the current cyclic domain. This excludes a look-back generation of the language in (17). Assume that at a first cycle no phonological rule applies, only the interior brackets are deleted, as in the derivation in (22). At the next cycle, the two words are computed together. As a first rule, interior brackets are deleted. Now, we have our two rules in a counterfeeding order. The first rule applies and tenses non-iteratively a single vowel. This vowel is tense in the desired output [lʊtu putuku], so this is not necessarily a bad step. The second rule cannot apply across brackets. However, due to bracket erasure, there are no brackets, so the rule applies across the board. This derives a language where there is factually only one vowel harmony process, which is not word bound.

(22) *Strict Bracket Erasure blocks countercyclic counterfeeding*

Cycle φ_1	
[[pʊtʊ]ku]	Input
[pʊtʊku]	Bracket erasure

Cycle φ_2	
[[lʊtʊ][pʊtʊku]]	Input
[lʊtʊ pʊtʊku]	Bracket erasure
[lʊtʊ pʊtuku]	ʊ → u __(][)C_0u
[lutu putuku]	ʊ → u __C_0u (iter)

*[lutu putuku]	Output

I will call this form of bracket erasure strict bracket erasure. No internal brackets are accessible at a subsequent cycle. Bracket erasure was significantly modified by Pesetsky (1979). (23) is the formulation of Bracket erasure that arguably most phonologist are familiar with.

(23) Pesetskian Bracket Erasure (Pesetsky 1979: 35)
Given the nested constituents
$[\ldots[\ldots]_{n\text{-}1}\ldots]_n$
the last rule of cycle j is: Erase brackets j-1.

Bracket erasure is still a rule, but its is not the first rule of any cycle any more, but its last. That effectively means that all brackets that where the outermost at a previous cycle are still accessible. Depending on the assumption of the relationship of cycles and morphemes, i.e. whether every morphological operation projects a cycle or not, this can actually be many brackets. If we assume that according to Kiparsky (1983) post-lexical phonology has only a single cycle of application and adopt Pesetskian Bracket erasure, phrasal phonology can see the entire morphosyntactic structure above the word. Our hypothetical countercyclic language from (17) can be accounted for with Pesetskian bracket erasure, see (24), but this does not extend to all imaginable countercyclic patterns, only the ones where the relevant brackets have not yet been deleted.

(24) *Weak Bracket Erasure allows countercylic counterfeeding*

Cycle φ_1	
[[pʊtʊ]ku]	Input
[pʊtʊku]	Bracket erasure
Cycle φ_2	
[[lʊtʊ][pʊtʊku]]	Input
[lʊtʊ][pʊtuku]	ʊ → u __(][)C_0u
[lʊtʊ][putuku]	ʊ → u __C_0u (iter)
[lʊtʊ putuku]	Bracket erasure
[lʊtʊ putuku]	Output

Such an interaction is excluded by Pesetsky with another assumption, the strict cycle condition which is discussed in 2.3.2.[8]

It is important to distinguish Bracket erasure as a rule from (strict) Bracket Erasure as a phenomenon. The effect of strict bracket erasure is derived without a bracket erasure rule if the access of phonology to morphosyntactic structure is restricted, see section 2.3.2 and also a.o. Orgun & Inkelas (2001); Bermúdez-Otero (2012); Scheer (2010).

2.3.2 Strict cycle condition

As seen above, a cyclic framework with weak bracket erasure can generate countercyclic interactions. However, if such a framework is combined with the strict cycle condition (SCC; Kean 1974; Mascaró 1976; Kiparsky 1982, 1985), (most) countercyclic interactions can be excluded. The initial empirical motivation for the SCC was to

[8]Furthermore, there have been stipulations on which way rules can refer to brackets. In SPE, a rule can be triggered, but not blocked by brackets, cf. Brame (1974). This is an unnecessary stipulation, because given the adoption of strict bracket erasure in SPE, there are no potentially blocking brackets. This stipulation can be subsumed under Kean's definition of the strict cycle condition, but only partially under later definitions like the one in (Mascaró 1976): If a process P bound by domain D_i is fed by a rule Q applying in D_{i+1}, it cannot apply under Kean's SCC, but it can apply under Mascaró's SCC. The pattern prevented with either Kean's SCC or the additional stipulation on rules is a subset of the feeding countercyclic interactions discussed in 3, which I call there breaching patterns.

derive cyclic counterfeeding[9] without resorting to different rule blocks. In its first version, see (25), it blocks processes from targetting material in an inner cyclic domain unless a (part) of the environment of the rule is exclusively in the outer cyclic domain.

(25) On any cycle A no cyclic rule may apply to material within a previous cycle B without making crucial use of material uniquely in A. (Kean 1974: 179)

This SCC enforces cyclic counterfeeding if there are two rules in a counterfeeding order in the rule block, compare (26). In cycle i, the first rule is counterfed because it applies before its context is created by the second rule. In cycle j, its context is met but its application is blocked by the SCC.

(26) *SCC enforces cyclic counterfeeding*

Cycle φ_1			
ABC		Input	
—	Rule R	A → E __ D	*counterfed due to rule ordering*
ADC	Rule S	B → D __ C	
Cycle φ_1			
$[[ADC]_iZ]_j$		Input	
—	Rule R	A → E __ D	*blocked by the SCC*
—	Rule S	B → D __ C	
ADCZ		Output	

It furthermore also enforces counterfeeding if the context for the rule is not created by a rule in cycle i, but also by a rule in cycle j.

(27) *Kean's SCC enforces more types of counterfeeding*

Cycle φ_1			
AB		Input	
—	Rule R	B → D ____ Z	
—	Rule S	A → E ____ D	
Cycle φ_2			
$[[AB]_iZ]_j$		Input	
$[[AD]_iZ]_j$	Rule R	B → D ____ Z	
—	Rule S	A → ____ D	*blocked by the SCC*
ADZ		Output	

Here is it where later instantiations of the SCC differ, take clause b. from Mascaró

[9] For Kean (1974), this was its only purpose. Following Mascaró (1976), the SCC has been employed as a tool to derive derived environment effects (DEEs), too. The question of DEEs is orthogonal to the issue of cyclic process interactions, so I will not discuss it further.

in (28).

(28) Strict Cycle Condition (Mascaró 1976: 9)
A cyclic rule R applies properly [*sic*] on cycle j if either a, b or c is met:
a. R makes specific use of information uniquely in cycle j. That is, it refers specifically to some A in $[_j XAY[_{j-1} \dots]Z]$ or $[_j Z [_{j-1} \dots]XAY]$.
b. R makes specific use of information within different constituents of the previous cycle which cannot be referred to simultaneously until cycle j. R refers thus to some A, B in $[_j X[_{j-1} \dots A \dots] Y [_{j-1} \dots B \dots]Z]$.
c. R makes specific use of information assigned on cycle j by a rule applying before R.

This clause allows a rule in an inner cyclic domain to apply at cycle j, if the context was created by a rule in cycle j, even though all elements that condition the first rule are within the brackets of cycle i. There are good empirical reasons to prefer the second version of the SCC, because such feeding interactions are widely attested, see e.g. Mascaró (1976). Both versions of the SCC exclude (some) countercyclic process interactions: Kean's SCC, in fact, excludes all interactions, whereas Mascaró's SCC excludes countercyclic opacity and countercyclic bleeding, but not countercyclic feeding.

Take the countercyclically opaque language from (17). If we simply transfer the analysis with weak bracket erasure, which did successfully derive the countercyclic pattern, from (24), and add the SCC (any definition), word internal vowel harmony is blocked completely, compare (29).

(29) *SCC + weak bracket erasure block countercyclic derivation*

Cycle φ_1	
[[pʊtʊ]ku]	Input
[pʊtʊku]	Bracket erasure
Cycle φ_2	
[[lʊtʊ][pʊtʊku]]	Input
—	ʊ → u __(][)C_0u
—	ʊ → u __C_0u (iter) *Blocked by SCC*
[lʊtʊ pʊtʊku]	Bracket erasure
*[lʊtʊ pʊtʊku]	Output

The derived output is a form in which vowel harmony does not apply at all.

If we assume that the two rules apply at the first cycle as well, we get a different output, yet still not the desired countercyclic pattern. Here, the choice of the exact version of SCC matters. (30) assumes Mascaró's SCC; with Kean's SCC, the second application of the second rule would be blocked in φ_1, yielding the output *[lʊtʊ pʊtuku]. If we can reformulate this rule in some way that it is not iterative, but targets all vowels in its domain simultaneously, so that it is not blocked by Kean's SCC, it will still be blocked from applying in φ_2 This would thus yield the output *[lʊtu putuku].

(30) *Rules on both cycles do not derive the desired pattern*

Cycle φ_1	
[[pʊtʊ]ku]	Input
—	ʊ → u __(][)C_0u
[[putu]ku]	ʊ → u __C_0u (iter)
[putuku]	Bracket erasure
Cycle φ_2	
[[lʊtʊ][putuku]]	Input
[[lʊtu][putuku]]	ʊ → u __(][)C_0u
[lutu putuku]	ʊ → u __C_0u (iter)
[lutu putuku]	Bracket erasure
*[lutu putuku]	Output

Countercyclic counterbleeding is excluded in exactly the same way: If we have a rule that is blocked by brackets applying after a rule that is not blocked by brackets, destroying the latter's context, it is blocked by the SCC from applying in the only context it can apply, in between brackets. Countercyclic feeding however can be derived with Mascaró's SCC. Recall the language from (18), where word-internal palatalisation is fed by phrasal epenthesis. At a first cycle, palatalisation applies word-internally. At the next, phrasal cycle epenthesis applies to a word like [atn] if followed by a consonant or the edge. This epenthesis can feed another cycle of palatalisation, see the derivation in (31). If we adopt Kean's SCC instead, the second application of palatalisation would be blocked, because both the target /t/ and the trigger [i] a within the brackets of the interior domain.

(31) *Mascaró's SCC derives countercyclic feeding*

Cycle φ_1			
[atn]	[at]	[[at]i]	Input
—	—	[[ac]i]	t→c / __i
[atn]	[at]	[aci]	Bracket erasure
Cycle φ_2			
[atn]#	[at][ima]	[aci]	Input
[atin]#	—	—	Ø→ i __C(][)C(][){#,C}
[acin]#	—	—	t→c / __i
[acin]#	[at ima]	[aci]	Bracket erasure
[acin]#	[at ima]	[aci]	Output

Bleeding is different from feeding in so far, that the rule Q which is bled by some process P in the outer domain cannot apply due to the SCC in configurations where it is not bled by P. Imagine Q maps A→B before a C, and P maps C→D before E, and Q is blocked across words. If in a string [[ABC]E] P bleeds Q countercyclically, yielding the output [[ABD]E], Q cannot apply in a string [[ABC]D], where it is not bled, but blocked by the SCC in the second cycle.[10]

A more recent version of the SCC, but even stronger than Kean's version, can be found under the name Phase Impenetrability Condition (PIC), motivated from syntax (Chomsky 2001) and employed in (some) phase-based cyclic architectures (Marvin 2002; Samuels 2012). (32) gives a description of the PIC in phonology from Pak (2008).

(32) 'where phonological rules apply directly to the spelled-out content of each cycle *minus what has already been spelled out on previous cycles*.'
(Pak 2008: 23, emphasis in original)

The PIC is a super strong version of the SCC. Under the SCC, material in an inner cycle is still accessible to modification, as long as the modification is motivated by some element that was not present in that former cycle. The PIC goes beyond this: The previously computed material cannot be altered any more. The PIC derives cyclic counterfeeding and excludes countercyclic interactions, but it also excludes very many well motivated cyclic interactions, see Newell (2017) for a discussion.

2.3.3 Restrictions on inter-modular information availability

It has been observed multiple times, that one module – modules being here Phonology and Morphosyntax[11] – does not generally refer to features of the other module. Thus, multiple mechanisms of different strength have been proposed, that restrict the accessibility of information of a different module for the computation of the other. The most radical of those is the No-Reference-hypothesis, named so by Šurkalović (2015), and proposed among others by Scheer (2010); Bye & Svenonius (2012); Orgun & Inkelas (2001). For some, No-Reference is axiomatic, compare e.g. Newell & Sailor (to appear); Scheer (2012).[12]

Under No-Reference thus, a phonological process cannot make reference to morphosyntactic constituents, as the constituent structure is morphosyntactic information. It has thus a similar effect to strict bracket erasure: If no phonological process can refer to morphological features and brackets, internal brackets have no bearing on phonology. In a structure like (33), no rule can pick out the first BA substring by

[10] As mentioned in footnote 8, if this version of the SCC is enriched with the stipulation that rules cannot be blocked by brackets, countercyclic feeding is excluded, too.

[11] Whether morphology and syntax are part of the same module or not is an orthogonal question.

[12] No-Reference defined like this has problem in deriving phonologically conditioned allomorphy. It thusly needs some weakening, too, Scheer (2016) suggests that some morphological operations can be sensitive to some phonological features, like syllable count and the difference between consonant and vowels.

referring to brackets, because no rule can refer to brackets.[13]

(33) [[BA]BA]

Another widely adopted implementation of restricted reference is the INDIRECT-REFERENCE-HYPOTHESIS (IRH: Selkirk 1984; Nespor & Vogel 1986; Hayes 1989). It states that no phonological process may refer to (morpho)syntactic domains, instead they refer to prosodic domains. Prosodic domains are phonological structures that are built with respect to morphosyntactic structure. This building can be a list-like mapping, eg. in Selkirk (1986); Nespor & Vogel (1986); Orgun & Inkelas (2001); Lee & Selkirk (2022) or derived in phonology without reference to morphosyntactic information, purely based on cycle size and dominated prosodic structures, as in Šurkalović (2013, 2015). If so, the IRH is compatible with NO-REFERENCE. More often, it is assumed that the building of prosody takes place in the phonological module, and that the processes that built prosody are sensitive (to some) morphosyntactic elements, namely brackets and major labels, compare among many others Selkirk (1995); Truckenbrodt (1995). An recent implementation is given in (35).

(34) **Indirect Reference Hypothesis** (Bermúdez-Otero 2012: 74)
A phonological constraint may not refer to syntactic, morphological, or lexical information unless to require alignment between designated prosodic units and the exponents of designated syntactic (word-syntactic or phrase-syntactic) nodes.

Bermúdez-Otero (2012) restricts the interaction between modules with three hypotheses, the version of the IRH as in (34), the 'morph-integrity hypothesis' which states that morphological operations cannot alter phonological content of morphemes[14], and the Interpretation hypothesis, which states that an output of phonology cannot contain material that is phonetically un-interpretable. The last hypothesis erases syntactic information after any cycle, thus mirroring bracket erasure.

Yet another approach to restrict the morphological and syntactic information phonology has access to can be found in the turbidity/morphological colour assumption (van Oostendorp 2008a; Trommer 2011; Revithiadou 2008), which supposes that phonology cannot access morphological information except for affiliation of phonological material to morphemes. This is arguably not really a morphological feature, but rather an interface feature, as it cannot be defined without accessing the

[13] Strict bracket erasure makes no statement on morphosyntactic features. Therefore, while NO-REFERENCE would exclude a rule like (i), which refers to the syntactic type of an outermost bracket, Such a rule is not excluded by strict bracket erasure alone.

(i) A → B __]$_{\text{PERFECT}}$

[14] However, morphology must be able to access (but not alter) phonological information for allomorph selection and arguably morpheme placement with mobile affixes, see e.g. Kim (2010, 2015), and infixation, see Yu (2007); Kalin (2020, 2022a).

phonological structure. In the following, we will discuss how the assumptions on reference shape the predictions of a cyclic framework.

Bracket Erasure as a rule, and the Strict Cycle Condition as a concept are incompatible with No-Reference. If bracket erasure is a rule that applies in phonology, it violates No-reference because it can see and alter morphological material. Any rule that refers to brackets is excluded by No-reference and mostly adopting the IRH, too. The strict cycle condition cannot be maintained, because it crucially blocks phonological rules from applying if target and trigger are within morphological boundaries, which the phonological rule, if it has restricted reference, should not be able to recognise. This extends to turbidity, where the information on which morphemes are more embedded is not available (i.e. morpheme boundaries are visible but no hierarchy). On the other hand, No-reference delivers the effect of strict bracket erasure without further assumptions, as observed by Orgun & Inkelas (2001). The IRH derives the effect of strict bracket erasure partially: regular processes cannot refer to morphosyntactic brackets or labels, and behave thus as if strict bracket erasure would apply. This is however not true for prosody building operations. Approaches that adopt turbidity and cyclicity (Trommer 2011; Paschen 2018) assume that morpheme affiliation can only be distinguished if the morphological operation of concatenation did not undergo a round of phonological interpretation. This is very similar to Bermúdez-Otero's 2012 condition on phonetic interpretability and reduces the number of morphemes discernible at each cycle. It somewhat mirrors the effect of Pesetskian Bracket Erasure, but cannot derive the countercyclic patterns as easily, because, while it can restrict a process to a monomorphemic string, it cannot restrict a process to the *most embedded* monomorphemic string.

2.3.4 Modular interleaving

The strategies we have seen so far block counter-cyclic look back, meaning that the derivational history is inaccessible at the current step of the derivation. However, they do nothing to rule out look-ahead. Consider (35a): If we are at the computation of cycle φi, neither bracket erasure, the strict cycle condition nor modular assumptions can block a rule like (35b).

(35) a. $[[AB]_{\varphi i}\ C]_{\varphi j}$
b. $B \rightarrow D\ /\ \_\_\ C$

This is an issue shared by all phonology morphosyntax interface theories that order all morphosyntactic operations strictly before all phonological operations. Most theories of this type either tacitly assume some mechanism that blocks look-ahead, such as SPE, or explicitly adopt look-ahead as part of their framework (Odden 1990, 1993, 1996), making their framework functionally counter-cyclic. More recently, post-syntactic frameworks have used the conception of parallel phonological and syntactic computation and 'multiple spellout' (Uriagereka 1999; Chomsky 2001) in order to derive the absence of lookahead, for example Pak (2008); Newell (2008); Newell & Piggott (2014), the latter reduce the (problematic) PIC to an implementation of no-lookahead.

On the other hand, in frameworks that order at least some morphosyntactic operations after phonological operations, some cyclicity with no look-ahead falls out automatically. Imagine the morphological operation that concatenates the morphemes α mapping to the phonological string AB and β, mapping to C, and the syntactic operations that collocates the words ABC and DEF. If phonology applies *in between* these two operations, the concatenation of ABC and the juxtaposition of ABC DEF; and if there is a rule that would be sensitive to the presence of D, such as C → G / B__D, the rule cannot apply, because DEF is not yet merged. The invisibility of D is not a stipulation, it is invisible because it is not there. The vast majority of cyclic frameworks adopt a form of interleaving, amongst many others Pesetsky (1979); Kiparsky (1982); Pak (2008); Orgun & Inkelas (2001); Bermúdez-Otero (2012); Trommer (2011); Sande et al. (2020). A strong empirical argument for interleaving comes from allomorph selection, arguably a morphological process (cf. Paster 2006), which can be sensitive to phonological output derived at a previous cycle, compare Hargus (1993), or to predictable phonological information which is arguably not part of the underlying representation, such as allomorphy sensitive to predictable stress or syllable count, for the latter compare e.g. Paster (2005).

The question of interleaving is independent from the debate of pre- or postsyntactic morphology. Pre-syntactic morphology can be in principle combined with a strict modular sequence Morphology → Phonology → Syntax or Morphology → Syntax → Phonology, even if it is in practice in the field mostly combined with the assumption of interleaving, compare the immense corpus of work within Lexical Morphology and Phonology (LMP). In theories that assume postsyntactic morphology, the question of interleaving is also open. Phonology can be interwoven with the morphological module, as in many implementations of distributed morphology (DM, Halle & Marantz 1993 *et seq*), or strictly ordered thereafter. Most approaches in post-syntactic morphology do indeed assume interleaving; however, all the approaches without interleaving mentioned above assume post-syntactic morphology.

2.4 Cyclic Theories: Cycles and Rule blocks

In the short history of modern theoretical phonology, many cyclic theories have been proposed, so that this cannot be more than a cursory glance over some of the more influential and some more recent cyclical proposals. Cyclic models can be combined with diverse systems of computation, from extrinsically ordered rules (e.g. LMP, Kiparsky 1982; Mohanan 1986; SPE-style systems, Chomsky & Halle 1968; Brame 1974; Kean 1974), to constraints (e.g. Stratal OT Kiparsky 2000; Bermúdez-Otero 1999; cophonologies Orgun 1997; Sande et al. 2020) and even to intrinsically ordered rules (Bliß 2020). Also, they can assume very different types of representations, for example feature bundles (e.g. SPE), autosegmental representations (e.g. LMP; Trommer 2011), or element-theoretic representations with or without strict CV (e.g. Newell 2021). The questions of representation and computation do in fact impact the restrictiveness of the predictions of cyclicity greatly. The solution that I propose for the observed counter-cyclic patterns is the introduction of prosody, that is, a richer representation. Also, as discussed in chapter 5, the choice of extrinsically ordered rules instead of constraints with otherwise identical assumptions on cyclic architecture and representations can derive a different set of countercyclic phenomena. This section cannot cross-classify the existing theories of the architecture of cyclicity with diverging assumptions on computation and representations and define their predictions, it can merely give an overview over cyclic theories and show where the differences regarding cyclic assumptions lie.

In addition to the enforcement mechanisms discussed above, cyclic theories can be best classified along two questions: what defines a cyclic domain, and how does the number of cyclic domains relate to the number of rule blocks. We find the highest number of cyclic domains in theories that relate the number of morphosyntactic constructions directly to the number of cyclic domains: Every construction induces a cyclic phonological interpretation. Examples for such theories are e.g. SPE and cophonologies. Other theories reduce the number of cyclic domains, so that only certain nodes in the morphosyntactic tree trigger a cyclic domain. In Halle & Vergnaud (1987), some nodes are marked for being cyclical, while others are not. This is a lexical property. In LMP and Stratal OT à Kiparsky (2000, 2015), the utterance is a cyclic domain, the morphological word, and the stem, and any node dominated by the stem. In Stratal OT à (Bermúdez-Otero 2012), the last clause does not hold: there are only three nested cyclic domains, utterance, word and stem. In phase-based theories, the cyclic domain is defined by the phase, either as the complement of the phase head (e.g. Pak 2008), the phase-head phrase (Sande 2019) or, depending on the phase in question, both (Newell 2008).

The number of rule blocks is in most theories inferior to or equal to the number of cycles. In some theories, the number of rule-blocks is fixed. The lowest number of rule blocks is of course 1, that is, a system in which each cycle has the same phonological computation. Formally, SPE has only one rule block, although this is technically not quite accurate – because rules can be lexically indexed to (not) apply in certain morphological environments, SPE behaves factually more like a cophonology model where every cycle can have its unique set of rules (cf. Orgun

& Inkelas (2001)). I am not aware of a fleshed out proposal with ordered rules of a single rule block applying to each and every cycle without lexical or morphological exceptions or adjustments. A recently proposed phonological theory with only one rule block is Harmonic Layer Theory (Zimmermann & Trommer 2021, 2022; Trommer 2023), which has the same three cyclic domains of Stratal-OT without a cyclic stem level (that is, the stem, word and phrase), but only one constraint ranking in every cyclic application of phonology. A phase based framework with a single ranking is developed in Šurkalović (2013, 2015).

Most iterations of LMP and its constraint-based offspring Stratal OT assume three rule blocks, the stem level, word level, and phrase level, but there are deviations assuming higher numbers (e.g. Halle & Mohanan 1985; Mohanan 1986; Odden 1990, 1993, 1996). Kiparsky (1982) implies that the actual number of rule blocks is language specific, but minimally 2. LMP started with the reduction of cyclicity in Phonology, by assuming that postlexical phonology has no internal cycles (Kiparsky 1983), and LMP-like theories underwent a further reduction of cyclicity: In the early works (e.g. Kiparsky 1982, 1983) all lexical rule blocks are internally cyclic, so if you imagine a morphological structure as in (36), phonology applies six times (ignoring phrasal phonology),with four cycles of applications of stem-level phonology and two cycles of application of word-level phonology.[15]

(36) $[[[[[[a]b]c]d]_{\Sigma}e]f]_{\Omega}$

In the mid eighties, multiple people suggested more or less simultaneously that the word level, or second lexical level, should not be analysed as internally cyclic leaving the stem level as the only internally cyclic rule-block (Kiparsky 1985; Booij & Rubach 1987). Halle & Mohanan (1985) suggest a variation of this: In their framework, English has 4 lexical strata, two of which, level 1 and 3, are internally cyclic. The mainstream understanding of a non-cyclic stratum is that all morphosyntactic operations (relevantly concatenation and linearisation of words) happen before the rules of the non-cyclic rule block are applied. Borowsky (1993) however, while following this convention for phrasal phonology, argues that word level phonology is computed before the actual word level affixes are available.

The last step of decyclication of LMP-like theories was done in Stratal OT by Itô & Mester (2001) and Bermúdez-Otero (2012), who propose that no rule block is internally cyclic. Bermúdez-Otero (2012) states that not even the stem level has truly cyclic derivations, and that observed, stem-internal cyclic effects are attributable to storage. There were rule based predecessors to this, for example Mohanan & Mohanan (1984) do assume only internally non-cyclic strata. However, not all versions of Stratal OT adopt a non-cyclic stem level, a cyclic stem-level is maintained

[15]There is a long-standing and, as far as I can see, unsettled debate on whether the root alone constitutes a cycle or not, see e.g. Kean (1974); Mascaró (1976); Kiparsky (1982, 1985, 2021); Trommer (2011) for different positions. I argue that this debate is not of the essence in the questions discussed here, so I will put it aside.

by Kiparsky (2000) *et seq*. Inkelas (2014) reviews the evidence for processes that seem to apply with every morphological operation, and are thus evidence for cyclicity narrowly defined, and concludes that we hardly find processes that behave that way, except for stress and syllabification. This suspicion is old, it was already voiced by Brame (1974) and Kaisse & Shaw (1985), who however had access to less data. The strongest reduction of both cycles and rule blocks in a level-ordered framework can be found in Itô & Mester (2001), who assume only two cycles, the phrasal cycle and the word cycle, with two rule blocks.

Another theory that has only two rule blocks is found in Halle & Vergnaud (1987).[16] There are two rule blocks: The cyclic rule block is triggered whenever a cyclic affix is merged, and the non-cyclic rule block after the word is complete. Different from LMP approaches, the cyclic and non cyclic affixes are not ordered, but can be interspersed.

In the theories that can be bundled under the name *cophonology theories* (Orgun 1997; Orgun & Inkelas 2001; Inkelas, Orgun, & Zoll 2004) the number of rule blocks is identical to number of construction types. This is in very many cases identical to the number of cycles, but not quite. The number of cycles is equal to the number of construction *tokens* in a given utterance. If we have a the same morpheme twice in a given structure with n constructions, we have n cycles but n-1 rule blocks, just that one rule block is applied twice. Differently from Halle & Vergnaud (1987), or Stratal OT, where the rule blocks are strictly ordered, there might be rule-block-looping. A rule block is triggered by some construction A, than a construction B triggers another rule block, and later the repetition of structure A in the derivation as a hierarchically higher structure A that contains B, leads to the re-application of rule block A again, as in the structure in (37). In classical Stratal Phonology with an internally cyclic stem level, all iterations of the stem level rule-block precede the iteration of the word level rule-block (pace Mohanan 1986; Halle & Mohanan 1985 who propose a restricted looping mechanism for LMP).

(37) $[[[[[a]b]f]_A d]_B f]_A$

The last type of cyclic frameworks ties the cycles of phonology more closely to a syntactic analysis. In phasal theories, most people (Newell 2008) assume that the number of phases determines the number of rule blocks, but there are deviations. In Pak (2008), each phase consist of two cyclic domains with two rule blocks, plus there is a final, utterance-spanning domain with a separate rule-block. In *Cophonologies by Phase* Sande et al. (2020), the phasal ranking is determined by a calculus that considers not only the phase head, but also morphemes dominated by it. The number of rule blocks employed in a derivation is thus still equal to the number of phases, but the number of rule blocks that exists in the grammar is far higher and is a function of the possible combination of morphemes in a phase.

[16] However, it ignores phrasal phonology, so it is unclear what assumptions are taken in that regard.

Models can be classified for whether they employ every rule block in every derivation (LMP; Pak 2008; Halle & Vergnaud 1987), or whether there are more rule blocks in the language than in a given derivation, as in cophonologies or cophonologies by phase (Orgun 1997; Sande et al. 2020). A model in which there is only one rule block trivially employs this one rule block in every derivation. Models with fixed rule blocks tend to use them in every derivation, such as Stratal OT, where every utterance potentially shows effects of all three levels. In cophonology theories, the number of of rule blocks depends on the number of vocabulary items (Rolle 2018a) or constructions (Orgun 1997). Since every utterance, in practice, contains only a subset of constructions and vocabulary items available in a language, the derivation does only use a subset of rule blocks. For phasal theories, it depends on the assumptions: In Pak (2008), there is only one phase (CP, which can be stacked), which consist of two internal cycles with a rule block each. It is not fully clear whether the cycles are triggered if the phase consist only of a non-empty terminal, as they are tied to linearisation and concatenation, but otherwise all three rule blocks are employed in all derivations, assuming that every utterance is a CP. However, phasal theories that assume that e.g. vP is a phase, have no reason to assume that the rule block associated with vP plays a role in an utterance like 'the lamb', which clearly lacks a vP. If they have a vP associated rule block, it should not apply to that utterance. Cophonologies by Phase, lastly, is very explicit on their assumption of number of rule blocks (Sande et al. 2020: 1221). The ranking (=rule block) of a phase P is determined by the weightings introduced by each morpheme inside P. If P dominates another phase P', the morphemes in the latter phase do not contribute to the algorithm that derives the Rule block for P. (38) is an approximation for the formula that can give us the number of rule blocks in a system with cophonologies by phase. The number of rule blocks that can be associated with a first phase (phase that does not dominate a phase head) is equal the number of elements of the power set of the vocabulary items that can be inside this first phase. This is an approximation, because not all combinations of vocabulary items will be possible, some will participate in disjunctive blocking. The next embedding phase's number of rule blocks is equal to the cardinality of the power set of its vocabulary items minus the vocabulary items included in the embedded phase. The last subtraction in (38) is necessary to not count the empty sets, because if there are no VIs in a phase, there is arguably no phase and no rule-block.[17]

(38) a. $(2^{|VI(nP)|} + 2^{|VI(vP)|} ... + 2^{|VI(CP)|}) - n(Phase)$

b. VI(Phase P) is the set of vocabulary items that can be either in the complement of Phase P or express its head, minus those that can only be part of the complement if also dominated by another phase-head, or are a phase head themselves.

[17] Similarly, all combinations without a phase head must be excluded, too.

What also distinguishes theories is whether rule-blocks are strictly ordered, or may be looping. Stratal OT and most versions of LMP assume strictly sequential rule blocks, whereas the order of rule blocks follow in Cophonologies[18] and Phasal theories from the syntactic structure and allow for looping.

All the assumptions on cyclic domains and rule blocks are freely combinable with the enforcement strategies mentioned before. Table 2.1 gives an overview over the assumptions relevant for cyclicity adopted by some influential implementations of cyclicity in phonology. As mentioned before, a theory, even if known under a common name, can be and it is often associated with different cyclic assumptions in different papers, even by the same author. It is therefore not possible to give a definitive set of features for, let us say, LMP, and not even LMP as intended by Kiparsky. The overview thus compares only specific implementations of theory families.

2.4.1 Restrictions on Rule Blocks

Another orthogonal difference that distinguishes between cyclic theories lies in which way they allow different rule blocks to differ from each other, and whether there are universals that hold for specific rule-blocks. In fact a lot of the research within LMP in the eighties dealt with these questions, see sources cited below.

As said, the restrictions on rule blocks can be arrived at in two fashions: One can make the rules of a rule-block A dependent on the rule block B, or make it dependent on the structure of the rule or process itself. The first strategy to constrain rule blocks led first to the strong domain hypothesis (Kiparsky 1984, 1985; Borowsky 1986; Myers 1991), which states that if a rule belongs to a rule-block RB_i, it must also belong to a previous rule-block RB_{i-1}. This hypothesis has strong empirical problems and was consequently abandoned, see e.g. Mohanan (1989); Inkelas & Orgun (1995); Popp (2022). Another, diametrically opposed, hypothesis was advanced by Booij & Rubach (1987), who propose that a rule can only belong to one rule block and that rule blocks thus must be maximally different, but they weaken this position in the same paper.

The strong domain hypothesis cannot trivially be transferred into serial OT where different rule-blocks are modelled as reranking, because processes in OT are an epiphenomenon and cannot be referred to directly, unlike rules in rule-based phonology. A proposal to derive the strong domain hypothesis within OT was made by Itô & Mester (1995), who model it with the assumption that while reranking, only faithful-

[18]Phasal theories that adopt a holding bin (Pak 2008) or a strict version of the PIC are somewhat different: If we take Pak (2008) as exemplary, the CP phase phonology is applied multiple times, but to different chunks of linearised string. Thus, CP-phonology is not applied cyclically to them, but only once. In that way,the framework is more similar to LMP, replacing the stem level with the two-word cycle, the word level with the CP cycle, minus the parts already in the holding bin, and having a final cycle that is strikingly similar to a traditional phrase level. If a phasal theory has more phase heads and rule blocks, it becomes less similar to LMP, but the PIC suffices to rule out looping.

	|φ|	|RB|	MIL	Ref.	SCC	BE
Cophonologies						
SPE (Chomsky & Halle 1968)	|C|	d.j. 1; d.f. |φ|	No	R	No	Strict
Cophonologies	|C|	|φ|	Yes	NR	No	strict
LMP-like theories						
Kiparsky (1982)	|M|+1	3	Yes	R	Yes	weak
Kiparsky (1985)	$\|M_\Sigma\|+2$	3	Yes	R	L1	weak
Borowsky (1993)	$\|M_\Sigma\|+2$	3	Yes	R	?	Yes
Booij & Rubach (1987)	$\|M_\Sigma\|+2$	3	Yes	R	L1	Yes
Halle & Mohanan (1985)	$\|M_\Sigma+M_{L3}\|+3$	5	Yes	R	L1,L3	Yes
Odden (1990, 1993, 1996)	4	4	No	R	Yes	?
Phasal theories						
Pak (2008)	3	3	Yes	R	No	Weak
Sande et al. (2020)	|P|	|φ|	Yes	NR	No	Weak
Šurkalović (2013, 2015)	|P|	1	No	NR	No	Strict
Stratal OT-like theories						
Kiparsky (2000)	$\|M_\Sigma\|+2$	3	Yes	IR	No	Strict
Bermúdez-Otero (2012)	3	3	Yes	IR	No	Strict
Trommer (2011)	4	4	Yes	IR	No	weak
Itô & Mester (2001)	2	2	Yes	IR	No	?
Other cyclic theories						
Halle & Vergnaud (1987)	$\|M_c\|+1$	2	No	R	Yes	?
Harmonic layers	3	1	Yes	Yes	No	?
d'Alessandro & Scheer (2015)	≤|P|	?	No	Yes	PIC	Strict
This proposal (PaC)	3	3	Yes	IRH	No	strict

Table 2.1: Cyclic and interface properties of some cyclic frameworks in phonology
|φ| = number of cycles of phonology (the most embedded) root is submitted to in a given derivation, values: |C| = equal to number of constructions, |P| = equal to number of Phases, |M| = equal to number of morphological constructions, $|M_\Sigma|$ = equal to number of stem level morphological constructions, $|M_c|$ = equal to number of cyclic affixes; |RB| = number of rule blocks in a given derivation, values: |φ| = (potentially) equal to number of tokens of cycle-heads; MIL= Modular interleaving, value: Yes, No; Ref. = possible reference to morphosyntax, values: R = free reference, NR = No reference, IR = Indirect reference; SCC = strict cycle condition, values: Yes, No, Stratum at which SCC applies, PIC= inviolable Phase impenetrability condition; BE= Bracket Erasure, values: strict = only exterior brackets, weak= exterior brackets and exterior -1 brackets.

ness constraints can be moved, and they can only be promoted, that is, become more important. Conversely, Popp (2022) proposes that it is only markedness constraints plus the faithfulness constraint DEP against epenthesis that can be moved, precisely, demoted.

Orgun (1997) argues that effects attributed to the domain hypotheses follow from extralinguistic factors, principally learnability. The question of relations between rule blocks is intimately related to the question whether stratal architectures overgenerate, discussed more in depth in chapter 3.1.2.

The second approach of restrictions claims that lexical and post-lexical rules (Or cyclic and postcyclic rules) are structurally different and behave differently. Many criteria that distinguish between the two types of processes have been claimed, however, there have been exceptions for almost every one of those criteria, for a comprehensive overview, see Kaisse & McMahon (2011). Thus, it is true as a tendency that postlecxical processes are different from lexical processes, those differences are not universal and cannot be hardcoded in phonology.

2.5 Summary

Cyclic frameworks in phonology can be vastly different from each other and can be distinguished along many parameters. Crucially, all cyclic frameworks, as long as they have enforcing mechanism, predict NO-COUNTERCYCLICITY. However, especially the assumptions on what constitutes a cyclic domain have an impact on what concrete interaction is countercyclic. Imagine a process P feeding a process Q, P being in a bigger domain that would be considered word level in LMP, and Q in a smaller domain, equivalent to a typical stem level. In LMP, this is countercyclic. If we adopt a bicyclic approach that distinguishes only lexical from post-lexical phonology as cycles, such as in Itô & Mester (2001), the same interaction would not be countercyclic.

As I will elaborate in the present work, there are cases which are countercyclic and cannot be derived if the most principled enforcement mechanisms are adopted – interleaving and NO-REFERENCE. The way forward could now be threefold: A first option is to accept the countercyclic data-points as conclusive arguments that phonological architecture is not cyclic, and that the observed cyclic effects must have other explanations, such as Output-Output correspondence. A second option would be to argue that the countercyclic cases are indeed cyclic, just with different and unconventional cycles. Such an approach has been pursued e.g. by Pak (2008) or McPherson (2019) in order to derive unusual domains. However, it is not obvious that those approaches can be transferred to the countercyclic data at hand. Nonetheless, such an endeavour is most certainly a worthwhile project for future research. The third option is to weaken one of the enforcing mechanisms, and this is the path that pursue. I suggest weakening modularity by adopting the Indirect Reference Hypothesis[19] Prosodic structure, if it aligns with a cyclic domain, can function as a sort of memory device, which can restrict processes at later cycles seemingly to domains of the size of previous cycles. In the next Chapter, I will discuss prosody and the prediction on countercyclic interactions that can be derived by a framework that has both prosodic and cyclic domains.

[19]Depending on the mechanism that is assumed for the construction of prosodic structure, the IRH needs not to be an abandonment of NO-REFERENCE. However, I will follow the mainstream mechanism of prosodic structure constructed in phonology proper, which implies some type of reference.

Chapter 3

Prosody and Cycles (PaC)

This chapter will be somewhat Janus-headed. In the first part, I will breifly discuss the history and reasoning behind prosody, and the indirect reference hypothesis (IRH). This will focus on the interplay between cyclic assumtions and prosodic assumptions, where we can delineate three camps: There is only one 'chunk building' mechanism in phonology, and it is the cycle (Seidl 2001; Pak 2008; Scheer 2010, 2012), There is only one 'chunk building' mechanism in phonology, and it is prosody (Golston 1996; Buckley 1996), and prosodic and cyclic domains coexist (i.a. Booij & Rubach 1984; Nespor & Vogel 1986; Bermúdez-Otero 2011, 2012; Bermúdez-Otero & Luís 2009; Šurkalović 2013, 2015).[20] Then, I will sketch out how the assumption of prosody can derive a case of attested countercyclicity from C'Lela (Dettweiler 2015; Gleim 2020), the full analysis of the C'Lela pattern follows in Chapter 4.1. After that, I will define the general assumptions that I make for the analyses of the attested countercyclic patterns, both regarding the issues discussed in this chapter and the previous one — cyclic architecture, enforcing mechanism and prosody — but also representation and computation. Lastly, I will discuss which types of countercyclic patterns can be derived under these assumptions, and which are still excluded.

3.1 Prosody

3.1.1 Prosodic structure

Prosodic phonology (i.a. Selkirk 1980, 1984, 1995, 2011; Nespor & Vogel 1986; Hayes 1989) assumes that parts of the segmental string are parsed into nested, hierarchical domains, the prosodic domains. The domains are assumed to come from a finite set which is commonly assumed to be universal, but there is disagreement about the exact number and labels of categories. (39) shows a typical hierarchy of prosodic domains, roughly adapted from Revithiadou (2011), and introduces the symbols I

[20] I fall in the last camp, however, the core line of argumentation is not 'we do need both', but, if we have cyclicity, we need prosody, too. Even though, while discussing the case studies, I will highlight where cyclicity is still crucial and cannot be replaced by prosodic domains.

use.[21]

(39) *Prosodic Hierarchy*

υ	Utterance
ι	Intonational Phrase
ϕ	Phonological Phrase
ω	Phonological word
FT	Foot
σ	syllable
μ	mora

The utterance υ is often rejected (see e.g. Itô & Mester 2012, 2013 who claim that it can be replaced by recursion of ι), and especially the space between the phonological word and the phonological phrase is often filled with additional nodes, such as the composite group κ in Vogel (2019).

The main argument for prosodic structure comes from non-isomorphism: domains for phonological rule-application do not perfectly align with morphosyntactic domains (Nespor & Vogel 1986; Cheng & Downing 2016). This is almost not controversial for the smaller prosodic categories, the syllable and the foot, whose distribution is almost entirely conditioned by phonological factors, and not morphosyntactic ones. On the other hand, higher prosodic domains tend to coincide with syntactic categories: the phonological word with the morphosyntactic word, and phonological and intonational phrases with specific syntactic phrases. However, the mapping is not strictly one-to-one: Very often, prosodic domains and the roughly corresponding syntactic phrases misalign. For a discussion see Selkirk (2011).

The most striking departure from morphosyntactic domains can be found in binarity constraints. Some prosodic categories are minimally, maximally or ideally binary, that is, dominate two nodes of the respective hierarchically lower category. Binarity restrictions are widely attested for feet (Hayes 1995),[22] and less widely but robustly for phonological phrases, compare Selkirk (2011). A very convincing case of this is found in Gua (Obiri-Yeboah & Rose 2022), others are e.g. from Spanish (Prieto 2006), Taiwanese Mandarin (Shih 2016), Connemara Irish (Elfner 2015), Kinyambo (Dobashi 2010) or Japanese (Selkirk & Tateishi 1988).

[21] The phonological word is synonymously also called prosodic word. I will use both terms interchangeably.

[22] Word minimality demands that a word must consist of two morae/syllables; it does not demand that a word consist of two feet (Hayes 1995). It remains to be seen whether it can be reanalysed as condition on wellformed feet and the, according to Selkirk (1995), inviolable constraint HEADEDNESS which demands i.a. every word to dominate a foot, see (Garrett 1999) for a claim to the opposite.

3.1.1.1 The Indirect Reference Hypothesis

Next to non-isomorphism, the other crucial argument for prosodic structure is the restricted reference that phonological processes make with respect to syntactic structure. Phonology is, in general, responsive to the size of domains and some aspects of their structure, but not to the features, not even major category features, or other aspects of the structure such as depth of embedding if the heads are phonetically zero, for a comprehensive discussion, see Hayes (1989). If the syntactic structure is remodelled at the interface into prosodic structure, and phonological processes refer exclusively to phonological objects such as prosodic structure, these restrictions follow automatically. This principle is known as the Indirect Reference Hypothesis, (IRH), discussed already in chapter 2.5.

3.1.2 Two or one 'chunk building' mechanism?

As pointed out by Golston (1996), allowing for both cyclic domains and prosodic domains leads to a proliferation of ambiguity: A process that applies in a domain D could be either bound to a cyclic domain D, or a prosodic domain D. Two mechanism that do something very similar, namely to group the phonological string into parts with a containment relationship among some (i.e. the stem cycle is included in the word cycle, the prosodic word is dominated by a prosodic phrase), very often with the same results, is superfluous labour and a theory should be reduced to having only one mechanism. Many scholars agree with Golston's judgement, compare Scheer (2012: 18), however, they agree less on which mechanism should be abandoned.

One camp, to which Golston (1996) belongs, is to stipulate that there are no cyclic domains, only prosodic domains. The argument of Golston (1996) is specifically against cyclic phonology with different grammars, such as LMP or Stratal OT, which do not posit limits on how the grammars in the domains may differ. He claims that a language that has e.g. the lexical phonology of English, but the postlexical phonological phonology of Hindi, doe not exist. Kiparsky (2015: 30) convincingly refutes this argument: Such a language is possible, and attested in the form of English with a Hindi accent. Other authors that explicitly reject any serial ordering include Buckley (1996, 1999) and Archangeli & Pulleyblank (2002). The latter issue a similar argument as Golston, namely that a non-cyclic architecture allows for a more principled account of similarities across domains. A recent empirical argument against cycles and in favour of prosodic constituents that does not reduce to countercyclicity comes from Tebay (2022) who argues that cyclic application of well-formedness constraints on root-sized domains overgenerate patterns of interaction between those constraints and infixation. theories that reject cyclicity are mostly couched within OT and thus suffer from the fact that parallel OT cannot derive (all) cases of attested opacity and cyclic effects. However, in principle there is no extrinsic reason against a rule-based approach without cycles that accesses all prosodic domains at once. Such an approach overgenerates massively and predicts countercyclic effects as easily as cyclic effects.

The opposite approach is taken by Kaisse (1985); Odden (1990, 1993); Seidl (2001); Pak (2008); Scheer (2010); d'Alessandro & Scheer (2015), among others. They contend that all prosodic domains can be reduced to domains imposed by morphosyntax, either as cyclic domains or via direct reference to syntactic bracketing and labelling. These approaches do not necessarily reject the lower reaches of the prosodic hierarchy (μ, σ,Ft), since these domains are only marginally affected by morphology and syntax, compare e.g. Odden (1996), who assumes morae and syllables. Scheer (2010) argues that the crucial phonological evidence for feet, binary grouping, is absent for higher prosodic categories. However, as discussed above, this is not accurate, and it is unclear how such a system can derive a pattern like the one observed in Gua. Prosody-less frameworks that allow free reference to syntax are arguably to powerfull and overgenerate, see Hayes (1989) for a discussion. Prosody-less frameworks that have no reference to syntax do not suffer from the same problem. Since the advent of phase theory in syntax (Chomsky 2001), they try to tie phonological domains to syntactic phases (Seidl 2001; Pak 2008; d'Alessandro & Scheer 2015). However, they arguably both under- and overgenerate. For an extensive critique of these non-prosodic, phase-based frameworks see Cheng & Downing (2012, 2016); Bonet, Cheng, Downing, & Mascaró (2019).

The third option is to reject Golston's conjecture and embrace ambiguity. This used to be the standard position within prosodic phonology, see Booij & Rubach (1984); Booij & Lieber (1993) for prominent examples and Scheer (2010) for a summary, and has been recently defended by Bermúdez-Otero & Luís (2009); Bermúdez-Otero (2012). Bermúdez-Otero & Luís (2009) argue that the ambiguity that arises in a framework that has both prosody and cycles is not a problem, but rather, that it is meaningful to categorise processes according to the domains they are restricted by and that processes sensitive to prosodic boundaries have a different behaviour with respect to processes that are sensitive to cyclic boundaries. In the case studies in Chapter 4, I postulate prosodic structure, at times with little more evidence than the one coming from the processes I analyse. Unfortunately, it is outside the scope of the present work to verify whether these prosodic domains behave according to the characteristica adduced in Bermúdez-Otero & Luís (2009).

In the next section, I will introduce the apparent countercyclic interaction from C'Lela and show how a strictly cyclic framework without reference to morphosyntactic features cannot derive the data, but a cyclic framework with prosodic structures can.

3.2 Prosody to the Rescue

In C'Lela, word-final vowels are deleted cyclically, unless they happen to be the very last vowel in a phrase which maps to an at least CP-sized morphosyntactic node. Compare (40) where the final vowel of /gʷɛ̀lɛ̀/ is deleted, whereas it surfaces in (41) where it is not separate from the right edge of the CP. For the detailed data and more comprehensive analysis, see chapter 4.1.

(40) *Phrase medially, word final vowels are deleted*

ɾémɨ́n	**gʷɛ̀l**	írù	dá
ɾémɨ́n	**gʷɛ̀lɛ̀**	í-ɾù	dá
because	goat	DIM-his	not

'because of his little goat'

(41) *Phrase finally, word final vowels are preserved*

àj	mhívkɨ̀ʔù	**gʷɛ̀lɛ̀**
àj	m-hívɨ̀-kɨ̀=ʔù	**gʷɛ̀lɛ̀**
COMP	1SG-steal-PFV=3SG	goat

'that I stole his goat'

In the terms established in the last chapter, this is an instance of countercyclic bleeding. The process associated with the outer, phrasal domain, preservation of the final vowel, bleeds the process associated with the smaller domains, final vowel deletion. Consequently, a cyclic derivation with strong enforcing mechanisms such as NO-REFERENCE or strict bracket erasure fails to account for this data. I will show this here with Stratal OT, but it trivially extends to rule based approaches. At a first level, the root final vowel is deleted, enforced by a constraint *V#[23] see (42).

(42) *Derivation of final vowel deletion*

gʷɛ̀lɛ̀	*V#	MAX
a. gʷɛ̀lɛ̀	*!	
☞ b. gʷɛ̀l		*

If this output is now inserted in a syntactic context where it is not at a phrase edge, everything is fine. However, phrases in C'Lela never end in a consonant. So we do need a final vowel in phrasal phonology, enforced by a constraint *C#. We can satisfy this constraint either by deleting final consonants, or by epenthesising default vowels, but it is not possible to restore the underlying vowel which has already been deleted, see the tableau in (43).[24]

[23] # here is not a boundary symbol in the sense of SPE, it just marks the absolute right edge of the string.

[24] gʷɛ̀lɛ̀ is of course a candidate, too. However, since the epenthetic vowel in C'Lela is [ɨ] – not [ɛ], nor a copy vowel – it will be bounded by the candidate that epenthesises ɨ due to general constraints.

(43) *Derivation of phrasal vowel preservation fails*

	gʷɛ̀l	*C#	*V#	DEP	MAX
	a. gʷɛ̀l	*!			
☞	b. gʷɛ̀lɨ̀		*	*	
☞	c. gʷɛ̀		*		*

Neither the number of cycles nor the assumptions of constraints are what makes this cyclic analysis fail. If we assume more cycles, e.g. that each syntactic node projects a cycle, there are just more cycles of (vacuous) vowel deletion in between the deletion of the word-final vowel and the requirement of the vowel at the (presumably) CP-sized cycle. A rule-based mechanisms that has NO-REFERENCE and does have interleaving runs into the same problem, the only difference is that the 'have a vowel phrase finally' generalisation cannot be enforced by a constraint, but needs some process-specific rule of epenthesis or consonant deletion.

If we however allow prosodic structure that aligns with words, we can derive vowel deletion and non-deletion in parallel on the phrase level. Let us assume that /gʷɛ̀lɛ̀-nɛ̀/ maps to the prosodic structure $[[[g^w\grave{\varepsilon}l\grave{\varepsilon}]_\omega n\grave{\varepsilon}]_\omega]_\phi$. Then, we can reformulate the constraints used above into $*V]_\omega$ and $*C]_\phi$ respectively. If the latter is ranked above the former, we get word-final vowel deletion, except if a word final vowel happens to be phrase final, too. In the tableau in (44), the correct winner is selected.

(44) *Derivation of deletion and preservation in parallel*

	$[[g^w\grave{\varepsilon}l\grave{\varepsilon}]_\omega[\acute{\imath}r\grave{u}]_\omega]_\phi$	$*C]_\phi$	$*V]_\omega$	MAX
	a. $[[g^w\grave{\varepsilon}l\grave{\varepsilon}]_\omega[\acute{\imath}r\grave{u}]_\omega]_\phi$		**!	
☞	b. $[[g^w\grave{\varepsilon}l]_\omega[\acute{\imath}r\grave{u}]]_\omega]_\phi$		*	*
	c. $[[g^w\grave{\varepsilon}l]_\omega[\acute{\imath}r]_\omega]_\phi$	*!		**

It is not entirely straight-forward to transfer this analysis into a rule based system, but nonetheless possible: At the phrasal cycle, a rule that strengthens phrase-final vowels precedes ω-final vowel deletion, the strengthened vowel, then, falls outside the target definition of the deletion rule.

The observation that prosodic structure opens a back door for countercyclic processes was first made by (Kiparsky 1984), quoted in (45).

(45) Of course, postlexical phonological representations may signal word-internal structure indirectly via its lexically assigned phonological reflexes, for example the organization of a word into syllables and feet. (Kiparsky 1984: 136)

To my knowledge, it has not been explored which types of countercyclicty is derivable with a cyclic framework that makes also use of prosodic structure. In the next section, I will lay down concrete cyclic, computational and representational assumptions and then, in section 3.4 discuss which types of countercylicity, next to the C'Lela case, are derivable, and which are still excluded. In chapter 5, this is extended to a rule-based variation.

3.3 Implementation of PaC

The framework I propose for accounting for the allegedly countercyclic patterns in a PaC framework is not revolutionary and largely compatible with the framework laid out and developed Bermúdez-Otero (2011, 2012); Bermúdez-Otero & Luís (2009). In the following, I will make my assumptions explicit, first regarding prosody, then for cycles and lastly for the core computational function of phonology.

3.3.1 Prosodic assumptions

Models of prosodic phonology diverge chiefly regarding three fundamental questions, namely: Where is the prosodic structure built? How is the prosodic structure built? And, which prosodic structures are licit? The last question has arguably been the focus of discussion in the literature on prosodic phonology. In the following, I will give a very brief overview over the proposed answers to these questions and situate my proposal in the field. I will note which assumptions are crucial for the predictions that I make, and which are rather orthogonal.

The first question regards the timing of prosody building, the question whether it precedes phonology proper, or whether it is a part of phonology proper. In early works, the prosodic rules where assumed to be part of the interface, prosody building preceded thus other phonological rules (e.g. Nespor & Vogel 1986). With the advent of OT, it as largely assumed that prosody building and other processes happen in parallel, compare among many others Selkirk (1995, 2011); Truckenbrodt (1995, 1999); Bermúdez-Otero (2012).Scheer (2010) criticises the parallel approach, as it allows phonology to access syntactic information, which is necessary for prosody building. Kratzer & Selkirk (2020); Lee & Selkirk (2022) reimplemented to the view that prosodic structure is built before phonology only with respect to syntax in an OT based framework, where prosodic wellformedness constraints enforce phonological wellformedness after the basic prosodic structure has been built. This question is not crucial for the discussion of countercyclic process interactions. I adopt for the time being the mainstream framework with parallel prosody building and other computation. However, nothing crucial hinges on this, and all analyses in this work can be transferred to a framework in which prosody building happens in the interface and precedes other phonological operations on each cycle.

The second question deals with how the prosody is built, how are the constraints (or rules) formulated that lead to the insertion and construction of prosodic structures. In OT, we can distinguish three wide spread approaches, Align, Match and subcategorisation. With Align constraints, an edge of a prosodic category is forced to align with the same edge, left or right, of a syntactic category, see Selkirk (1995) or Truckenbrodt (1995, 1999) for an early implementation, more recently Bermúdez-Otero (2012); Cheng & Downing (2016). In general, Align constraints (McCarthy & Prince 1993; McCarthy 2003a) count a number of interveners of a certain type between the edges it wants to be aligned. This counting nature is computationally problematic Eisner (1997); Lamont (2021a). Match constraints (Selkirk 2011; Elfner 2015; Ishihara & Kalivoda 2022) are symmetric, they demand that the left and right edges of a syntactic structure align with the left and right edges of a prosodic structure. Compared to Align constraint, they cannot derive non-isomorphism alone, but only in conjunction with phonological wellformedness constraints, compare Selkirk (2011). Recently, there have been proposals to the point that both Align and Match constraints are necessary (Weber 2020; Bellik, Itô, Kalivoda, & Mester 2022).

Prosodic subcategorisation is chiefly employed by approaches with a high number of cycles, such as cophonologies or cophonologies by phase (Sande et al. 2020) or Rolle & Hyman (2018). Here, each morpheme comes with a prosodic subcategorisation that determines the prosodification, non mopheme specific prosodification is, at leat in Sande et al. (2020) phase-sized, derived by a constraint similar to the one in Šurkalović (2013). A last approach is pursued by Šurkalović (2013, 2015), which builds prosodic structure cyclically without referring to morphological or syntactic information, just to previous round of structure building. Like the question of ordering prosody and other processes, the question of how exactly the prosodic structures come about are not crucial to the arguments presented here. My analyses are compatible with any approach, however, for expository clarity I will employ Match constraints when discussing prosody building.

The last question regards which prosodic structures are licit. In the beginning of prosodic phonology, the Strict Layer Hypothesis was assumed, (SLH, Selkirk 1984; Nespor & Vogel 1986; Hayes 1989), see (46) for the original definition from Selkirk (1984). The SLH demanded that every prosodic category must dominate a node of the next lower category, and must not dominate a node of any other category.

(46) **Strict Layer Hypothesis**: A category of level i in the hierarchy immediately dominates a (sequence of) categories of level i-1. (Selkirk 1984: 26)

However, in the nineties the SLH has been considered to be too strict: Selkirk (1995) splits the SLH into four constraints, Headedness which demands a prosodic node to dominate at least one node of the immediately lower category, ie. a Foot must dominate a syllable; Layeredness which is violated by a hierarchically lower node dominating a hierarchically higher node, i.e. a syllable dominating a prosodic word; Exhaustivity, a node must be dominated by a node of the immediately higher level, i.e. a mora must be dominated by a syllable; and NON-RECURSIVITY which is violated if a node is dominated by a node of the same category, i.e. a prosodic word by a prosodic word. Level-skipping and thus the violability of EXHAUSTIVITY are now almost universally accepted. More controversial is recursivity, whereas many people accept recursivity for higher domains such as ι or ϕ, and reject it for lower levels such as σ or μ, it is contested for intervening levels FT and ω.[25] I will follow the mainstream line and accept level skipping without discussion. For recursivity, I assume that recursive prosody is possible including recursive ω. I employ recursive phonological words for my analyses of C'Lela and Kimatuumbi. In Kimatuumbi, the recursion has a depth of three, in C'Lela it is less clear but arguably higher. In both cases, recursion can be replaced by the adoption of more prosodic domains, only to the detriment of elegance. This assumption is thus again not at the core of the present analysis, but a rejection of recursion would have implication on the number and types of presumably universal (cf. Nespor & Vogel 1986: 11) prosodic categories.

Selkirk (1995) assumes that the other two constraints, HEADEDNESS and DOMINANCE are universally inviolable. This is still the predominant position in the field. I follow Selkirk's position and assume that they are indeed inviolable.

A further condition on well-formedness of prosodic structure is known as proper bracketing Nespor & Vogel (1986), see (47) for the definition according to Itô & Mester (1992/2003). It prohibits any prosodic node to be dominated directly by more then one node. Depending on the definition of the SLH, it can be subsumed under the SLH, however, it is not derived from any of the constraints in Selkirk (1995) nor does it follow from the original definition in Selkirk (1984).

(47) **Proper Bracketing**: Every C_j ($\neq C_{max}$) has one and only one mother node (i.e., a given prosodic category cannot simultaneously be part of two or more higher prosodic constituents). (Itô & Mester 1992/2003: 8)

Most accounts in prosodic phonology confirm with proper bracketing. However, there are exceptions, compare e.g. Buckley (1996); Hyde (2002) and more recently Weber (2020) and Tebay (2022). Proper bracketing is crucial for the predictions that I make. A prosodic structure that does not confirm to proper bracketing can derive a wider range of countercyclic interactions, such as the transparent aligned language in section 3.4.3.

3.3.2 Cyclic and Interface assumptions

Based on the characterisation of cyclic frameworks developed in the previous chapter, the cyclic characteristica of this implementation of PaC are the following: I adopt three cycles of phonological computation, each with potentially its own rule block

[25]For arguments in favour of recursive feet, see e.g. Martínez-Paricio & Kager (2015, 2021), for arguments against recursive feet, compare Golston (2021). Arguments in favour and against recursive prosodic words are discussed in Chapter 4.1.2.

(Kiparsky 1985, 2000, 2015; Borowsky 1993; Bermúdez-Otero 1999; Bermúdez-Otero 2011, 2012, 2018). I follow Bermúdez-Otero (2012) and not Kiparsky (2015) in so far in that I assume an internally non-cyclic stem level, this is important for the analysis of Chamorro in Chapter 4.5, where a cyclic stem level would derive an incorrect stress pattern. In section 3.4.2 I show that the intermediate level makes it possible to derive a specific unattested countercyclic pattern. This overgeneration could be avoided if the number of strata was reduced to two, as in Itô & Mester (2001, 2003). However, I generally accept the evidence for three strata crosslinguistically Bermúdez-Otero (2012), and this extends to the languages discussed here: The PaC analyses I propose for Icelandic, Chamorro and Kimatuumbi all crucially require three strata. Regarding the interface with morphology and syntax, I adopt the Indirect Reference Hypothesis (IRH) and interleaving of morphosyntactic operations and phonology. I also adopt the Generalised non-linear affixation hypothesis (GNLA, Bermúdez-Otero 2012; Bye & Svenonius 2012), which together with the IRH entails that there are no morpheme or construction specific rules or processes. Lastly, I adopt the position that allomorph selection is not phonological optimisation, but a process that happens either in morphology or at the interface prior to phonology (Paster 2006). However, since morphology and phonology are interleaved, allomorph selection can be fed or bled by phonological processes on a previous stratum.

3.3.3 Computational assumptions

For this work, I adopt a constraint based computation in Optimality Theory (OT, Prince & Smolensky 1993) and Correspondence Theory (McCarthy & Prince 1994, 1995). Both assumptions are important for the predictions I make because they limit the number of possible process interactions. I will first discuss OT, before coming to correspondence. OT, generally, can account for transparent interactions but not opaque interactions (McCarthy 1999, 2007b,a; Baković 2007). This is the major undergeneration problem for classical, parallel OT (de Lacy 2007; Iosad 2018), because opacity is widely attested, productive, and psychologically real (cf. Al-Mozainy 1981). Cyclic versions of OT do not have the same problem, because derivations have some degree of seriality, opacity can be derived where it aligns with cyclic constraint evaluation (Kiparsky 2000, 2015; Bermúdez-Otero 2012, 2018). Similarly, Harmonic Serialism (McCarthy 2008, 2016), a serial but not cyclic implementation of OT, can account for some opacities via the sequence of operation of the generator GEN. Fully parallel implementations of OT require other mechanisms, such a sympathy constraints (McCarthy 1999), candidate chains McCarthy (2007b), local constraint conjunction (Łubowicz 2002; Smolensky 2006) or transderivational constraints (Benua 1997; Kager 1999). All of those are problematic either for reasons of overgeneration or computation, for a discussion see e.g. McCarthy (2007b); Pater (2016) for local conjunction, Kiparsky (2000); Rasin (2024) for sympathy, Kaplan (2011a) for candidate chains and Bermúdez-Otero (2011); Trommer (2013); Kiparsky (2015); Gleim & Rasin (to appear) the discussion in chapter 5 for transderivational constraints. I do not adopt any of these mechanisms and contend that the limited degree to which Stratal OT can derive opacity is an advantage: As will be discussed in section 3.4, it reduces the number of predicted countercyclic patterns. As discussed in chapter 5.3, a framework that allows for opacity more easily such as rule based phonology is less restrictive.

Correspondence Theory (McCarthy & Prince 1995) is commonly considered to be an integral part of OT in general, cf. Lamont (2024). However, the earliest versions of OT do not use correspondence, but containment (Prince & Smolensky 1993). In containment, the generator cannot delete material, only mark it as invisible. Therefore, constraints can still refer to deleted material, or input configurations in general, cf. Goldrick (2000); van Oostendorp (2006, 2008c); Revithiadou (2008); Trommer (2011). This makes it possible to derive opaque interactions that are not derivable under correspondence. The space of opacities that containment can derive without serial process application is still somewhat ill defined, and defining it is outside the scope of this dissertation. However, since it is less restrictive in deriving opacity, it is most likely that it can also derive more countercyclic process interactions.[26] Summarised, I adopt Stratal OT with Correspondence Theory as a mapping mechanism and fairly standard constraints.[27] In the next sections, I will address the basic faithfulness constraints I adopt for prosodic affiliations, and then discuss restrictions of phonological processes to prosodic domains.

3.3.3.1 Prosodic faithfulness

Even though most research in prosodic phonology couched in OT does not reject cyclicity outright, it tends to ignore previous cyclic evaluations, and inputs typically do not have prosodic structure. Therefore, most prosodic mapping approaches consider constraints for the syntax-phonology mapping, such as MATCH, and phonotactic constraints, such ϕ-BINARITY, but do not include faithfulness constraints. For a cyclic and prosodic approach in OT it is paramount to define a set, or scheme for deriving a set, of constraints that penalise unfaithful in out output mappings. Those constraints cannot derive from the three basic faithfulness constraint DEP,MAX and ID, because a change of association between a prosodic or melodic node and a prosodic node does not necessary involve deletion, insertion or feature changes.

I suggest the following basic constraints schemata in (48). *INTEGRATE penalises the insertion of new material into an existing prosodic structure, and *EXCORPORATE penalises the taking out of some node from an existing prosodic structure.

[26] Containment is more restrictive in other areas, it cannot derive (true) metathesis, coalescence, or fission (Zimmermann 2009; Zaleska 2020). Correspondence can be restricted accordingly, if indices are not allowed to reorder and must have a one-to-one association with a phonological element.

[27] Some standard constraints have been shown to be pathological and computationally more complex then needed for Phonology, such as ALIGN (Eisner 1997), counting constraints like ALL-FEET-RIGHT/LEFT (Lamont 2021b) and symmetrical IDENT[±F] (Lamont 2021a). I will refrain from using the former two, and use IDENT[±F] only as a shorthand for asymmetric IDENT[+F] and IDENT[−F] if their ranking is not important.

(48) a. *INTEGRATE (π, •)
For an input pair π_i and $\bullet_j$ where π_i is a prosodic node and • a root node or prosodic node hierarchically below π, and π_i does not dominate $\bullet_j$ in the input, count a violation for the output pair π_i and $\bullet_j$ where π_i does dominate $\bullet_j$ directly or indirectly.

b. *EXCORPORATE (π, •)
For an input pair π_i and $\bullet_j$ where π_i is a prosodic node and • a root node or prosodic node hierarchically below π, and π_i dominates $\bullet_j$ in the input directly or indirectly, count a violation for the output pair π_i and $\bullet_j$ where π_i does not dominate $\bullet_j$.

The constraints are defined in such a way, that *EXCOPRPORATE is only violated if the excorporated material is not deleted, and *INTEGRATE is only violated if the integrated material is not epenthetic, the tableaux in (49) and (50) show which mapping violates which constraint.

(49) *Violation of* *EXCORPORATE

	*INTEGRATE	*EXCORPORATE	MAX-π	MAX-•
π | • → π •		*		
π | • → •			*	
π | • → π				*

(50) *Violation of* *INTEGRATE

	*INTEGRATE	*EXCORPORATE	DEP-π	DEP-•
π • → π | •	*			
• → π | •			*	
π → π | •				*

If *INTEGRATE were defined to include the integration of a hierarchically lower elements into hierarchically higher epenthetic nodes we would make the prediction that unsyllabified material, e.g. affixes, would always integrate into existing prosodic structure, and never build their own. This is, dependent on the underlying representations one assumes, a wrong prediction. I formulated *EXCORPORATE in a parallel fashion, however, the predictions are not as bad: All candidates in (49) create marked structures, unless the orphaned root node can integrate into an existing or epenthetic prosodic structure. A mapping such as c. can thus still emerge as a winner, if reintegration of the root node is impossible due to other constraints such as DEP-π or *INTEGRATE-π.

These constraint can be parametrised with respect to edges: Excorporation or integration at a left edge must not be necessarily as bad as at the right edge. This will be important for the analysis of C'Lela, where a consonant can resyllabify more easily as an onset than as a coda. Furthermore, the constraint must have at least access to the information of whether the mora or root node it refers to is associated to a vowel or a consonant, because vowels an consonants submit do different constraints under resyllabification.

3.3.3.2 Prosody and processes

Prosodic structure has two main effects on phonological processes: It can induce processes, so-called boundary effects, and it can delineate the domain of processes, either by restricting assimilatory or dissimilatory processes, or by defining the domain of stress-assignment or comparable processes. The former can be derived with markedness constraints like the one in (51) used in the derivation of C'Lela.[28]

(51) $*C]_{\phi}$
Count a violation for a phonological phrase that ends in a consonant.

Next to boundary effects, a prosodic boundary can block a process from applying across it. This can be derived with two types of constraints: either, the markedness constraint responsible for the process is parametrised to apply only to the relevant phonological domain, as for example in Kimper (2011a), a schme is given in (52).

(52) AGREE-$[F]_{\omega}$
Count a violation four any pair of adjacent segments *inside a prosodic word* that disagrees in the value for feature F.

If assimilation processes are analysed as feature spreading, the constraint in (52) can be reconceptualised as an interaction of two constraints, namely a general markedness constraint (53) and a CRISP-EDGE(F-D) constraint (Itô & Mester 1999; Selkirk 2011), as in (54), that penalises a feature F that is associated to a node dominated by some prosodic domain D but also associated to material outside D.

[28]Work that derives prosodic structuring in OT is notoriously silent on the derivation of the processes that argue for said structuring such as boundary tones.

(53) AGREE[F]
Count a violation four any pair of segments that disagrees in the value for feature F.

(54) CRISP-EDGE(F-ω)
Count a violation for a feature F that is associated to material inside a phonological word ω and outside it.

The second approach is in so far more restrictive, in that it can only block repairs that are contingent on spreading. It cannot block epenthesis, deletion or feature changing. However, such processes could arguably be blocked by positional faithfulness constraint (Lombardi 1999), given that prosodic edges are privileged positions. The empirical differences between these two approaches are therefore not well defined; I will adopt the second option for expository reasons. Selkirk & Lee (2015) assume both types of constraints, but restrict melodic constraints to make reference, as a hypothesis to restrict the power of the framework, to at most one prosodic domain. This hypothesis is compatible with the constraints used in the present work. In the remainder of this chapter, I will discuss the interactions that are countercyclic under strict cyclicity, but can be derived cyclically with PaC.

3.4 Predictions of PaC

Unlike strictly cyclic frameworks, this proposal can derive some countercyclic interactions. As we have seen in the case of C'Lela, some such cases do exists, and it is thus desirable to device a system that can derive them. However, if a system can derive all imaginable countercyclic interactions, cyclicity ceases to impose any constraint on the phonological faculty, and a (simpler) non-cyclic framework becomes preferable.[29] It is thus important to establish which types of countercyclic patterns can be derived with the assumptions outlined above, and which, if any, are still excluded.

To anticipate the results, PaC can derive countercyclic interactions if a) the interaction itself can be derived by parallel OT[30] and b) the relevant cyclic boundary coincides with a relevant prosodic boundary at the stage of the derivation, where the interaction takes place. I will call these types of countercyclic pattern 'transparent aligned'. Other patterns, where either the interactions is opaque (opaque aligned), there is no coinciding prosodic domain (transparent missaligned) or both

[29] Still, an argument could be made for a framework that derives cyclic interactions easily, and countercyclic interactions more convolutedly against a framework that derives them both with the same ease. This would be a qualitatively different argument from the empirical argument I am trying to make, and should be considered only if it turns out that either all frameworks that derive the existing countercyclic problems overgenerate equally (I argue against this), or that the full power of a system that can derive countercyclicity is indeed needed.

[30] Mostly transparent interactions, but also some opaque interactions. As Baković (2007); McCarthy (2007b) show, some opaque interactions can be derived in parallel with out the adoption of opacity-specific mechanism, such as candidate chains or sympathy. Among them are chain-shifts with a zero as initial/final step and some instances of counterbleeding.

(opaque missalgned) can generally not be derived, however, there is a specific opaque interaction that can be derived, discussed in 3.4.2.

3.4.1 Transparent Aligned

As seen above, the framework can account for countercyclic bleeding as in C'Lela, if the prosodic domains are (at the right edge) aligned with the cyclic domains.[31] Countercyclic feeding, where the relevant domain edge(s) coincide can be derived in the same way. Imagine the toy-language in (55). Here, we have a process of sibilant harmony that is word bound: A sibilant agrees in place of articulation with a following sibilant long-distance. Such a process is quite common, found e.g. in Tsilhqút'ín (Cook 1993) or Barbareño Chumash (Beeler 1970). Now imagine the same language has a phrasal process of palatalisation, where a sibilant is palatalised if followed by a glide [j]. Again, this is an attested process, found for example in English.

(55) *Hypothetical language with countercyclic feeding*

a. sa-san → sasan
b. sa-ʃan → ʃaʃan
c. sa ʃan → sa ʃan
d. tas jan → taʃ jan
e. sas jan → ʃaʃ jan

Now, palatalisation can either feed or counterfeed sibilant harmony. In a strictly cyclic framework, it must counterfeed it, yielding [saʃ jan] instead of (55e). However, if we have a prosodic domain, lets say the phonological word, that aligns with a word-level cycle, both processes – palatalisation and harmony – can be placed at the phrase level and feeding can be derived. In the tableau in (56), the constraint CRISP-EDGE([±distr]-ω) blocks the spreading of the feature 'distributed', assumed to be responsible for the difference between [s] and [ʃ] across the boundaries of a phonological word. It outranks AGREE[±distr], the constraint responsible for sibilant harmony, but is dominated by *sj, responsible for palatalisation.[32]

[31] If this framework is adopted, it is not strictly necessary to assume that there are cyclic domains that coincide with the prosodic domains, unless there is additional evidence for the cyclic organisation. For C'lela, there is no independent evidence that all of the prosodic words assumed here are cyclic domains, but there is evidence for word- or stem-level phonology preceding the phrase level, discussed in Chapter4.1.

[32] I assume that it is only possible to satisfy these constraints by feature spreading, not feature insertion. However, if feature changing is assumed instead, the main point still holds, just the constraint that restricts harmony to phonological words must be reformulated.

(56) *Derivation of a word bound phrasal process*

[sa]$_\omega$[ʃan]$_\omega$	*sj	CRISP-EDGE[±distr]	AGREE[±distr]
☞ a. [sa]$_\omega$[ʃan]$_\omega$			*
b. [ʃa]$_\omega$[ʃan]$_\omega$		* !	

Thus, if in order to satisfy *sj, CRISP-EDGE[±distr] must be violated, harmony applies gratuitously, see (57). Thispattern is counterintuitive and the prediction might seem pathological, however, breaching patterns like this are marginally attested: In vowel harmony in Kinande (Schlindwein 1987; Archangeli & Pulleyblank 2002) cross -word harmony targets only high vowels, but can spread inside the targeted word onto non high vowels. Another potential case of breaching is found in Tsilhqút'ín phrasal tone spread: here, a high tone spreads rightward onto following functional material (mostly prefixes of the following word) but stops before it reaches the root. However, it can spread into the root if it spreads first onto an epenthetic vowel that is necessary for word-minimality reasons (Cook 2013). The precise phonological analysis is more complex compared to the toy example or Kinande, but it follows the same lines: Spreading into the prosodic domain of root and epenthetic vowel is possible, if it serves to cater the epenthetic vowel with a tone. As soon as the tone is inside the domain, it can spread onto the root. Still, it seems that such breaching phenomena are exceedingly rare, while PaC can derive them with ease.

(57) *Derivation of countercyclic feeding*

[sas]$_\omega$[jan]$_\omega$	*sj	CRISP-EDGE[±distr]	AGREE[±distr]
a. [sas]$_\omega$[jan]$_\omega$	* !		*
b. [saʃ]$_\omega$[jan]$_\omega$		*	*!
☞ c. [ʃaʃ]$_\omega$[jan]$_\omega$		*	

Next to feeding and bleeding, PaC can also derive countercyclic opaque interaction, where the interaction alone can be derived by standard parallel OT. This holds for chain shifts, a type of counterfeeding on focus, where one of the end stages is zero, cf. Kirchner (1996). The famous case of counterfeeding in Hijazi Bedouin Arabic (Al-Mozainy 1981; McCarthy 2007b) can be analysed in this way, I, however, opt for another possibility in chapter 4.3 and argue that we do not have counterfeeding, but simply no feeding. It remains that countercyclic simple chain-shifts can be derived with PaC. While I am not aware of any such cases, given that Hejazi Bedouin Arabic is amenable to such an analysis I will tentatively not consider this prediction to be pathological.

Some instances of counterbleeding can be derived in SPOT, depending on the assumptions on representations and constraints McCarthy (2007b). These tend to have the following form: First, assimilation is enacted, the, the trigger of assimilation deletes or loses its assimilating feature; deletion counterbleeds thus assimilation. Now, if we allow for MAX constraint to refer to feature values (Lombardi 2001), such a counterbleeding interaction can be derived in parallel. For this counterbleeding to be countercyclic, deletion must be at an earlier cycle, and assimilation at a later, larger cycle. Consider the pseudo-language in (58). We have two processes: An assimilation process lowers vowels if succeeded by an uvular, see (58a,b). Such processes are attested e.g. in Tsilhqút'ín (Cook 1993) or Arabic varieties (i.a. Davis 1995; Rose 1996; Faircloth 2020). This process is word-bound. As a second process we have, again, phrasal palatalisation, this time triggered by high but not by mid front vowels. see (58c,d). This is a common pattern, c.f. Bateman (2007); Kochetov (2011) amongst many others. Crucially, lowering counterbleeds palatalisation countercyclically, as seen in (58e).

(58) *Hypothetical language with countercyclic counterbleeding*

a. ilu-qa → eloqa
b. ilu qa → ilu qa
c. tak ilu → tak^j ilu
d. tak emo → tak emo
e. tak ilu-qa → tak^j eloqa

To construct an Analysis in PaC following the lines of the breaching analysis in feeding, we need a constraints that induces assimilation such as AGREE[±high] and a constraint to block assimilation across word boundaries, such as CRISP-EDGE([±high]-ω). Furthermore, we need a constraint *ki against a ki sequence, the first constraint dominated by the crisp edge constraint, the latter dominating it. As the tableau in (59) shows, this ranking derives the counterbleeding output for the input from (58e).

(59) *Derivation of apparent countercyclic bleeding*

$[\text{tak}]_\omega[\text{iluqa}]_\omega$	*ki	CRISP-EDGE[±high]	AGREE[+high]	MAX[−high]	*k^j
a. $[\text{tak}]_\omega[\text{iluqa}]_\omega$	* !		*		
b. $[\text{tak}]_\omega[\text{eloqa}]_\omega$				*!	
☞ c. $[\text{tak}^j]_\omega[\text{eloqa}]_\omega$					*
d. $[\text{tak}^j]_\omega[\text{iluqa}]_\omega$		*!	*		*

However, it does not derive the language in (58), but a different language: For the input in (59c), it derives an output [tak^j elu], see (60).[33]

[33]The way the constraint is defined, it actually derives [tak^j elo], however, this is due to the harmony constraint which are not the focus of this discussion.

(60) *Derivation of countercyclic self-destructive feeding*

	[tak]$_\omega$[ilu]$_\omega$	*ki	CRISP-EDGE[±high]	AGREE[+high]	MAX[–high]	*kʲ
	a. [tak]$_\omega$[ilu]$_\omega$	* !				
	b. [tak]$_\omega$[elu]$_\omega$				*!	
☞	c. [takʲ]$_\omega$[elu]$_\omega$					*
	d. [takʲ]$_\omega$[ilu]$_\omega$		*!			*

This is an instance of self-destructive feeding (Baković 2011), and it is also countercyclic. More investigation is needed, but it seems that PaC cannot derive countercyclic counterbleeding, but countercyclic self-destructive feeding. The crux here lies actually on the definition of the CRISP-EDGE cosntraint and the fact that it is not violated if the feature moves across into the other word, i.e. by the candidates O^3 in (60) and (59). If the constraint was redefined in such a way that it was violated by O^3, too, the winners would be candidates O_2 and we would have a language with regular, cyclic dissimilation. Whereas bleeding (C'Lela, Kimatuumbi) and Feeding (Akan, section 4.2, but also the breaching pattern from Kinande mentioned above) are attested, and a countercyclic chainshift might be (Hijazi Bedouin Arabic, but see section 4.3 for a different take), I am not aware of any data that resembles such an instance of countercyclic self-destructive feeding derived in (60) and (59). Here, PaC overgenerates, as long as the domain bounding constraints are not amended.

3.4.2 Opaque aligned

The hypothetical language we have encountered in (17) in chapter 2.5, repeated in (61), instantiates a case of an opaque, aligned countercyclic counterfeeding interaction.

(61) *Hypothetical language with countercyclic counterfeeding*

a. tʊ-ku → tuku
b. pʊtʊ-ku → putuku
c. tʊ mutʊ → tu mutʊ
d. lʊtʊ mutʊ → lʊtu mutʊ
e. lʊtʊ pʊtʊ-ku → lʊt**ʊ** putuku

This language cannot be derived with PaC. If we try do derive both processes at the phrase level, we necessarily derive a feeding, not a counterfeeding interaction. The constraint that is responsible for phrasal vowel harmony, HARMONY-φ,[34] outranks CRISP-EDGE, because it is possible, in order to satisfy it, to spread across a word boundary. HARMONY-ω, the constraint responsible for word internal (iterative) harmony must be dominated by CRISP-EDGE, because iterative harmony does not cross word-boundaries. Both need to outrank IDENT, because harmony applies. However, this ranking does not derive the desired output [lʊt**ʊ** putuku]. Instead it derives *[lutu putuku], with harmony throughout the board: Word-bound harmony must feed phrasal harmony, and phrasal harmony must feed word-bound harmony, yielding a single harmony domain, compare the tableau in (62). If such a pattern was to be observed, it would be analysed as a single, phrasal harmony process. Such a process is indeed attested, for example in Nawuri (Casali 2002) and in Somali (Nilsson & Downing 2019).

(62) *Derivation of countercyclic counterfeeding fails*

		$[\text{lʊtʊ}]_\omega[\text{pʊtʊ-ku}]_\omega$	HARMONY-ω	HARMONY-φ	CRISP-EDGE	FAITH
	a.	$[\text{lʊtʊ}]_\omega[\text{pʊtʊku}]_\omega$	*!			
	b.	$[\text{lʊtʊ}]_\omega[\text{putuku}]_\omega$		*!		
☞	c.	$[\text{lutu}]_\omega[\text{putuku}]_\omega$			*	****
	d.	$[\text{lʊtu}]_\omega[\text{putuku}]_\omega$	*!		*	** *

The only way in which PaC can account for an aligned opaque interaction is if the interaction extends across all three strata. Consider the toy language in (63). In isolation, monosyllabic roots insert a prothetic vowel, presumably in order to satisfy word minimality. Similar processes abound, e.g. in Tsilhqút'ín (Cook 2013), or Mohawk (Michelson 1989). If some affixes add to the syllable count, the prothetic vowel is inserted, whereas it does not appear with other affixes. The former are interpreted as word-level, and the latter as stem-level affixes. In a strictly cyclic approach, prothesis would have to be assigned to the stem level. Another process of the toy language is lenition — a voiceless obstruent voices in between two vowels, compare e.g. Korean (Ahn 1997). In the toy language, lenition (LEN) does not apply across word boundaries. A strictly cyclic approach would predict that stem level epenthesis (EPEN), if it inserts a high vowel, feeds word-level lenition. If lenition is instead counterfed, the interaction is countercyclic, as in (63).

[34] For a less stipulative analysis of such phenomena in OT, see Kügler (2015b); Obiri-Yeboah & Rose (2022).

(63) *Hypothetical language with complex countercyclic opacity (3-Level language)*

	#	ki-	hi=	ta #	
/map/	ʔimap	kimap	hiʔimap	ta ʔimap	Stem level EPEN
/tilip/	tilip	kidilip	hidilip	ta tilip	Word level LEN
/tap/	ʔi**t**ap	kidap	hiʔidap	ta ʔi**t**ap	EPEN couterfeeds LEN

This type of opaque countercyclic interaction is derivable under PaC. The necessary ingredients are i) a prosodic domain that is convincingly aligned with the stem level at the left edge, ii) a word level process, and iii) a process that applies in the stem, or rather the stem-level sized prosodic domain. If this is given, we can model an interaction in which the word-level process is counterfed (or bled or shifted) by the other process.

In the toy language, this would look accordingly: At the stem level, a prosodic domain, let us call it π, is build that encompasses all available material, as in (64).

(64) *Stem level derivation*

a. /tap/ → $[\text{tap}]_\pi$
b. /ki-tap/ → $[\text{kitap}]_\pi$

At the word level, this structure stays in place. If a vowel final prefix adjoins, an initial obstruent is lenited, see (65).

(65) *Word level derivation*

a. $\text{hi}[\text{tilip}]_\pi \rightarrow [\text{hi}[\text{dilip}]_\pi]_\omega$
b. $\text{hi}[\text{tap}]_\pi \rightarrow [\text{hi}[\text{dap}]_\pi]_\omega$

At the phrase level, a high ranked constraint, such as π-MINIMALITY, forces the insertion of an epenthetic syllable, which contains a high vowel.

(66) *Phrase level derivation*

a. $[[\text{tap}]_\pi]_\omega \rightarrow [[\text{ʔitap}]_\pi]_\omega$
b. $[\text{hi}[\text{dap}]_\pi]_\omega \rightarrow [\text{hi}[\text{ʔidap}]_\pi]_\omega$

Since the constraint that triggered lenition is ranked lower than a faithfulness constraint that prevents it, lenition of the consonant following the inserted high vowel is blocked. Summarized, this framework can derive countercyclic interaction with convincing prosodic domains that are co-exhaustive with the stem- or word level if i) the interaction is transparent or generally derivable in SPOT or ii) it is opaque and involves all three levels in the fashion outlined above. I will call this pattern henceforth '3-level language'. The 3-level language the countercyclic self-destructive feeding discussed before are most likely pathological, whereas the other predictions regarding feeding and bleeding, and potentially counterfeeding on focus, are met.[35]

[35]In the Chamorro case study in chapter 4.5, I am deliberately vague on the size of the relevant

3.4.3 Transparent misaligned

Unlike aligned patterns, misaligned patterns cannot be derived. A misaligned pattern is found if there is no prosodic edge that can define the domain of the relevant phonological process. A misaligned countercyclic interaction is given if a process tied to a bigger domain feeds/bleeds/shifts a process tied to a smaller domain and the relevant phonological context of the fed/bled/shift process is not contained within a convincing prosodic domain. We have, in fact already seen a toy language that examplifies such a case, the Acin-language from Gleim & Rasin (to appear), repeated in (67). Here, a process of palatalisation (PAL) is fed by epenthesis. Crucially, epenthesis is sensitive to phrasal information, whereas palatalisation is word-bound, the process is thus countercyclic. It is also misaligned, because, the word level domain does not correspond to a prosodic domain at the phrase level — the relevant word final stops are re-syllabified and are consequently a part of the same higher prosodic domains. This follows from the assumption that proper bracketing is a universal wellformedness condition.

(67) *Hypothetical language with misaligned countercyclic feeding*

		#	/-i/	/#ima/	
a.	/at/	at	a.ci	a.t i.ma	PAL is word-bound
b.	/apn/	a.pin	ap.ni	ap.n i.ma	EPEN is phrasal
c.	/atn/	a.cin	at.ni	at.n i.ma	EPEN feeds PAL

Interactions of this kind cannot be derived. In order to get phrase sensitive epenthesis and palatalisation that is fed by epenthesis, both need to apply at the phrase level, as in the tableau in (68).

(68) *Derivation of epenthesis feeding palatalisation*

		[atn]	*CC.	ONSET	*ti.	CRISP-EDGE	ID
	a.	[atn]	*!				
	b.	[at.in]		*!			
	c.	[a.tin]			*!		
☞	d.	[a.cin]					*

In order to get resyllabification across word boundaries, ONSET, the constraint demanding onsets must rank above a faithfulness constraint that prohibits the excorporation of consonants from a prosodic word, see (69).

prosodic domain at the phrase level, chiefly because the data regarding secondary stress has lacunae. If my conjecture from the sources is correct and the articles fall outside of the secondary stress domain, Chamorro would indeed exemplify a 3-level language: The prosodic domain π relevant for phrasal stress assignment is constructed at the stem level, and phrasal stress assignment interacts opaquely with word-level Umlaut.

(69) *Derivation of resyllabification*

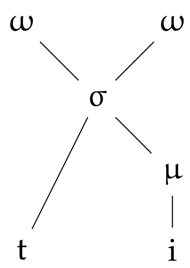
		[at][oma]	*CC.	ONSET	*ti.	CRISP-EDGE	*EXC-C	ID
	a.	[at][o.ma]		*!				
☞	b.	[a][to.ma]					*	

If we now consider resyllabification across word boundaries with a palatalisable consonsonant and a palatalisation trigger, these rankings put together predict palatalisation to apply, see (70).

(70) *Derivation of word-bound palatalisation fails*

		[at][ima]	*CC.	ONSET	*ti.	CRISP-EDGE	*EXC-C	ID
	a.	[at][i.ma]		*!				
☞	b.	[a][ti.ma]			*!			
✄	c.	[a][ci.ma]					*	*

As Gleim & Rasin (to appear) argue, this unattested pattern can be derived by Output-Output correspondence, but not by a classical cyclic approach, see also Chapter 5. This diverging prediction is maintained by this prosodically enriched cyclic proposal. However, proper bracketing is crucial to exclude the language: If we allow a structure such as (71), the language can be derived.

(71)


Palatalisation here can be blocked if a syllable is dominated by two prosodic words. A similar result can be achieved if Cardinaletti & Repetti's 2009 approach of phrasal resyllabification, which strictly speaking does not violate proper bracketing, but does so in spirit, is pursued.

3.4.4 Opaque misaligned

Of course, it is possible to imagine a pattern which is both opaque and prosodically misaligned. Accounting for such misaligned opaque cases with PaC fails for two reasons: the opacity[36] and the misalignment. This should not be surprising, since either feature makes a derivation with PaC impossible.

The toy language in (72) constitutes an hypothetical example of a misaligned opaque interaction. It is very similar to the Acin-language, only that the cyclic affiliation of the two processes and their interaction are reversed: epenthesis is word level

[36] Meaning here, again, opaque patterns that cannot be derived in SPOT.

and counterfeeds phrasal palatalisation. Again, both processes are attested associated with the respective levels in the languages of the world, Arapaho for instance exhibits word-bound epenthesis (Cowell & Moss 2008), whereas palatalisation in English varieties is phrasal.

(72) *Hypothetical language with misaligned countercyclic counterfeeding*

	/atn/	/at/	/apn /	
__##	atin	at	apin	
__# oma	a.ti.no.ma	a.to.ma	a.pi.no.ma	word level EPEN
__-i	atni	aci	apni	
__# ima	a.ti.ni.ma	a.**c**i.ma	a.pi.ni.ma	phrase level PAL
__##	a**ti**n	at	apin	EPEN counterfeeds PAL

In order to derive phrase level palatalisation, the constraints that trigger palatalisation and resyllabification must outrank the respective faithfulness constraints that would prevent them, see (73).

(73) *Derivation of phrasal palatalisation*

	[at][ima]	*CC.	ONSET	*ti.	CRISP-EDGE	FAITH
	a. [at][i.ma]		*!			
	b. [a][ti.ma]			*!		
☞	c. [a][ci.ma]					*

If palatalisation would have applied at the word level, this ranking predicts palatalisation to target the consonant preceding the epenthetic front vowel, too. Epenthesis cannot be transferred to the phrase level while referring to the prosodic word, as this would wrongly predict epenthesis to be blocked under the posibility of resyllabification. Also, due to the parallelity, phrasal epenthsis would result in palatalisation, too — compare candidates c. and e.

(74) *Derivation of countercyclic opacity fails*

	[atn][ima]	*CC.	ONSET	*ti.	CRISP-EDGE	FAITH	DEP
	a. [atn][i.ma]	*!	*				
	b. [atin][i.ma]		*!	*			*
	c. [ati][ni.ma]			*!		*	*
☞	d. [at][ni.ma]					*	
✄	e. [aci][ni.ma]					* *!	*!

This pattern has certain similarities with (phrasal) derived environment effects, which are convincingly attested. There are two main ways to approach derived environment effects: One is to refer to morphosyntactic structure and distinguish in this way derived from non-derived environments, that can be implemented with the strict cycle condition (Kean 1974), or by restricting certain processes to across boundary contexts (eg. van Oostendorp 2008b). This type of approach is incompatible with my assumptions on availability of cross modular information. The second approach is representational: The segments in question are representationally different from the same segments which have already been the context, for example via underspecification (Bermúdez-Otero 2006; Rasin 2016; Gleim 2023). This approach is compatible with the assumptions adopted here. For the toy language in (72), this would signify that the word-final /t/ becomes underspecified for [± anterior] at the word level. At the phrase level, only underspecified coronals palatalise. This account makes the wrong prediction the /at-i/ surfaces as [ati]. However, I reckon that with actual language data it might not always be trivial to distinguish a language with derived environment effects from a language with misaligned counterfeeding.[37]

3.4.5 Summary of predicted interaction Patterns

If there are two processes P and Q, and P applies in a cyclic domain D that is contained in a bigger cyclic Domain D′, strict cyclicity predicts that P must apply before Q and therefore either feed, bleed or shift it, and Q must counterfeed, counterbleed or countershift P. With the adoption of prosodic structure as proposed here, in combination with the above elaborated computational assumptions, two additional patterns can be derived: Transparent and aligned 'countercyclic' patterns, and opaque and aligned 'countercyclic' patterns in which a stem level sized domain is at the relevant edges aligned with a prosodic domain at the phrase level and a process bound to that domain opaquely interacts with a word-level process. Table 3.1 gives an overview of the predicted patterns and shows whether there are cases. as can be seen, one of the Kimatuumbi interactions and the Icelandic interactions fall into categories that cannot be derived with PaC. Both will be reanalysed as cyclic interactions in Chapter 4.4 and 4.6 respectively.[38]

Of the patterns that can be derived with PaC, a few are indeed attested, namely

[37]It is, however, possible to construct a language that shows misaligned opaque counterfeeding that cannot be considered a derived environment effect: In the language in (i), word-final sonorisation (attested e.g. in Heligoland Frisian (Borchert, Århammar, & Århammar 1987)) counterfeeds phrasal nasalisation, that is blocked by obstruents but not sonorants. The language is misaligned, because the consonant is not word-final after re-syllabification. Here, since the trigger of the phrasal process, the nasal, is outside the prior cyclic domain, the interaction cannot be regarded as a derived environment effect.

(i)
  a. /liv/ → liw
  b. /law # ak/ → la wak
  c. /law # an/ → lã w̃ãn
  d. /laf # an/ → la fãn
  e. /liv # an/ → li wãn

[38]The same hold for hijati Bedouin Arabic, which means that the chain shifts are actually a case of overgeneration for PaC.

Countercyclic Interaction	PaC	Attested
aligned feeding	✓	Akan, Kinande, Eton
aligned bleeding	✓	C'Lela, Kashaya, Hausa, Kimatuumbi
aligned shifting	✓	Seenku
misaligned feeding	✗	—
misaligned bleeding	✗	Icelandic
misaligned shifting	✗	—
chain shift	✓	Hijazi Bedouin Arabic
self-destructive feeding	✓	—
aligned counterfeeding	✗	—
aligned counterbleeding	✗	—
aligned countershifting	✗	—
misaligned counterfeeding	✗	Kimatuumbi
misaligned counterbleeding	✗	—
misaligned countershifting	✗	—
3-Level-language	✓	Chamorro

Table 3.1: Predictions of Pac

countercyclic aligned transparency. However, PaC overgenerates two patterns of countercyclic aligned opacity, self-destructive feeding and the three-level pattern discussed in 3.4.2. In Chapter 5 I argue that PaC still manages to the data better then alternative approaches, like Output-Output correspondence.

Chapter 4

Countercyclic Case Studies

In this chapter I will discuss some potential and/or alleged cases of countercyclic process interactions, mostly cases that are known from the literature and have been used as arguments against cyclic phonology in general, this is the case of Hijazi Bedouin Arabic (McCarthy 2007b) or parts of the cyclic architecture: the interactions in Kimatuumbi motivated Odden (1990, 1993, 1996) to abandon the prohibition of look-ahead, the interaction in Chamorro motivated Chung (1983) to postulate transderivational relationships, the interaction in Akan was analysed by Paster (2010) with countercyclic look-back, and the interaction in Icelandic was the reason that Kiparsky (1985) proposed a specific version of the strict cycle condition. This chapter is structured as follows. First, in 4.1, I will discuss the apparent countercyclicity in C'Lela (Kainji, Nigeria, data from Dettweiler 2015), where a process of cyclic, word final deletion is blocked in a phrasal context. This constitutes a case of countercyclic transparency, specifically bleeding: phrasal preservation of vowel deletion bleeds lexical vowel deletion. This process is analysed closely following the lines laid out in 3: Vowel preservation and deletion happen in parallel at the phrase level, deletion is sensitive to prosodic boundaries that align with morphosyntactic boundaries. The second case study in 4.2 comes from Akan (Kwa, Ghana, relevant data from Paster 2010). In Akan, a lexical, morpheme specific process of polar tone insertion is fed by phrasal tone spread. As in C'Lela thus, this is a case of countercyclic transparency, and the analysis follows the same gist: The lexical process is phrasal and sensitive to prosodic boundaries. The fact that the process is morpheme specific is derived by assuming that only in this morphosyntactic context the correct conditions for phrasal polar tone insertion are created. The third case study in 4.3 is Hijazi Bedouin Arabic (HBA, Semitic, Saudi Arabia, data from Al-Mozainy (1981)), in this language, a phrasal iteration of high vowel syncope is counterfed by a word-level iteration of low vowel raising. This is not countercyclic transparency as the previous cases, but opacity. However, since it is a chain shift, it belongs to the cases of opacity that PaC can derive. Nonetheless, i opt to reanalyse the phrase level iteration of syncope as a process restricted to prosodic word final vowels, thusly the process is transparently not fed by raising which never applies in the correct position. I argue that this captures the data better, because there is convincing evidence that vowel raising is indeed not a phrase level process. The analysis does thus not make use of the core PaC machinery introduced in the last chapter, but it crucially relies on prosodic structure at the phrase level nonetheless. The fourth cases study in 4.4 deals with Icelandic (Germanic, Iceland, data chiefly from)) where a word level affixation of a clitic sometimes bleeds epenthesis, and sometimes counterbleeds epenthesis. The generalisation is that it bleeds epenthesis with non-masculine clitics, but counterbleeds it if the clitics are masculine. Whether this is countercyclic bleeding (i.e. word level affixation bleeds stem level epenthesis) or countercyclic[39] counterbleeding (i.e. word level affixation counterbleeds word level epenthesis) depends on the assumption on what is the 'regular' order. I propose that the clitic is a variable affix, which attaches to feminine and neuter nouns as a word level suffix, but to masculine nouns as a phrasal clitic. The next case study is from Chamorro (Austronesian, Guam and the Northern Marianas, data from Chung 1983, 2020), see 4.5. In Chamorro, cyclic, lexical stress counterbleeds and counterfeeds arguably phrasal umlaut. I reanalyse the trigger of umlaut to be word-level, and parts of the stress-assigning processes to apply at the phrase level. This analysis thus analyses the pattern as cyclic counterfeeding, stress assignment can be shifted to the phrase level because it is sensitive to the adequate prosodic boundaries. The last, and longest, case study in 4.6 discusses two countercyclic interactions from Kimatuumbi (Bantu, Tanzania, data from Odden 1996). First, lexical glide formation with concomitant compensatory lengthening is bled by phrasal high tone insertion. This is a transparent. bleeding interaction and can thus be handled with PaC, however, I argue that the second process is better analysed as allomorph selection that applies between the word and the phrase level. The analysis of the first process follows the PaC playbook: It applies at the phrase level in a previously built prosodic domain. The second interaction also deals with glide formation, which counterfeeds a phrasal process of shortening. This is countercyclic opacity and can a priori not be analysed with PaC. I argue that the shortening process is not phrasal after all, but a reflex of a stem level Ezafe morpheme. The presence of the morpheme is sensitive to its wider morphosyntactic context. If this assumption is adopted, the interaction can be reanalysed as run of the mill cyclic counterfeeding.

[39] From the perspective of Stratal OT, not necessarily for other frameworks; but the problem persist for frameworks that allow stratum internal opacity given that they usually assume affixation before phonology, pace Borowsky (1993).

4.1 C'Lela Phrase Final Vowel Preservation Bleeds Apparent Cyclic Vowel Deletion

The first case study of a seemingly countercyclic interaction in phonology comes from C'Lela (Kainji, Niger-Congo). Here, a cyclic process of vowel deletion is blocked by the necessity to end a phrase in a vowel. Unlike the patterns discussed in the other case studies, this pattern does not have a long history in the theoretical phonological literature. The theoretically informed descriptive literature on C'Lela phonology and morphology is limited, and includes next to my main source, Dettweiler (2015), previous work by Dettweiler, of note Dettweiler (2000), and works by Aliero (2013, 2015). The only aspect of C'Lela that has been discussed in the wider field of theoretical phonology is its vowel harmony system, compare Dettweiler (2000), Pulleyblank (2002) and Michel (2009). None deal with vowel deletion from a theoretical perspective, which was first noticed as a challenge for cyclicity in Gleim (2020). This section is structured as follows: First, I will introduce the pattern and argue that it poses a problem for cyclicity. After that I lay the fundaments of the cyclic analysis which relies on recursive prosodic structure: Vowel deletion targets a prosodic position, not a cyclic position. This is followed by a detailed analysis of the process of vowel deletion. Before concluding, in section 4.1.4 I discuss a major complication for my analysis that arises from the interaction of vowel deletion with epenthesis.

4.1.1 Puzzle

In C'Lela, suffixes and polysyllabic roots are vowel final at the right edge of a phrase, and consonant final elsewhere, see (75) for the root /gʷɛ̀lɛ̀/ in a phrase medial, and (76) in a phrase final context. All the data is from Dettweiler (2015), in the examples abbreviated as (SD15).[40]

(75) *Phrase.medial vowel deletion*

ɾémɨ́n	**gʷɛ̀l**	íɾù	dá
ɾémɨ́n	**gʷɛ̀lɛ̀**	í-ɾù	dá
because	goat	DIM-his	not

'because of his little goat' (SD15:150)

(76) *Phrase-final vowel preservation*

àj	mhívkɨ̀ʔù	**gʷɛ̀lɛ̀**
àj	m-hívɨ̀-kɨ̀=ʔù	**gʷɛ̀lɛ̀**
COMP	1SG-steal-PFV=3SG	goat

'that I stole his goat from him' (SD15:150)

[40] Note on transcription: I follow Dettweiler (2015) in the transcriptions, with the exception of the high-to-mid central vowel which I transcribe, following Dettweiler (2000), as ɨ because it behaves phonologically as a high vowel.

The final vowel must be part of the underlying representation of the root or affix in question, because its quality and its tone are unpredictable. (75) shows a root at the edge, where the edge-vowel is identical to the preceding vowel, but (77) shows a case where both the vowel quality and the tone are different.

(77) *The vowel is not predictable*

a. ʔá-n-bìtí là **ʔìs** dá
NEG-2PL-cover RESP eyes not
'Don't cover your eyes' (SD15:122)

b. à-bìtí **ʔìsɨ́**
3PL-cover eyes
'They should cover their eyes' (SD15:122)

An epenthetic vowel should be predictable, be it a default vowel or a copied one. However, no such regularity can be found in C'Lela. Since it therefore cannot be phrase final epenthesis, it must be vowel deletion[41]. Our preliminary description, 'delete a word final vowel, unless phrase final' is correct, but only derivationally: The final vowel is deleted if it was word final at some stage in the derivation. This can bee seen in (78)[42], where the final ɛ of 'goat' is deleted, even if it would not be final if it surfaced in the surface form. It seems thus that deletion applies cyclically and deletes the vowel at the point where it is final.

(78) *deletion is cyclic*

a. g^wɛ̀l-nɛ̀
g^wɛ̀lɛ̀-nɛ̀
goat-PL
'goats' (SD15:96)

b. g^wɛ̀l-nànzó
g^wɛ̀lɛ̀-nɛ̀=ànzó
goat-PL=those
'those goats' (SD15:96)

However, if deletion applies cyclically at the stage where the vowel is indeed final, we do not yet have cyclically available information on the presence of the phrase edge. At the time this information becomes available — the phrase level — the vowel must have been already deleted and cannot be reconstructed. If the process of deletion is to apply cyclically, but is blocked if there will be a phrase boundary later, we have an instance of a countercyclic look-ahead effect.

Speaking in opacity terms, phrasal vowel preservation bleeds lexical vowel deletion. It is obvious how that can be derived in a framework that processes all

[41] A third possibility, allomorphy, will be discussed and discarded in section 4.1.3.3.

[42] In the row that shows the underlying forms in the examples, I will, unless specifically mentioned, give the quality of the affix vowels as they show up on the surface. This abstracts away from the processes of vowel harmony and vowel copy. Some affix vowels have to agree in height with the preceding vowel, while other agree in every feature.

information of morphosyntactic boundaries at once: The process that makes the phrase final vowel invisible to deletion applies first, then, the deletion process targets all the vowels preceding a morphosyntactic word-edge.

Given the presented data so far, one might argue that this is not word final vowel deletion, but a strategy to avoid hiatus. This is however not the case, as the data in (79) makes clear: Vowel deletion applies, even if it creates quite cumbersome consonant clusters.

(79) *Vowel deletion is not hiatus resolution*

a. dàptà
'monkey' (SD15:32)

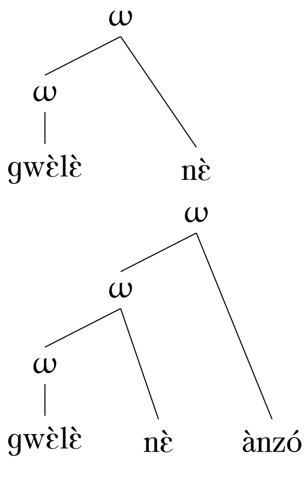
b. dàpt ʔɛ̀lló
'it's a monkey' (SD15:32)

4.1.2 Solution in a nutshell

The solution to this case of apparent countercyclicity is rather straight-forward: Recursive prosodic words are built in such a way that all potentially deleting vowels are at the right edge of a prosodic word. (80) shows the assumed (input) prosodic structure for /gʷɛ̀lɛ̀-nɛ̀/ and (81) for /gʷɛ̀lɛ̀-nɛ̀=ànzó/. Note that every final vowel, that is the root final vowel, the affix final vowel and the clitic final vowel, is at the right edge of a prosodic word. However, only the root-initial syllable is word initial.

(80) *Recursive prosodic domains*

a.
b.



At the phrase level, a constraint against word final vowels is active (81a). It is outranked by a constraint against phrase-final consonants, given in (81b). A similar constraint has been proposed in McCarthy (1993a, 2005a) under the name FINAL-C.[43]

[43] Faust & Ulfsbjorninn (2018) criticise such constraints because they make it possible to derive languages with only consonant-final words. However, given that they assume morpheme structure constraints, and that nothing precludes a morpheme structure constraint from banning word final vowels, I do not see how their typological predictions diverge. Itô & Mester (2010) also argue that FINAL-C is unnecessary, however they base their argument on data from English that is very different from the C'Lela (or Arabic) facts. Itô and Mester's analysis without FINAL-C avoids overgeneration,

(81) a. $^*\mathrm{C}]_\phi$
Count a violation if the rightmost segment dominated by a phonological phrase ϕ is a consonant.

b. $^*\mathrm{V}]_\omega$
Count a violation if the rightmost segment dominated by a phonological word ω is a vowel.

This ranking makes sure that all word final vowels are deleted, except in the case that they appear at the right edge of a phrase. Compare the derivation in (82), where the candidate that deletes all word final vowels incurs a fatal violation of $^*\mathrm{C}]_\phi$ and the faithful candidate is suboptimal for violations of $^*\mathrm{V}]_\omega$.

(82) *Derivation of deletion and blocking of deletion*

[[[gʷɛ̀lɛ̀]$_\omega$nɛ̀]$_\omega$]$_\phi$	$^*\mathrm{C}]_\phi$	$^*\mathrm{V}]_\omega$	MAX
a. [[[gʷɛ̀lɛ̀]$_\omega$nɛ̀]$_\omega$]$_\phi$		**!	
☞ b. [[[gʷɛ̀l]$_\omega$nɛ̀]$_\omega$]$_\phi$		*	*
c. [[[gʷɛ̀l]$_\omega$n]$_\omega$]$_\phi$	*!		**

As can be inferred from the structures (80), in addition to the general assumptions on prosodic structure that I make, I adopt recursive prosodic structure, specifically recursive prosodic words (i.a. Ladd 1986; Selkirk 1995, 2011; Itô & Mester 1992/2003, 2007, 2009, 2010; Kabak & Revithiadou 2009; Bennett 2018). Unbounded recursive prosodic structure is computationally more powerful than required for most prosodic processes (Dolatian, De Santo, & Graf 2020), and it has been claimed that all cases (at least for prosodic words) can be re-analysed as a stacking of distinct prosodic domains (Vogel 2009, 2019; Schiering, Bickel, & Hildebrandt 2010; Miller 2018). Furthermore, it has been argued that such a re-analysis is empirically desirable because contained prosodic words do not always behave exactly like containing prosodic words (Vogel 2009, 2019; Vigário 2010). This last part is not true for C'Lela deletion: It targets all of the rightmost vowels in the domains I claim to be prosodic words identically. This can be, of course, derived by postulating *n* prosodic categories, intermediate between the phrase and the prosodic word, which all have the same behaviour regarding deletion. However, it is not really clear how many of such categories are needed: Every (inflectional) suffix and enclitic projects its own domain. The number of domains would thus equal the number of potential suffixes/enclitics +1.[44] This is more elegantly captured with recursive prosodic words. For my purposes, however, this is rather a matter of presentation than substance: Given that there

but could not extend to the cases in C'Lela where vowel deletion does not lead to hiatus avoidance.

[44]This number is not all that high in C'Lela. For inflection, there seem to be maximally two segmental suffixes, plus one enclitic. Derivation is mostly prefixal or employs ablaut (cf. Aliero 2013). However, there are a few derivational suffixes such as the causative -sa, the denominal verbaliser -sV and the deadjectival nominaliser -nè. The data is not sufficient to determine how they behave with respect to vowel deletion, however, for the causative at least it seems that it does not cause the deletion seen here, but another type of vowel deletion, compare Aliero 2013: 144 and Dettweiler 2015: 72.

are no unbounded morphological operations in C'Lela that I am aware of, all these structures can be translated to a structure where the different prosodic categories have different labels.

4.1.3 Analysis of elision

In this section, I justify and refine my analysis of phrase-medial final vowel deletion. First, I discuss the general domain of elision to let us get a better grasp of the process. Then, in section 4.1.3.2, I discuss vowels that are either systematically or idiosyncratically exempt from elision. Finally, I argue that even though idiosyncrasies exists, elision should be analysed as a process and not as allomorphy.

4.1.3.1 Domain of final vowel elision

An important question is the size of the domain that is marked by the preservation of the final vowel. Unfortunately, given the scarcity of the data, it is impossible to answer this question fully. Elision, as can be seen in (83), applies within simplex sentences, the exceptions to elision in this context, discussed in section 4.1.3.2, are not due to morphosyntactic or prosodic boundaries.

(83) *Elision in simple sentences*

hìv	zét	bɔ́
hìv**í**	zé-**tè**	bɔ́
thief	say-PFV.2	DEV

'Then the thief said...' (SD15:135)

However, a simple clause is not the maximal domain marked by the preservation of a final vowel. It also applies across the boundaries of relative clauses (84) and complement clauses (85).[45]

(84) *Deletion across relative clause boundary*

ɾèmɨ́n	zóː**ʔànl**	áù	ɾè-t-ìnê
ɾèmɨ́n	zóː=**ʔànló**	áù	ɾè-t-ìnê
because	smithing=this	REL	be-SUBJ-PFV

'because of this smithing that he was involved in' (SD15:131)

(85) *Deletion across CP boundary*

ɨ̀mtɔ́n**k**	àz	ìnmí	sòːt	ɨ́nzó
m-tɔ́nV-**kV**	àz	ìnù-mí	sòːtV	nzó
1SG-want-PFV	COMP	mother-INAL.1SG	sit	yonder

'I want that my mother sits there' (SD15:132)

[45]The quality of the deleted vowels is not always inferrable for all examples from Dettwelier (2015). However, according to Dettweiler (2015: 18), there is such a vowel in all cases: All roots are either vowel final, or end in a nasal. The vowels for which I could not infer the underlying representation are marked as V in the glosses.

Elision also applies across a (potential) boundary between a focused element and the rest of the sentence (86). Focus is cross-linguistically very often aligned with prosodic boundaries, see Féry (2013) for an overview.

(86) *Deletion across focus phrase boundary*

í dɛ̀ːdɛ̀ nɨ́m**zàn** ɨ́mgàdìnʔô
í dɛ̀ːdɛ̀ n=m-**zànà** m-gàd-ìne=ʔô
be.EQ yesterday LOC=CL8-morning 1SG-meet-PFV.REL=3SG.OBJ
'It was yesterday morning that we met' (SD15:132)

Vocatives show variation: Sometimes they block elision, and other times they do not. There is, however, not enough data to make a hypothesis on the causes of this variation. (87a) shows the failure of elision of the last vowel of the vocative[46], whereas (87b) shows elision in a syntactically very similar context. I will call this variation and not optionality, since it is not at all clear whether there is a systematic condition for this variation or not.

(87) *Variable elision with vocatives*

a. tɔ̀ **hìví** tʃɨ́nókà
tɔ̀ **hìví** tʃɨ́-nókà
okay thief 1.DL-go
'Okay, thief, let's go' (SD15:123)

b. **zɔ̀ːɾ** í jɛ̀ káːn...
zɔ̀ːɾè í jɛ̀ káː=n
Zoore be.EQ what EXP=REL...
'Zoore, what is it that..' (SD15:150)

Variation of application of elision is also found with adverbial clauses. (88) shows blocking of elision in a temporal clause, (89) the application of elision, also in a temporal clause.

(88) *Variable Elision with adverbiale clauses*

a. àíhɔ́ː**ínè** údɔ́ː
à=í-hɔ́ː-**ínè** ú-dɔ́ː
when=CL7-drie.up-PFV.REL 3SG-pound
'when it was dried up, he pounded it' (SD15:135)

b. ánwaː háv**ín** údɔ́ːk ìwàgà
án=waː hávɨ-**ínè** ú-dɔ́ː-ko ì-wàgà
when=child go-PFV.REL 3SG-pound-PFV CL7-sprig
'when the boy left there, he pounded the sprig' (SD15:135)

Prepositional phrases have similar variation, but the evidence for non-application of elision is less un-ambiguous here. As said before, the data is not exhaustive enough to conclude what the domain of elision is, but it certainly must be big. Also, there are

[46]hìví is not a lexical exception to vowel deletion, it shows up as [hìv] elsewhere.

intriguing patterns of variation that wait to be analysed, but an thorough analysis is outside the scope of this dissertation. I will continue to assume that the prosodic domain to which elision is sensitive is the prosodic phrase ϕ. However, given that the domain includes subjects, focused material and relative clauses, elements that cross-linguistically very often fall outside the phonological phrase, it might very well be sensitive to a prosodic category that is higher in the hierarchy than the phrase, such as the intonational phrase ι.

4.1.3.2 Underapplication of elision

Inside the domain where we regular find elision, there are three types of word final vowels that are never deleted, even if they are not at the phrase edge. Those are, first, the only vowel of monosyllabic roots, second, vowels that become word final due to resyllabification and, lastly, a group of lexically specified vowels. Let us first turn to the monosyllabic cases. The example in (89) shows that the monosyllabic verb /hó/ 'kill'[47] does not undergo vowel deletion. (90) shows that a plurisyllabic verb in exactly the same context where the final vowel does undergo deletion. This can be generalised: No monosyllabic verb or noun root loses its vowel.

(89) *No elision in monosyllabic roots*

tʃètvó **hó**k dàptê
tʃètó-vó **hó**-kà dàptà-ê
father-2SG.INAL kill-PFV monkey-Q
'Did your father kill a monkey?' (SD15:118)

(90) *Elision with plurisyllabic roots*

hɨ̀nvú **hɛ́n**k dàptâ
hɨ̀nú-vú **hɛ́nɛ́**-kɛ̀ dáptá-ê
brother-2SG.INAL see-PFV mantis-Q
'Did your brother see a mantis?' (SD15:118)

Two analyses lend themselves for this case: Either, a word should not become entirely vowel-less, or that the vowel in this position is prominent and thus protected. Gleim (2020) takes the first approach, and has thus to assume that prefixes do not integrate into the prosodic word, because monosyllabic roots never lose their vowel even if prefixed, as can be seen in (91).

(91) *Prefixes to not contribute to syllable counting*

ùhókʔò
ù-hó-kà=ʔò
3SG-kill-PFV=3SG.OBJ
'he killed him' (SD15:116)

This assumption is not in itself problematic, but I will argue here that this syllable

[47] The perfective of 'kill' is irregularly hókà, and not hókò (Dettweiler 2015: 116).

is indeed prominent and that an analysis which treats this syllable as stressed can be extended more easily to the other cases of underapplication of elision. There are some arguments that the first syllable of a root is indeed prominent, as it is different from other C'Lela syllables in a lot of regards (Dettweiler 2015: page). While C'Lela tolerates onsetless syllables, the first syllable of a root must have an onset (Dettweiler 2015: 21).[48] This syllable is also the only syllable that shows contrastive length (Dettweiler 2015: 30).[49] Furthermore, root-initial syllables allow for onsets, that are unattested in other syllables, such as the glottal stop or labialised or palatalised stops. Syllables with codas are also rare outside this position, and lastly, root-initial syllables are the only ones with complex codas.

If we accept that the first syllable of a root is special, there are two ways to implement the blocking: A high ranked constraint against the deletion of stressed vowels, or a relativisation of the *V] constraint to unstressed vowels, (92).[50] While the former seems more elegant and in the spirit of OT, I will adopt the latter, because it extends more straightforwardly to the other cases of non-elision. The tableau in (93) demonstrates how this constraint does not enforce the deletion of the stressed vowel in a root like /hó/, marked here in bold face.

(92) $*\breve{V}]_\omega$
Count a violation if the rightmost segment dominated by a prosodic word ϕ is an unstressed vowel.

(93) *Stressed vowels are never elided*

	[[[h**ó**]$_\omega$kà]$_\omega$[dàptê]$_\omega$]$_\phi$	$*C]_\phi$	$*\breve{V}]_\omega$	Max
	a. [[[h**ó**]$_\omega$kà]$_\omega$[dàptê]$_\omega$]$_\phi$		*!	
☞	b. [[h**ó**k]$_\omega$[dàptê]$_\omega$]$_\phi$			*
	c. [[hk]$_\omega$[dàptê]$_\omega$]$_\phi$			**!

The assumption that the first root-syllable is stressed and its resistance to deletion as sketched out in (93) is important for the next case of a vowel that fails to elide. If a root is not monosyllabic and has the shape CVCV, where its first syllable does not have a coda consonant, it becomes phrase internally CVC; due to vowel elision. Now, if that root is followed by a vowel, like the prefix in (94), we have resyllabification.[51]

[48]There are two inconsistent examples to this claim in Dettweiler (2015) /ín/, 'mother' and /ʔìrmî/ ~ /ìrmî/ 'man' (SD15:21). The latter at least has sometimes a glottal stop.

[49]Other syllables obligatorily have a long vowel if they carry a falling tone. Falling tones, however, are restricted to final vowels, not to stressed vowels.

[50]Many analyses of apocope in OT do not refer to the position of the vowel at an edge, but either derive the deletion of word final vowels by assuming them to be extrametrical/unfooted, e.g. Anttila (2006); Bermúdez-Otero (In Preparation), or by referring to a constraint that deletes weak vowels generally, e.g. Raffelsiefen (2000); Wheeler (2007); Broś & Nazarov (2023), and is blocked in non-final positions. Kavitskaya & Staroverov (2010) use a constraint similar to mine, but mention in a footnote that it could/should be replaced with a constraint against unfooted syllables. There is no evidence in C'Lela that the deleted syllables are not footed, I will thus leave this constraint as it is.

[51]Evidence for resyllabification with prefixes like this comes from epenthesis, for a discussion on

Crucially, this resyllabification moves the consonant out of the prosodic word of the first root into the prosodic word of the second root. The first vowel of /kùsú/ is now word-final [kù]$_\omega$[sírù]$_\omega$.

(94) *No root-initial syllableelides*

a. ìkùsú
ì-kùsú
CL.7-garment
'shirt' (SD15:57)

b. kù.s í.rù
kùsú í-rù
garment CL.7-POSS.3SG
'his shirt' (SD15:57)

This pattern is not surprising given that we have established that initial vowels are stressed and do not delete in monosyllabic roots. However, whereas there where two possible analyses for monosyllabic roots — banning the deletion of stressed vowels, or excluding stressed vowels from the scope of the markedness-constraint — only the latter is available here. A faithfulness constraint that prevents the deletion of stressed vowels would not only block the deletion of stressed vowels, but of *all* vowels in this situation, compare the tableau in (95). Candidates that do not show resyllabification are omitted.

(95) *Derivation with reference to stress fails*

[[kùsú]$_\omega$[ìrú]$_\omega$]$_\phi$	MAX-STRESS	*C]$_\phi$	*V]$_\omega$	MAX
☞ O[1]: [[kùsú]$_\omega$[ìrú]$_\omega$]$_\phi$			**	
✄ a. [[kù]$_\omega$[sìrú]$_\omega$]$_\phi$			**	*!
b. [[k]$_\omega$[sìrú]$_\omega$]$_\phi$	*!			**

The analysis with a constraint relativised to unstressed vowels does not encounter the same problem, see (96). The stressed vowel does not violate *V̆]$_\omega$, even if its syllable is opened by resyllabification.

(96) *Derivation with reference to unstressed syllables succeeds*

[[k**ù**sú]$_\omega$[ír**ù**]$_\omega$]$_\phi$	*C]$_\phi$	*V̆]$_\omega$	MAX
a. [[k**ù**sú]$_\omega$[ír**ù**$_\omega$]$_\phi$		*!	
☞ b. [[k**ù**]$_\omega$[sír**ù**]$_\omega$]$_\phi$			*
c. [[k]$_\omega$[sír**ù**]$_\omega$]$_\phi$			**!

The last category of vowels that do not undergo elision is less systematic. Some lexical items have a final vowel in an open, second (or, marginally, third) syllable that simply resist deletion. Those resistant vowels occur both in roots and functional material, but we will look at roots and affixes/enclitica separately. A striking example for this

epenthesis see section 4.1.4.

idiosyncratic nature are (97a-b) and (97c-d), which are near homonyms. However, 'monkey' behaves regularly and loses its final vowel phrase medially, while 'mantis' does not. This is not a property of the tones, as the example discussed in (96) shows, high toned vowels delete just as readily as low toned vowels.

(97) *Lexical exception to elision*

a. dáptá
'mantis' (SD15:32)

b. dáptá ʔèlló
'it is a mantis' (SD15:32)

c. dàptà
'monkey' (SD15:32)

d. dàpt ʔèlló
'it's a monkey' (SD15:32)

There is nothing immediately special about these vowels or syllables, it is still the first syllable that has the properties correlated with stress; in (97) e.g. the presence of the coda consonant. Dettweiler (2015: 32) argues that it is lexical information alone that distinguishes vowels that undergo elision from vowels that do not, and I do not see a reason to doubt this. In his impression, the latter group (i.e. roots that resist vowel elision) is much smaller, but consistent. The lexical information that these exceptions carry can be formalised in many approaches that are compatible with the Indirect Reference hypothesis. Previously, exceptional non-undergoers of a process have been analysed with strength, see e.g. Zimmermann (2018a), or some floating or degenerate material, compare for example Charette (1991). A representationally more conservative approach could assume that those vowels are long underlyingly — recall that vowel length is only phonemic in stressed syllables —; the long vowels are then shortened but cannot be deleted, just as in the chain shift that I suggest for Hijazi final high vowels in Chapter 4.3.3.

Like some root-final vowels, some affix or clitic final vowels are also non-undergoers of elision. Most monosyllabic enclitics that resist deletion are the object-clitica. Object-clitica are related to the corresponding class prefixes, however, if the respective prefix is vowel initial, the enclitic starts optionally with a glottal stop. Compare the third person enclitic in (98). As discussed above, this glottal stop can be considered evidence that the vowel is stressed, and we do not expect stressed vowels to delete.

(98) *the object clitic vowel does not elide*

a. ùhók**ʔò**
ù-hó-kà=(ʔ)ò
3SG-kill-PFV=3SG.OBJ
'he killed him' (SD15:116)

b. nánzé**ʔò** túkkùwà
nán-zé=(ʔ)ò túkkùwà

3PL.INCL.ICM-say=3SG.OBJ Tukkuwa
'he was called Tukkuwa' (SD15:121)

The suffixes that mark inalienable possession are very similar to the object clitica, but unlike them they are clearly inside the vowel harmony domain with the root.[52] As the example (99) shows, the vowels of both the inalienable possessor suffixes /mé/ and /vó/ do not delete, even if followed by another suffix. (99b) shows that vowel harmony takes indeed place, we find a high vowel after a root with high vowels.

(99) *Some affix vowel do not elide*

a. tʃètménè
tʃètó-mé-nè
father-1SG.INAL-PL
'my fathers' (SD15:69)

b. hɨ̀nmínì
hɨ̀nù-mí-nì
sibling-1SG.INAL-PL 'my siblings' (SD15:70)

c. tʃètvónò
tʃètó-vó-nò
father-2SG.INAL-PL
'your fathers' (SD15:69)

Most instances of object clitica and inalienable possession suffixes in Dettweiler (2015) resist deletion, however, elision seems to be optional for the second person singular, both as object clitic and inalienable possessor, compare (100).

(100) *2nd person singular clitic/suffix elides optionally*

a. ɨ̀mnɛ̀ː**v** tàːríhì
m-nɛ̀ː=**vò** tàːríhì
1SG-give=2SG.OBJ story
'Let me give you a story' (SD15:70)

b. hɨ̀nɨ́**v**nì
hɨ̀nù-**vú**-nì
sibling-2SG.INAL-PL

[52] Dettweiler (2015) marks the object clitics as not undergoing vowel harmony. However, there is no clear example that demonstrates that they do not undergo it. The only example of a clitic following a high vowel – vowel harmony in C'Lela refers to vowel height – actually does show vowel harmony, see (i), so they might be inside the vowel harmony domain after all.

(i) àj mhívkɨ̀ʔù gʷɛ̀lɛ̀
àj m-hívi-kɨ=(ʔ)ò gʷɛ̀lɛ̀
COMP 1SG-steal-PFV=3SG.OBJ goat
'that I stole the goat from him' (SD15:150)

Dettweiler (2000) presents the facts differently and considers first and second person singular clitics to undergo harmony, in contrast to the other clitics.

'your siblings' (SD15:108)

A specially interesting case of an affix that does not undergo elision is the ventive. The ventive affix is tonal, it has no fully segmental exponent. However, the ventive protects either the root final vowel, or, if present, the vowel of the perfective suffix from deleting. (101a-b) shows the tonal effect of the ventive affix, whereas (101c-d) shows that the root final vowel, if followed by the perfective suffix used in embedded clauses, elides in the itive, but not in the ventive.

(101) *The ventive protects a root final vowel*

a. nòkà
'go' (SD15:89)

b. nòká
'come' (SD15:89)

c. nò**k**ìnê
nò**kà**-inê
'go-PFV.REL' (SD15:89)

d. nò**ká**ínê
nò**ká**-inê
'come-PFV.REL' (SD15:89)

The perfective used in main clauses interacts differently with the ventive: Here, the protection from elision is not awarded to the root final vowel, but to the affix vowel, see (102b). As previous examples show, e.g. (88), the vowel of this suffix normally does undergo elision.

(102) *The ventive protects the vowel of the main claus perfective suffix*

a. àz ɨ̀vɔ̀mɔ́ín tèp
àz v-ɔ̀mɔ́-ínê tèp
C 2SG-pick.up.VEN-PFV.REL tape
'that you brought a tape recorder' (SD15:137)

b. ɨ̀vɔ́mkɔ̀ tèp
ɨ̀vɔ̀mɔ́-kɔ̀ tèp
2SG-pick.up.VEN-PFV tape
'You brought a tape recorder' (SD15:137)

The analysis suggested for root-final vowels such as a long vowel in e.g. /dáptá:/ can be extended to the inalienable suffixes, whereas the assumption that object-clitica carry some stress does not seem far fetched, given they can have an onset with a glottal stop. For the ventive, I assume that it consists not only of tone, but also of a mora which lengthens a final vowel. For this to work, I must make two assumptions: The mora attaches to its host before the phrase level, so that the lengthened vowel can behave as an underlying long vowel at the phrase level. Second, In order to get the lengthening in the right position with the perfective, I must assume that the ventive precedes the relative perfective but follows the main clause perfective, which might be syntactically odd.

In summary, some vowels are systematically exempt from elision – stressed vowels – and others are lexically marked. It is not fully clear to which group exceptional affix material belongs, but the optional glottal stop and the resistance to vowel harmony hint that at least some of the affixes may carry some stress as well.

4.1.3.3 Is elision allomorphy?

Given the lexical exceptions and the somewhat non-optimising character of the process, a valid hypothesis would be to assume that elision is not a phonological process but an instance of allomorphy. Under an allomorphy approach, most roots, affixes and enclitica have two allomorphs, one allomorph is selected phrase finally and another one is selected phrase medially. Similar allomorphy has been argued for Taiwanese (Tsay & Myers 1996) and K'ichee' (Henderson 2012). There are several reasons why such an analysis is not adequate for C'Lela. First, the process that we observe is quite regular. If it applies, it takes away the last vowel, there are otherwise no idiosyncratic changes. Second, there is a conspiracy. All C'Lela words are vowel final at the edge of a phrase, and most achieve this by not-deleting the final vowel. However, there are a few words that achieve this by deleting a final consonant, a nasal (103). The nasal elides at the same position in which a final vowel does not elide — phrase finally — and, reversely, it stays where a final vowel would elide — phrase medially.

(103) *Phrase-final consonant deletion*

a. tʃᵊtʃõ̃
   tʃ-tʃón
   'ears' (SD15:31)

b. tʃõ̃n tʃᵊri
   tʃón tʃ-ri
   'my ears' (SD15:31)

The most important argument, however, is that we see reflexes of the elided vowel phrase medially, even if it is deleted. A subset of suffixes do not have an underlying vowel quality, they always copy the vowel to their left. (104) shows this for the animate plural with roots that are lexically exempt from vowel elision: The vowel of the affix is a copy of the preceding vowel.

(104) *Copy of overt vowel*

a. dáptá 'mantis' (SD15:65)

b. dáptánà 'mantises' (SD15:65)

c. bàtkê 'eagle' (SD15:65)

d. bàtkénè 'eagles' (SD15:65)

However, if the affix is attached to regular roots that undergo elision, it does not copy the vowel left to it on the surface, but the vowel that is elided. This is ambiguous in many cases, because vowels in C'Lela roots tend to be identical, but evident in cases like (105c–f), where copying the closest surface vowel would yield a wrong result.

(105) *Copy of elided vowel*

a. dɛ̀kɛ́ 'warthog' (SD15:65)

b. dɛ́knɛ̂ 'warthogs' (SD15:65)

c. sìbɨ̀ 'orbi' (SD15:65)

d. sìbnɨ̀ 'orbis' (SD15:65)

e. dòndóːkà 'antelope' (SD15:65)

f. dòndóːknà 'antelopes' (SD15:65)

Under my approach, this is analysed as counter-bleeding: The copy operation happens before the vowel is deleted, e.g. at the word level. If we however assume that e.g. 'orbi' has not one underlying representation /sìbɨ̀/ but two allomorphs, i.e. /sìbɨ̀/ and /sìb/; and the latter is chosen phrase medially, vowel copy could not access the correct vowel, /ɨ/, to copy. I argue thus contra Dettweiler (2015: 32) that elision is indeed a phonological process, albeit with lexical exceptions.

4.1.4 A major complication: epenthesis

There is one major complication for the account proposed here, namely the interaction of vowel deletion with phrasal epenthesis. An epenthetic vowel is inserted in most three and four consonant clusters. This vowel is invariably [ɨ], and it can break up a [–high] vowel harmony domain, cf. (109). Epenthesis is clearly phrasal, it is triggered by proclitics, as in (106), and it is also fed by vowel elision, see (107). In (107a), we see that elision feeds epenthesis in the same position as the deleted vowel, whereas the epenthetic vowel in (107b) appears in a different position.

(106) *Epenthesis fed by phrasal clitic*

lá nɨ̀mlɨ̀vî
lá n=m-lɨ̀v-î
be.Q LOC=NMLZ-
'is he sleeping?' (SD15:118)

(107) *Epenthesis fed by elision*

a. dàptɨ̀vrù
dàptà v-rù
monkey CL-3POSS
'his monkey' (SD15:94)

b. ùnwá túbálɨ́m dʷìrì
ùnwá t-ú-bàlmá dʷìrì
3SG-DET ICM-3SG-turn hyena

'This man would often turn into a hyena' (SD15:147)

The feeding itself is not problematic for cyclicity, since the interaction is transparent. However, as seen in (107b), the epenthetic vowel can appear linearly at the same locus as the elided vowel. This is a problem for OT, as long as we want to derive epenthesis and elision at the same stratum. As the tableau in (108) shows, the correct candidate is harmonically bounded by the faithful candidate.

(108) *Derivation of epenthesis fails*

	$[[\text{dàptà}]_\omega[\text{vrù}]_\omega]_\phi$	*CLUSTER	$*\breve{\text{V}}]_\omega$	MAX	DEP
☞	a. $[[\text{dàptà}]_\omega[\text{vrù}]_\omega]_\phi$		*		
✄	b. $[[\text{dàptɨ̀}]_\omega[\text{vrù}]_\omega]_\phi$		*	*!	*
	c. $[[\text{dàpt}]_\omega[\text{vrù}]_\omega]_\phi$	*!		*	

The epenthetic vowel is not a reduced version of the original vowel[53], its position is purely decided by the number and quality of consonants in the cluster. The exact conditions for epenthesis and its locus are somewhat complicated, discussed more in depth in section 4.1.4.1. For the time being, 'after the second consonant from the right' is a good enough approximation. It is clear that epenthesis does not depend on the presence of an underlying vowel. This can be exemplified by (109), where we have epenthesis in the same position as the deleted vowel if there are two consequent consonants (109c), but at another position if there is only one following consonant (109b).

(109) *Locus of epenthesis is phonologically determined*

a. ʔòblâ
ʔòblâ
snake
'snake' (SD15:33)

b. ʔòbɨ̂lnà
ʔòblâ-nà
snake-PL
'snakes' (SD15:33)

c. ʔòblɨ̂n zá dá
ʔòblâ-nà zá dá
snake-PL be.NEG not
'There are no snakes' (SD15:33)

This interaction is puzzling for OT, but straightforward in a rule based system: A rule that iterates right to left and inserts vowels (roughly) after two consonants before another consonant can derive the data, if it is ordered after vowel deletion. Both processes can apply at the phrase level. However, the same prosodic structure

[53] Also, ɨ does not behave like a reduced vowel in C'Lela: It can host any tone, appear in any position another vowel can appear in, can be long, and is a trigger of vowel harmony.

that was necessary to define the locus of vowel deletion can also be employed to derive epenthesis in OT. The relevant constraint $*\breve{V}]_\omega$ is not violated by the linear position of the vowel, but by its structural position. If the epenthetic vowel is not the rightmost segment of a prosodic word, it does not violate the constraint. Gleim (2020) argued that the vowel must be analysed as hanging outside any prosodic word, yielding quite cumbersome prosodic structures. The introduction of stressed syllables allows me to simplify the prosodic structure considerably.[54] The tableau in (110) demonstrates that it is possible to account for the interaction of epenthesis and elision in C'Lela in parallel with a rather simple prosodic structure.

Candidate b. deletes the final vowel of /dàptà/ and does not epenthesise a new vowel. It creates the illicit cluster and is thus out. Candidate a., the faithful candidate, still binds the candidate harmonically, that inserts a vowel in exactly the same position – both linearly and structurally – as the elided vowel, in (110) candidate. c. This is exemplified with DEP, MAX is omitted from the tableau for space reasons, but either would suffice to show the harmonic bounding. The winner is candidate d., which inserts the epenthetic vowel into the second prosodic word. It thus does not violate any of the two high ranked constraints.

In order to properly satisfy the constraints summarised as CLUSTER here, I also assume that in candidate d. the epenthetic vowel builds a syllable with the preceding and following consonants. The justification follows in the next section, section 4.1.4.1. This assumption makes it necessary to consider also the candidates e. and f. I exclude e., because it excorporates a vowel and violates thus EXC-V. Candidate f. is more similar to the winner; it excorporates and incorporates one consonant. However, it is more optimal with respect to the faithfulness constraints DEP and MAX, as there is no deletion and insertion. This candidate can be excluded by adopting the constraint in (111)[55], which prohibits the integration of a segment at the right edge of a word.

(111) *INTEGRATE-RIGHTMOST
For an input pair ω_i and $\bullet_j$ where ω_i does not dominate $\bullet_j$ in the input, count a violation for an output pair ω_i and $\bullet_j$ where ω_i does dominate $\bullet_j$ and $\bullet_j$ is the rightmost segment dominated by ω_i.

Elision and epenthesis together yield the optimal output, because only like this we can avoid a final unstressed vowel, the excorporation of a vowel and the integration

[54] In Gleim (2020), without stress, vowels of monosyllabic words are protected from deletion by virtue of the word being monosyllabic. An epenthetic vowel that is integrated into the left-edge of a word would make the vowel of a monosyllabic word available for elision, wrongly predicting that it elides if it follows an epenthetic vowels.

[55] To derive the entire data correctly, this constraint must refer to morae, not to root nodes. If it was referring to root nodes, it would incorrectly predict that a consonant cannot become a word-final coda in a structure such as [dáp.tá v.rù] 'his mantis', where the final /a/ does not delete. If, as I suggest, dáptá is except from vowel deletion because the final /a/ has an additional mora, it is this mora that can absorb the new coda consonant. A word like /dàptà/ 'monkey' lacks this mora. This is arguably extendable to other representational solutions to derive the stable final vowels, such as strength or a floating C slot. For the legibility of the tableaux, I will leave it here as referring to root nodes.

(110) *Derivation of epenthesis*

I:a.	*CLSTR	*V]$_\omega$	EXC-V	INT-RMST	INT-C	EXC-C	DEP
a. φ ω ω dàptà vrù		*!					
b. φ ω ω dàpt vrù	*	!					
c. φ ω ω dàptɨ̀ vrù		*!					*
d. ☞ φ ω ω dàp tɨ̀v.rù					*	*	*
e. φ ω ω dàp tàv.rù			*!		*	*	
f. φ ω ω dàp.tàv rù				*!	*	*	

into a coda. In the next section, I will discuss epenthesis itself in more depth.

4.1.4.1 Optionality and loci of epenthesis

In C'Lela, the maximum number of consonants in the onset is generally one, and the maximum number of consonants in the coda is two, where the second consonant cannot be a sonorant Dettweiler (2015: 17ff). Sonorant-obstruent (112a) and obstruent-obstruent codas (112b), however, are abundantly attested.

(112) *Licit complex codas*

a. káɾg.sà 'gather' (SD15:19)

b. bɨ̀tk.sɨ́ 'expose' (SD15:19)

Given the discussed process of vowel deletion, but also the fact that there are multiple prefixes and proclitics that consist of only a single consonant in C'Lela, there are many scenarios that involve either a string of three consonants where the middle one is a sonorant, or of more than three consonants either via concatenation alone, or via vowel deletion.[56] In most cases, these clusters are repaired by epenthesis, however, there are a few cases where epenthesis fails to apply and we see the marked structure, see (113). These exceptions do not seem to be systematic, and I will treat them as an effect of variation.

(113) *Unexpected underapplication of epenthesis*

a. gàm tʃpá**sk** **dk**àl dkàlà
gàmV tʃ-pásV-kV d-kàlà d-kàlà
mischief CL6-pass.over-PFV CL5-always CL5-always
'Trouble was always happening' (SD15:147)

b. nètàú**nl** **z**ɔ̀ːrè
nètà=únló zɔ̀ːrè
woman=that Zoore
'That woman, Zoore' (SD15:148)

In some cases, epenthesis applies in three consonant clusters where the middle consonant is not a sonorant, but a voiced obstruent. Mostly if the obstruent is [v] but also with other obstruents such as [d]. There seems to be some gradualness: The more sonorous the middle consonant is, the worse the cluster. (114) shows three consonant clusters with medial obstruents without epenthesis, and (115) shows very similar clusters with epenthesis.

(114) *No epenthesis with middle obstruent*

a. ɔ̀m vrù
ɔ̀mɔ́ vrù

[56] I will only look at phrase medial instantiation of clusters and epenthesis, which is also the context relevant for vowel elision. Phrase initially, consonant clusters seem to be more licit, creating either complex onsets or single-consonant syllables.

dog CL1-POSS.3SG
'his dog' (SD15:93)

b. ján dvódkà
ján d-vódà-kà
world CL5-change-PFV
'The world has changed' (SD15:119)

(115) *Epenthesis with middle obstruent*

a. dòprò dɨ́vdʒúː
dòprò d-v-dʒúː
joint CL5-CL9-finger
'finger joint' (SD15:100)

b. dìn dɨ́rù
dìnɨ́ d-rù
name CL5-POSS.3SG
'his name' (SD15:94)

There is not only variation regarding whether epenthesis applies, but also where it applies. Again, it is not completely random, there are some strong tendencies. If there are four consonants in a row, and the third one is a sonorant, epenthesis is invariably before that sonorant (116). In all of Dettweiler (2015), I did not find a single counterexample for this. If the second consonant is a sonorant, but the third one is not, the epenthetic vowel seems to mostly precede the sonorant (117a), but there is also one example for it appearing right in the centre (117b).

(116) *Epenthesis before sonorant in CCRC sequences*

a. ʔòblɨ́n zá dá
ʔòblâ-nà zá dá
snake-PL be.NEG not
'There are no snakes' (SD15:33)

b. tɛ̀l kɨ́ntɔ̀rɔ́
tɛ̀lɛ̀ k-n-tɔ̀rɔ́
large.bone CL11-LINK-neck
'neckbone' (SD15:100)

(117) *Variable locus of epenthesis in CRCC sequences*

a. húl ɨ̀mtʃvùktʃù
húlV m-tʃ-vùktʃù
blow CL8-CL6-bellows
'blowing the bellows' (SD15:111)

b. ʔùèl ɨ́nwàːg mɨ̀dbàː
ʔù-èl n=wáːgà m-d-bàː
3SG-be LOC=sweep CL8-CL5-place
'S/he is sweeping a place' (SD15:84)

If both of the middle consonants in a four consonant cluster are obstruents, epenthesis may fail, as seen above in example (113). If it applies, it inserts the vowel in the centre, see (118). However, I want to stress that the number of data points to illustrate this is really rather low, and it can by no means be used to exclude another locus of epenthesis.

(118) *Epenthesis with two middle obstruents*

a. ɾém dɨ̀tʃlélà
ɾémé d-tʃ-lélà
tongue CL5-CL6-Lela
'C'Lela language' (SD15:100)

b. àsòːtk ɨ́dbàː dɨ́nkɨ̀
à-sòːtV-kV d-bàː dɨ́nkɨ̀
3PL-sit-PFV CL5-place single
'They stayed alone' (SD15:137)

In three consonant clusters, where the middle consonant is a sonorant, epenthesis seems to be strongly preferred — there are only four counterexamples in Dettweiler, of which, interestingly, none involves the most frequent sonorant n —, and its locus to be predictable; preceding the sonorant, see (119).

(119) *Epenthesis before middle sonorant*

a. ʔòbɨ́lnà
ʔòblâ-nà
snake-PL
'snakes' (SD15:33)

b. lɔ̀gɨ́mnɔ̀
lɔ̀gmô-nɔ̀
elephant-PL
'elephants' (SD15:33)

If the middle consonant is a voiced obstruent[57] there is both less data points and more variability. Both epenthesis in the position before, see (120), and after, see (121), the obstruent is possible. Given the scarcity of data it is not possible to determine whether there are other conditions that influence the placement of the vowel.

(120) *Epenthesis before middle obstruent*

a. dòprò dɨ́vdʒúː
dòprò d-v-dʒúː
joint CL5-CL9-finger
'finger joint' (SD15:100)

b. règɨ́dkò
règdó-kò

[57]In all cases, d or v, which are frequent in affixal material. b, g and z do not appear in the data in this position. At least for z, this is an artefact of the data in Dettweiler (2015); it is possible to construct a cluster with z as the middle consonant.

guard-PFV
'[he] guarded' (SD15:148)

(121) *Epenthesis after middle obstruent*

a. kùmìnv ɨ́ká:
kùmù-inê=vó ká:
get-PFV.REL=2SG.OBJ EXP
'so [what] got you [into this mess]' (SD15:79)

b. dìn dɨ́rù
dìnɨ́ d-rù
name CL5-POSS.5S
'his name' (SD15:94)

While there is lots of data in Dettweiler (2015) for epenthesis in genreal, as well as its interaction with elision, there is unfortunately not enough data for every potential segmental context of epenthesis. It is thus impossible, at least for me, to make a clear generalisation an thus a fully satisfying analysis of epenthesis in C'Lela. It seems to be optional if none of the central consonants is a sonorant and more frequent with voiced consonants than with voiceless ones. With sonorants it is (almost) obligatory, especially if there are four consonants. For the locus, the generalisation needs to be somewhat vague as well. If it is a three-consonant cluster and the second consonant is a sonorant, epenthesis applies between the first two consonants. If the second consonant is not a sonorant, the place of epenthesis is more frequently after the second consonant, epenthesis being generally more rare here.

4.1.4.2 Analysis of epenthesis

As said above, as a consequence of the vague generalizations, a full and satisfying analysis of the locus and context of epenthesis cannot be achieved. The following sketch is thus necessarily preliminary. I will also just consider cluster with at least a sonorant in the middle positions, because the other clusters have less clear patterns.

The constraint CLUSTER used before is obviously a rough cover-constraint, it can now be broken into more specific constraints. First, there is a constraint against complex onsets, (122). The second constraint, (123) prohibits sonorants in the second position in complex codas. This can be conceptualised as a prohibition of a coda with rising sonority. These constraints do not only derive epenthesis, but also the regular syllabic phonotactics of C'Lela.

(122) COMPLEXONSET
Count a violation for a complex onset.

(123) SONORITYSEQUENCING
Count a violation for a sonorant in a coda that is preceded by a consonant.

If there is a four consonant cluster with two central sonorants, the only way to satisfy these two constraints with only one instance of epenthesis is to epenthesise right in between the two consonants, see the tableau in (124). The tableau only considers candidates that have undergone vowel elision.

(124) *Derivation of epenthesis in 4 consonant cluster*

		oblnzada	*ComplexOnset	SONSEQ	DEP
a.		obln.za.da		*!	
b.		ob.lnzada	*!		
c.	☞	ob.lɨn.za.da			*
d.		obɨln.za.da		*!	*
e.		ob.lnɨ.za.da	*!		*
f.		o.bɨ.lɨn.za.da			**!

Candidate a. puts the two medial consonants into the coda, and creates thus a coda that violates SYLL-CONT, because it has coda sonorants that are not adjacent to a vowel. Candidate b. puts the medial cosnonants into the onset, which violates *COMPLEXONSET. The winner, candidate c., epenthesises right in the middle and violates so none of the two constraints. If the vowel is epenthesised between the first and second consonant (candidate d.), SYLL-CONT is still violated; and if it is inserted between the third and fourth, COMPLEX-ONSET is violated. Candidate f. does not violate any of those constraints either, but it inserts two vowels and violates so DEP more than the optimal candidate c.

If there is only one medial sonorant, either in a three consonant cluster or in a four consonant cluster, these three constraints do not suffice to determine the preferred output. However, there is a strong tendency that we can tentatively formalise: Epenthesis leads to syllable contacts of flat (sonorant-sonorant), or falling sonority (sonorant-obstruent).[58] It does not create contacts of rising sonority. There is a cross-linguistic tendency called 'Sonority Sequencing' that states that syllable contacts with rising sonority are dispreferred (Vennemann 1988). The constraint in (125) is a possible formalisation of sonority sequencing, compare i.a. Davis (1998); Gouskova (2004).

(125) SYLLABLE CONTACT
Count a violation for an obstruent coda followed by a sonorant onset.

This constraint is lower ranked than DEP in C'Lela — a sequence that violates sonority sequencing is not repaired by epenthesis generally. However, it can arbiter between the candidates c. and d. in the tableau in (126), in favour of the latter.

[58] Depending on the language, more fine gained approaches to sonority might be necessary. This might even be the case for C'Lela, where voiced obstruents behave differently from voiceless obstruents.

(126) *Derivation of epenthesis in 3 consonant cluster*

	oblna	*ComplexOnset	SonSeq	Dep	SylCon
a.	obl.na		*!		
b.	ob.lna	*!			
c.	ob.lɨ.na			*	*!
d. ☞	o.bɨl.na			*	
e.	o.bɨ.lɨ.na			**!	

A second constraint of this type is needed that prefers falling sonority over level sonority, in order to get epenthesis right in sonorant-sonorant-obstruent sequences such as (127).

(127) *Falling sonority is better than level sonority*

ɨ́mʔèl ɨ́nbɔ̀m tʃróvò
m-ʔèl n=bɔ̀m tʃ-róvò
1SG-be LOC=praise CL6-POSS.2SG
'I am praising you' (SD15:84)

Sonority sequencing derives the vast majority of cases of epenthesis with a medial sonorant, but it cannot derive the distribution of epenthesis if all three consonants are sonorants. There is only one data point that shows such a configuration, and here we find epenthesis so that /n/ is in the coda, and not /l/, see (128). According to Krämer & Zec (2020), [n] is universally a more preferred coda than [l], so it is feasible to assume a low ranked constraint that prefers an n-coda over an l-coda.

(128) *Nasal coda is preferred*

àʔèl ɨ́nlɛ́ íʔùtù
à-ʔèl n=lɛ́ í-ʔùtù
3PL-be LOC=hometown CL7-old
'They were in an old hometown' (SD15:83)

Given that the data showing epenthesis without medial sonorants is scarce and seems to show huge degrees of optionality, I will refrain from sketching out an analysis for it.

4.1.5 Summary

Word-final vowel deletion in C'Lela seems to apply to cyclic domains and is bled, or rather blocked by phrase final vowel preservation — every phrase in C'Lela ends in a vowel. This is an issue for cyclicity, because a phrasal configuration should not be able to block a previous, cyclic process. If vowel deletion is correctly analysed as cyclic, then we are confronted with a look-ahead problem: It must be blocked if the vowel will end up in a phrase final position in some consequent cycle.

The solution I proposed relies on prosodic structure: Vowel deletion is a phrasal process that refers to a prosodic domain, in this case, the recursive prosodic word. It is transparently blocked by a constraint that demands a phrase final vowel. For a partially parallel approach, a problem arises: Epenthesis breaks up consonant clusters, according to some rather complex conditions. Crucially, however, the epenthetic vowel can surface in linearly the same position as the deleted word-final vowel. This is an issue for OT, because not deleting the vowel instead of deleting it and epenthesising a new one should be less costly. The adoption of prosodic structure, independently motivated for accounting for the counter-cyclic effect, gives us the possibility of stipulating that the epenthetic vowel is, though linearly in the same position as the deleted vowel, not structurally in the same position. It can be dominated by the prosodic word to its right. In conclusion, the core of the countercyclic pattern in C'Lela is straight-forwardly captured with the assumption of prosodic structure. In addition, prosodic structure gives us a mean to handle the interaction of elision and epenthesis, which would otherwise be a problem for OT.

4.2 Akan: Phrasal Tone Spread Feeds Lexical Polar Tone

The next case of countercyclic process interactions comes from Akan (more specifically, Asante Twi; Atlantic-Congo, Paster 2010). Here, a phrasal process of tone spread feeds the insertion of a polar tone on the root-initial syllable of a verb in the perfect. That this pattern is a challenge for cyclicty, and that Paster's 2010 analysis is countercyclic, as has been noted in Trommer (2015). The cyclic reanalysis that he proposes, however, assumes a very non-standard morphology, where verbal prefixes are reclassified as nominal suffixes. In this case study I reëxamine the data and suggest an analysis that is cyclic, compatible with the Indirect Reference Hypothesis (IRH), in contrast to Paster (2010), and assumes the morphological affiliation traditionally assumed for Akan, in contrast to Trommer (2015). The case study is structured as follows: First, I will introduce the puzzle and show which part is a problem for cyclicity and why, before, in section 4.2.2 briefly laying out the gist of the reanalysis. After that, we'll look at the data in more detail and, in section 4.2.4 work out the analysis going from the stem level through to the phrase level.

4.2.1 Puzzle

In Akan, the morphological tone that marks the perfect on the verb root is polar with respect to the last tone of the subject, which is either a pronoun or taken from the open word-class of nouns. The tone of the subject spreads left-to-right onto the perfect prefix, which is the regular mechanism for tone association on toneless material. The verb root (or, more precisely, its first mora) has in other Tempus-Aspect-Modus-Polarity[59] (TAMP) categories a fixed morphological tone, depending on the category and the verbs syllabic shape, but not so in the perfect. Also, the tone that has spread from the subject onto the prefix does not spread into the root. Instead, the first root mora takes the opposite tone with respect to the preceding tone.

Paster's analysis of this pattern is both incompatible with the IRH and also countercyclic: A rule specifically indexed to the perfect induces polarity on the root-tone, but only after the subject has been merged. At this point, even if rules that make direct reference to morphological features are accepted, the root of the perfect is not an identifiable locus under any conception of bracket erasure, and the cycle for perfect-specific rules has arguably already passed, see the scheme in (129).

(129) *Countercyclic Interaction in Akan*

φ_1	
[PRF[root]]	Root is identifiable, time for perfect specific rules
[verb]	Bracket erasure

φ_2	
[subject][verb]	**Perfect specific rule identifies root initial mora**

[59]Polarity in the morphosyntactic sense; i.e. negative vs. positive.

Let us look at the perfect in more detail. (130) shows the perfect for three verb types following a subject with a high tone. The tone on the perfective prefix is high, because it is preceded by a high tone. The tone on the first mora of the verb root is low. (130b-c) have a second root mora, which may be high or low. This tone almost never changes for each individual lexeme, so I will assume that it is underlying.[60]

(130) *Perfect polarity: low tone after high toned subject*

a. ésí á-tɔ̀ pɛ̀n
Ésí PRF-buy.PRF pen
'Ésí has bought a pen' (Paster 2010: 102)

b. ésí á-nòm̀ ìnsyù
Ésí PRF-drink.PRF water
'Ésí has drunk water' (Paster 2010: 102)

c. ésí á-dàné nè hɔ̂
Ésí PRF-turn.PRF self
'Ésí has turned herself' (Paster 2010: 102)

(131) shows the same verbs in the perfect, but this time with a subject that has a final low tone. The prefix shows up as low in all cases, copying the tone to its left. The first mora of the root however, carries now a high tone.

(131) *Perfect polarity: High tone after low toned subject*

a. yàw à-tɔ́ pɛ̀n
Yàw PRF-buy.PRF pen
'Yàw has bought a pen' (Paster 2010: 102)

b. yàw à-nóm̀ ìnsyù
Yàw PRF-drink.PRF water
'Yàw has drunk water' (Paster 2010: 102)

c. yàw à-dáné nè hɔ̂
Yàw PRF-turn.PRF self
'Yàw has turned himself' (Paster 2010: 102)

This polarity pattern is both specific to the perfect and to verbs of specific morphological classes, which I will call classes 1 (131a-b) and 2 (131c) respectively. There are two more patterns, which I will group into a class 3, and these do not exhibit polarity in the same way.[61] (132) shows class 3 verbs with a low toned subject. Here, the prefix is, again, copied, and the root tone is high. This looks just like the cases discussed above. However, if the subject and thus the prefix are high-toned, the verb tone is not low, but a downstepped high tone. Because the difference between high tones and

[60] The only exception is the imperative, where a second mora high tone is replaced with a low tone.

[61] The membership to a class is correlated with the segmental shape of the verb root. Class 1 verbs are monosyllabic with a simple onset, or have a sonorant onset in the second syllable, class 2 has a sonorant onset in the second syllable, class 3 is either monosyllabic with a complex onset or bisyllabic, with the second syllable being either onsetless or having an obstruent onset. The only shape that can belong to two different classes are thus bisyllabic verbs where the second syllable has a sonorant onset or is a syllabic sonorant.

downstepped high tones is neutralised after a low tone (Paster 2010), we can argue that the root tone in the perfect of verbs of class 3 does not depend fundamentally on the preceding tone. It is always a downstepped high tone, which is, after a low tone, indistinguishable from a regular high tone. The perfect in these verbs thus does not constitute a problem for cyclicity, only the truly polar instances in (131) and (130) do. Reformulated, the Akan perfect in these verb classes poses a problem for cyclicity, because the phrasal spreading of the tone feeds lexical, morpheme specific polarity.

(132) *Perfect in class 3 after low toned subject*

a. yàw à-káé kòfì
Yàw PRF-remember.PRF Kòfì
'Yàw has remembered Kòfì' (Paster 2010: 103)

b. yàw à-bwá yàà
Yàw PRF-help.PRF Yàà
'Yàw has helped Yàà' (Paster 2010: 103)

(133) *Perfect in class 3 after high tones subject*

a. ésí á-ꜜkáé kòfì
Ésí PRF-remember.PRF Kòfì
'Ésí has remembered Kòfì' (Paster 2010: 102)

b. ésí á-ꜜbwá yàà
Ésí PRF-help.PRF Yàà
'Ésí has helped Yàà' (Paster 2010: 102)

Other TAMP categories behave consistently in the same way as verb class 3 does in the perfect. In the other TAMPs, the tone of the verb root is either completely independent from the preceding tone, illustrated with the habitual in (134), or varies between a downstepped high tone and a regular high tone[62], illustrated with the negative past in (135).[63]

(134) *Habitual: Verb tone independent of subject (H)*

a. ésí tɔ́ pɛ̀n
Ésí buy.HAB pen
'Ésí buys a pen' (Paster 2010: 80)

b. yàw tɔ́ pɛ̀n
Yàw buy.HAB pen
'Yàw buys a pen' (Paster 2010: 80)

(135) *Negative past: H after L, !H after H*

a. ésí áń ꜜtɔ́ pɛ̀n
Ésí PST-NEG-buy.NEG pen

[62]Phonetically, the high tone after a a low tone is more similar to a downstepped high tone, cf. Genzel (2013). The important fact is, that in this position there is no differentiation between downstepped and regular high tones.
[63]There are also some tones that vary, depending on the subject tone, between a low tone (if preceded by low) and a downstepped high tone (if preceded by H). This will be discussed in section 4.2.3.1.

'Ésí did not buy a pen' (Paster 2010: 95)

b. yàw àǹtɔ́ pɛ̀n
Yàw PST-NEG-buy.NEG pen
'Yàw did not buy a pen' (Paster 2010: 95)

The desideratum for a reanalsysis of polarity in the Akan perfect for me is thus twofold: The analysis ought to be cyclical, but it should also do away with the blatant violation of the IRH introduced by a perfect-specific rule. In the following, I will sketch out such an analysis.

4.2.2 Solution in a nutshell

The gist of the reanalysis is as follows: The first root mora in the perfect in the relevant verb classes, classes 1 and 2, is toneless, and it remains toneless until it reaches the phrasal phonology. These morae are not the only toneless morae in the input of the phrasal phonology in Akan: Plenty of prefixes are toneless, too (Dolphyne 1988; Paster 2010; Genzel 2013 pace Marfo 2005). However, they are the only completely tonally unspecified morae that we find in a verb root. At the phrase level then, all tone-bearing units (TBUs) are bestowed a tone. The toneless prefixes get their tone by spreading it from the preceding syllable rightwards, this is, in the relevant cases, the final syllable of the subject. For the empty TBUs in the roots, this possibility must be ruled out. This cannot be done by referring to roots themselves, as this would be incompatible with the assumption on reference to morphological information adopted here, and also ruled out by even weak bracket erasure. However, we can stipulate that the root constitutes some prosodic domain. For the sake of this argument, it is not important what domain this is, it could be the phonological word or something smaller, such as a foot. For the time being, I will call it D.[64] The tone from the subject cannot cross into this domain, so spreading it is not an option. The tone of the second mora (if present) also must not spread leftward, which is consistent with the fact that we generally do not find leftward spreading of tone in Akan.[65] Instead, a new tone is inserted. This tone is polar with respect

[64] An alternative to the somewhat diacritic domain D would be to assume that the prefixes integrate at the phrase level as suffixes into the preceding word, mirroring the behaviour of ditropic clitics(Cysow 2003; Himmelmann 2014). For a precedent of such an approach, see Hyman (1987). Under that assumption, the well motivated prosodic word would suffice to delineate the relevant phonological domains. Such an analysis works for the data in Paster (2010), but it makes wrong predictions for when a perfect verb is phrase initial and the prefix cannot integrate into a preceding word: Here, the prefix obtains a default low tone, and the root is polar with respect to that default tone (Joana Serwaa Ampofo, p.c.).

[65] There is a process of phrasal tone spread in Stewart (1993) which spreads a high tone from a verb rightward onto the first mora of a noun root if that is low toned. If that first mora is part of the root, it should be part of the D domain and thus be immune to spreading. Potentially, this data could be very problematic for the approach presented here. However, the data on this is really unclear, Paster (2010) e.g. does not mention this process, Marfo (2005) analyses this as a side effect of a wider rule of 'boundary assimilation'. Genzel (2013), in her careful phonetic study, does not find evidence for this type of spreading, at least with the behaviour that Marfo (2005) predicts, and she implies that this extends to the definition of the process proposed by Stewart (1993). Genzel says about a low toned

to the preceding tone, in order to satisfy an OCP constraint. Polar tone insertion on toneless syllables is widely attested, for example on epenthetic syllables in Wandala (Frajzyngier 2012) or on toneless affixes in Kɔnni (Cahill 2007a).

The tableau in (136) shows in broad strokes how this analysis can account for the feeding countercyclic polarity. In the input to the phrase level, we have, to the left, a subject with a tone, in this case high, and, to the right, a verb that has two morae, both toneless. The verb has two nested prosodic domains, the prosodic word ω containg both morae, and D dominating only the root.

(136) *Phrase level derivation of e.g. 'Ésí átɔ̀'*

		µ́(µ(µ))	Crisp-Edge	Dep-Tone	OCP	*Spread-R
a.		µ́(µ́(µ́))	*!			**
b.		µ́(µ́(µ́))		*	*!	*
c.	☞	µ́(µ́(µ̀))		*		*

Candidate a. spreads the high tone from the subject to all morae — tone spreading is indicated with an underline. This fatally violates a constraint that prohibits association lines from crossing into D; a Crisp-Edge constraint. Candidate b. spreads the high tone of the subject onto the prefix only, and inserts another high tone on the root vowel. This violates the OCP. Candidate c. wins because it avoids both a violation of the OCP and Crisp-Edge.

As mentioned before, a first assumption I have to make to implement this idea is that, underlyingly, Akan verb roots do not have tone, at least not on the first mora. In most cases, some tonal morpheme is attached to the verb root, depending on the TAMP category and partially the segmental shape of the root. I assume that this happens on the stem level. In the perfect, no tone is assigned to the first mora of the verb. If the root has a second mora, it gets a tone depending on its shape or, alternatively, already has an underlying tone on this position. Also on the stem level, the prosodic domain D is built around the verb root. At the word level, segmental prefixes are joined, in the case of the perfect, a toneless prefix /a-/. The root-sized domain stays intact. At the phrase level, the subject is concatenated. The toneless prefix gets its tone via spreading. The tone cannot spread into the root, because this violates a Crisp-Edge-constraint relativised to the root-sized prosodic domain D. (137) gives a schematic overview with the derivation of the perfect to the left and the habitual to the right.

object after a high toned verb: 'However, in both cases the pitch on the first syllable of the object falls towards an L target' (Genzel 2013: 34). I choose thus to ignore this additional spreading process, but if it turns out that this spreading process is real and targets vowels that are unambiguously part of the root and not prefixes, my analysis cannot stand without major amendments.

(137) *Cyclic derivation of Akan*

Stem level phonology		
tɔ	H tɔ	Input
[tɔ]$_D$	H[tɔ]$_D$	Prosodic structure is built
[tɔ]$_D$	[tɔ́]$_D$	Floating tones are integrated
Word level phonology		
a[tɔ]$_D$	[tɔ́]$_D$	Input
[a[tɔ]$_D$]$_\omega$	[[tɔ́]$_D$]$_\omega$	Prosodic structure is built
Phrase level phonology		
ésí [a[tɔ]$_D$]$_\omega$	ésí [[tɔ́]$_D$]$_\omega$	Input
ésí [á[tɔ]$_D$]$_\omega$	ésí [[tɔ́]$_D$]$_\omega$	Tone spreading (blocked by D-boundary)
ésí [á[tɔ̀]$_D$]$_\omega$	ésí [[tɔ́]$_D$]$_\omega$	Polar tone as last resort

4.2.3 Data

In this section, I will discuss the data in more detail, which is necessary to refine the analysis presented above in a way to avoid contradictions with the wider picture of verbal morphophonology in Akan. We will look at the regularities of the tones in verb roots, which I will use to argue for underlyingly toneless morae. Akan has three surface tones, high (H), low (L) and a downstepped high (!H). High and downstepped high are only distinguished from another after another high tone (Dolphyne 1988; Genzel 2013). This yields the tonal patterns for two morae in (138).

(138) *Tonemes*

a. HH pápá 'good' (Dolphyne 1988: 52)
b. LL pàpà 'fan' (Dolphyne 1988: 52)
c. HH pàpá 'good' (Dolphyne 1988: 52)
d. HL nóm̀ 'drink' (Paster 2010)
e. H!H ɔ̀bɔ́ꜜfó 'messenger' (Dolphyne 1988: 55)

Whereas tone in nouns is fully lexical, the tone of a verb root is mostly predictable if its segmental shape and the morphosyntactic features of its exponents are known. The table in (139) gives an overview over the tonal shape of verbs. The upper row indicates the segmental shape of the roots, where V stands for a syllable with no or a simple onset, GV for a syllable with a complex onset, consonant + glide, and R(V) for either a sonorant initial syllable or a syllabic sonorant. The leftmost column gives the morphosyntactic contexts. In the cells, C stands for a copied tone identical to the preceding tones, P for a polar tone and (!)H indicates a high tone that is downstepped if preceded by another high tone. Again, there is no difference between downstepped and not downstepped high tones after a low tone. The verb roots are underlined.

(139) *Abstract Tonal Paradigm*

	V	VR(V)$_1$	VR(V)$_2$	GV	VV
HAB	H	HL	LH	(!)H	LH
NEG	C-(!)H	C-(!)HL	C-LH	C-(!)H	H-!HH / L-LH
FUT	H-H	H-HL	H-LH	H!H	H-!HH
FUT.NEG	H-!H	H-!HL	H-LH	H-!H	H-!HH
PST.NEG	CC-(!)H	CC-(!)HL	CC-LH	CC-(!)H	HH-!HH / LL-LH
PROG	(!)C-H	(!)C-HL	L-LH	L-H	L-LH
PST	L-L	LL-L	LH-L	LH-L	LH-L
PRF	C-**P**	C-**P**L	C-**P**H	C-(!)H	C-(!)HH
PRF.NEG	C-(!)H-L	C-(!)HL-L	C-(!)HH-L	C-(!)H-L	C-(!)HH-L
IMP	L	LL	LL	L	LL
IMP.NEG 1	HH-!H	HH-!HL	HH-LH	HH-!H	HH-!HH
IMP.NEG 2	LL-H	LL-HL	LL-LH	LL-H	LL-LH

Now, we will go through the morphosyntactic categories ordered by commonalities. There are two morphosyntactic categories without moraic or segmental affixes, the imperative and the habitual. In the imperative, every tone is low, see (140). This is the only category in which the second mora of VV type roots is not high toned.

(140) *Imperative (Paster 2010: 115)*

Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
—	tɔ̀ 'buy'	nòm̀ 'drink'	dànè 'turn'	bwà 'help'	kàè 'remember'

In the habitual, see (141), the tone follows from the segmental shape of the root: If it is monomoraic and has a simple onset, it has a high tone. If it is monomoraic, and has a glide before the vowel, it has a downstepped high tone after high, and a high tone after low — this is the behaviour that we expect from downstepped high tones. For bimoraic roots, there are two possible patterns: If the root belongs to the first group of VR(V) shaped roots (hence: VR(V)$_1$), the root has a high low sequence. If the root belongs to the second group of VR(V) (hence: VR(V)$_2$), or there is a second vowel that is either onsetless or has an obstruent onset (VV), the tones in the habitual are LH.

(141) *Habitual (Paster 2010: 80)*

Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
High (ésí)	tɔ́	nóm̀	dàné	ꜜbwá	kàé
Low (yàw)	tɔ́	nóm̀	dàné	bwá	kàé

The progressive (143) and the future (142) have similar patterns. They have prefixes, in case of the future the prefix is always high toned, /bɛ́-/. For the progressive, the prefix, a mora that copies its segmental features from the preceding subject, is low toned if it precedes VV, GV and VR(V)$_2$ shaped roots; for V and VR(V)$_1$ roots, it is somewhat more intricate: The tone of the prefix is low after a low toned subject, and a downstepped high after a high toned subject. In the progressive, the tones on the root itself are identical to the habitual, and in the future, they are identical with the exception of VV roots, where we find a downstepped high tone instead of a low tone on the first root mora.

(142) *Future (Paster 2010: 88)*

Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
High (ésí)	bɛ́-tɔ́	bɛ́-nóm̀	bɛ́-dàné	bɛ́-ꜜbwá	bɛ́-ꜜkáé
Low (yàw)	bɛ́-tɔ́	bɛ́-nóm̀	bɛ́-dàné	bɛ́-ꜜbwá	bɛ́-ꜜkáé

(143) *Progressive (Paster 2010: 96)*

Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
High (ésí)	ꜜí-tɔ́	ꜜí-nóm̀	ì-dàné	ì-bwá	ì-kàé
Low (yàw)	ẁ-tɔ́	ẁ-nóm̀	ẁ-dàné	ẁ-bwá	ẁ-kàé

There are various negative categories: The negative, the negative past, negative future, two negative imperatives and the negative perfect. The last one is somewhat peculiar, but all the others pattern alike regarding the tones of the root, see (144). The tone on the second mora, if present, is identical to the habitual (again, the only case where this tone is different is the *positive* imperative). The first mora in V, VR(V)$_1$ and GV roots has a high tone that is downstepped following another high tone. VR(V)$_2$ verbs have a low tone on the first mora. VV verbs show the most interesting pattern: The first mora carries a downstepped high tone following a high tone, and a low tone after a low tone. The negative prefix is a syllabic nasal that agrees in place with the following consonant, in the imperatives and the past there is an additional prefix. For the general negative and the negative past, the tone of the prefix(es) is copied from the subject, for the negative imperatives and the negative future, it is invariable: High in one negative imperative and the future, low in the other negative imperative. The negative future is the only category, in which the subject tone has an effect on the moraic structure of the verb: After a low tone, the negative prefix is lengthened. After a high toned subject, the general negative and the negative future are identical.

(144) *Negative tones (Paster 2010: 83,91,95,116)*

					Negative
Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
High (ésí)	ń-ꜜtɔ́	ń-ꜜnóm̀	ń-dàné	ḿ-ꜜmwá	ŋ́-ꜜkáé
Low (yàw)	ǹ-tɔ́	ǹ-nóm̀	ǹ-dàné	m̀-mwá	ŋ̀-kàé
					Negative Past
High (ésí)	á-ń-ꜜtɔ́	á-ń-ꜜnóm̀	á-ń-dàné	á-ḿ-ꜜmwá	á-ŋ́-ꜜkáé
Low (yàw)	à-ǹ-tɔ́	à-ǹ-nóm̀	à-ǹ-dàné	à-m̀-mwá	à-ŋ̀-kàé
					Negative Future
High (ésí)	ń-ꜜtɔ́	ń-ꜜnóm̀	ń-dàné	ḿ-ꜜmwá	ŋ́-ꜜkáé
Low (yàw)	ńː-tɔ́	ńː-ꜜnóm̀	ńː-dàné	ḿː-ꜜmwá	ŋ́ː-ꜜká é
					Negative Imperative 1
—	mɛ́-ń-ꜜtɔ́	mɛ́-ń-ꜜnóm̀	mɛ́-ń-dàné	mɛ́-ḿ-ꜜmwá	mɛ́-ŋ́-ꜜkáé
					Negative Imperative 2
—	ɛ̀ɛ̀-ǹ-tɔ́	ɛ̀ɛ̀-ǹ-nóm̀	ɛ̀ɛ̀-ǹ-dàné	ɛ̀ɛ̀-m̀-mwá	ɛ̀ɛ̀-ŋ̀-kàé

The past and the negative perfect are the only categories that have suffixes. These suffixes are a mora that copies its features from the preceding vowel and they are always low toned. The past does not have a prefix, see (145). The first mora of every root in the past carries a low tone, and the second mora, if present, carries its regular tone. The past of GV verbs is peculiar: In the past, and only in the past, they are bimoraic, the glide shows up as a non-low vowel, in (145), [o]. This new vowel carries the low tone that marks the past, the vowel that we see throughout carries a high tone. They look thus identical to VV verbs. The negative perfect has an over prefix, which behaves like many prefixes we have seen so far and copies its tone from the left. The tone on the first root mora is a downstepped high tone in all verb types.

(145) *Categories with suffixes (Paster 2010: 98,105)*

Past					
Subject	V	VR(V)$_1$	VR(V)$_2$	GV	VV
Any	tɔ̀-ɔ̀	nòm̀-m̀	dàné-è	bòá-à	kàé-è
Negative Perfect					
High (ésí)	ń-ꜜtɔ́-ɔ̀	ń-ꜜnóm̀-m̀	ń-ꜜdáné-è	ḿ-ꜜmwá-à	ŋ́-ꜜkáé-è
Low (yàw)	ǹ-tɔ́-ɔ̀	ǹ-nóm̀-m̀	ǹ-dáné-è	m̀-mwá-à	ŋ̀-káé-è

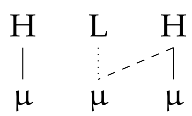
The last TAMP category to discuss is the positive perfect, see (146). Again, the second mora tone stays unaltered. The prefix of the perfect copies the tone from the left. The first mora in GV and VV verbs has a downstepped high tone, if preceded by a high tone, and a high tone if preceded by a low tone. It shows the same tonal behaviour that is seen in the negative perfect throughout. In V, $VR(V)_1$ and $VR(V)_2$ verbs we see the polarity that is the reason to discuss Akan in the first place in this dissertation: The first root mora has a high tone following a low tone on the prefix, and a low tone following a high tone. Keep in mind that this tone is not the prefix' own, but acquired from the subject.

(146) *Perfect (Paster 2010: 102)*

Subject	V	$VR(V)_1$	$VR(V)_2$	GV	VV
High (ésí)	á-tɔ̀	á-nɔ̀m̀	á-dàné	á-ꜜbwá	á-ꜜkáé
Low (yàw)	à-tɔ́	à-nɔ́ḿ	à-dáné	à-bwá	à-káé

4.2.3.1 Generalisations

After looking at all the data, we can generalise about the behaviour of tones in Akan verbs. Some tones are completely independent from their surrounding phonological context and have a consistent quality. They can be always high, or always low. Examples amongst others are all the tones in the habitual or the past for roots and suffixes, and the tones in the future or negative imperative 2 prefixes for prefixes. Some morae surface with a high after a low tone, and with a downstepped high tone after a high tone. Since we cannot have a downstepped high tone after a low tone, this is exactly the behaviour that is expected from a downstepped high tone, if we assume that such tones exist as an entity at some level. Some morae show up either with a low tone or a downstepped high tone. These can be prefixes – namely, the prefix of the progressive – or root morae – the first mora of VV verbs in the negative and negative past. Crucially, these morae are always followed by a high tone. The context of them showing up with a downstepped high tone is thus *in between* high tones. The existence of this pattern is the reason for the rule of plateauing in Paster (2010: 87), given in (147). The dotted line is to be interpreted as association deleted by rule (147), the dashed line as association created by the rule. However, only very specific low tones are subject to this rule, it cannot be by any means a general rule.

(147)


Of course, it can be argued, as Paster does — and I will follow her in this — that some downstepped high tones that are always found in between other high tones are the result of a plateauing process, too. An example would be tone on the first root mora in VV verbs in the future.

Stable tones and the plateauing tones are found with both affixes and roots.[66] The last two types of morae, however, are restricted to prefixes and roots respectively.

[66]The downstepped high tone is not found in verbal prefixes. I treat this as an accidental gap, after all, the number of prefixes is limited.

Some prefixes (e.g. the perfect, the negative) always show up with the tone of the preceding syllable. This pattern is not found in roots. Conversely, the first mora of roots in V, $VR(V)_1$ and $VR(V)_2$ verbs in the perfect has the polar value with respect to the preceding tone. We do not find this pattern in prefixes. (148) gives an overview of the tonal shapes and where we find them.

(148) *Overview of tone types*

Type	Description	Distribution
L	always L	root, prefix, suffix
H	H after H, neutralised with !H after L	root, prefix
!H	!H after H, neutralised with H after L	root
Plateau-L	!H in between Hs, L elswhere	root, prefix
Copy	H after H, L after L	prefix
Polar	L after H, H after L	root

4.2.4 Analysis

4.2.4.1 Assumptions on underlying representations

Paster (2010) assumes that the tones seen in the affix-less habitual are the underlying tones of the verb roots. I will take a different approach and assume that only the tone on the second mora is underlying, the first mora is (mostly) toneless. From the traditional point of view that only unpredictable information can be part of underlying representations (Chomsky & Halle 1968; Kiparsky 1982), this is not extreme enough: Almost all verb tones are predictable given the segmental shape of the root and the morphosyntactic features, even if they hardly alternate in a paradigm. I take thus the approach of Bermudez-Otero (2003) that non-alternating phonemic information is part of the underlying representation, even if it is predictable in a more specific subset of the data. This assumption gives us the underlying tonal/moraic structure for the 5 verb shapes in (149).

(149) *Underlying tonal shapes of verb roots*

V	$VR(V)_1$	$VR(V)_2$	GV	VV
µ	µµ̀	µµ́	!µ́	!µµ́

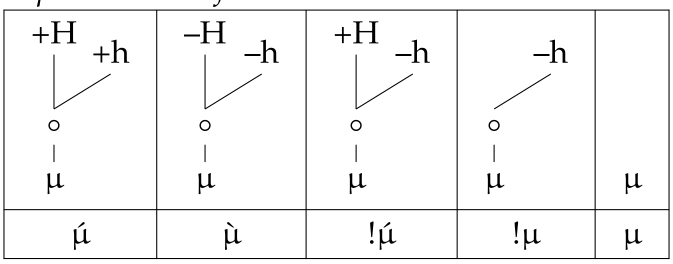
In V, $VR(V)_1$ and $VR(V)_2$ verbs, the first mora is empty, the second mora has a high tone (with $VR(V)_2$ verbs) or a low tone (with $VR(V)_1$ verbs). GV verbs have one mora which is fully specified, namely with a downstepped high tone. VV verbs have a fully specified second mora, which is high, and a partially specified first mora, which has a low register tone, this is indicated with the exclamation mark before a bare vowel in (149).

In order to model this representations, I employ register tone theory (Snider 1988, 1998, 1999) and sub-tonal features (i. a.Yip 1980; Snider & van der Hulst 1993; Snider 1999): ±H, the feature that gives us the melody tone and ±h, responsible for the register. A stable high tone has the + value for both features, and an stable low tone has the − value for both features. Those are the fully specified high and low tones respectively. A downstepped high tone is specified as +H −h on the surface. Alternating high tones, the ones that oscillate between H and !H, have the same representation in both contexts, the absence of downstep after a L is a consequence of phonetic implementation. On the reverse, a +h −H combination is not found in Akan, it is thus excluded by high ranked constraints against this combination.

For the tones that alternate between L and !H in a plateauing context, I assume that they are underlyingly partially specified (or become so at some point in the derivation) with only a specification for [-h]; that is, they have a low register tone but no melody tone.

The table in (150) give an overwiev on the representations for the various combinations of morae with melody and register tones, and shows how I represent them linearly in the lower row. The first three morae are fully specified, high, low and downstepped high respectively. The fourth mora is partially specified and the fifth one is not at all specified, i.e. it is a toneless mora. These tone/mora combinations will be important to derive the plateauing tone and the polar tone (in roots) respectively. The circle ∘ represents the tonal root node, compare Snider (1999), an organisational node that bundles the tonal feature just like the segmental root node • bundles the segmental features.

(150) *Representation of tone*



Prefix morae can take the same tonal specifications as root morae, (151) lists the tonal shapes of all the prefixes. Crucially, the empty mora in prefixes and in roots will behave quite differently: It gets a polar tone in roots, but a copied tone in prefixes.

(151) *Tonal shape of prefixes*[67]

Neg,Prf,Neg.Prf	μ-
Fut, Neg.Fut	μ́-
Neg.Pst	μμ-
Prog	!μ-
Neg.Imp 1	μ́μ́-
Neg.Imp 2	μ̀μ̀-

4.2.4.2 Verb classes

I propose that there are three verb classes in Akan, which are defined by the fact that they take the same tonal allomorphs that dock on the root.[68] Verb class 1 encompasses the V and VR(V)$_1$ verbs. Class 2 consists of only one shape, the VR(V)$_2$ verbs. Class 3 includes the GV and VV verbs. (152) shows the morphological tones that I assume for each class in each TAMP category. These tones are docked to the root and they depend on the morphosyntactic categories they express as a morpheme and the verb class they combine with. Since all these tones are to the left of the underlying tone on the second mora in bimoraic verbs, I assume they are prefixed and call them prefixed tones. They are not to be confused with the tones of prefixes. The workings of how these tones are realised precisely will be discussed in the next section.

(152) *Allomorphs of prefixed tones*

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>Hab</td><td>H-</td><td colspan="2">L-</td></tr>
<tr><td>Prog, Fut</td><td>H-</td><td>L-</td><td>Ø</td></tr>
<tr><td>Neg</td><td>!H-</td><td>L-</td><td>Ø</td></tr>
<tr><td>prf</td><td colspan="2">Ø</td><td>!H</td></tr>
<tr><td>Pst, Imp</td><td colspan="3">L- -L</td></tr>
<tr><td>prf.Neg</td><td colspan="3">!H-</td></tr>
</table>

As can be seen in (152), the perfect negative tone, and the imperative and past tones are independent of the verb class, they do not show any allomorphy. The past and imperative pattern is the only one which, alongside prefixation, employs suffixation, too. The habitual of classes 2 and 3 is syncretic and expressed with the same allomorph, and in the perfect which interests us most, classes 1 and 2 are syncretic: no tone for class 1 and 2, and a downstepped high tone for class 3. Progressive and future, and the negatives have different tones for each class, a

[67]It is for my purposes not relevant whether the negative past has a single, bimoraic prefix, or whether negative and past is marked by two monomoraic prefixes indicating negative and past in the context negative.

[68]The classes I suggest are not without alternative — slightly different classes with slightly different allomorphs are possible and would work in essentially the same way, but I will stick with this one proposal for expository reasons.

(downstepped) high tone for class 1, a low tone for class 2, and nothing for class 3.

4.2.4.3 Stem level: prefixed tone association

Now that we have introduced the assumptions on tone, and the underlying representations of roots, prefixes and the prefixed tones that mark TAMP, we can turn to how they are combined and how that combination is computed. At the stem level, the underlying form of the verb is combined with the morphological tones listed in (152). The prefixed tones that I assume are either fully specified tones or nothing. This is not a necessary assumption. A different splitting of the space of underlying tones of the root and prefix tones is possible, compare Paster (2010) and Trommer (2015), and many but not all of those partitions will be compatible with the gist of the analysis that I propose. I am not aware of any compelling empirical or conceptual arguments in favour of my exact partition, so take it as rather illustrative.

Before we turn to the perfect, the apparent countercyclic example, we will briefly look at the habitual, the negative and the past in order to understand how morphological tone assignment works, which is the crucial tonal process that occurs at the stem level. To recap the underlying representations, the habitual prefix tone has a high toned allomorph for class 1, and a low tone allomorph for classes 2 and 3. In classes 1 and 2, the first root mora is toneless, so the prefix tone can dock without competition, compare the tableau in (153) which shows this for a bimoraic verb from class 1 such as nóm̀, underlying nom̀.

(153) *Stem level derivation of e.g. nóm̀*

	H μμ̀	*FLOAT	MAX	*ASSOC
a.	H μμ̀	*!		
b. ☞	μ́μ̀			*
c.	μμ̀		*!	

This is derived with three standard constraints, *FLOAT against floating tones (Yip 2002), a constraint against associating the tone, *ASSOC (also Yip 2002), and, of course, MAX against deletion.

In class 3, the first mora is either completely specified, for verbs with the GV shape, or partially specified, for verbs with the VV shape. The latter is not an issue, because the specifications of the first mora and of the prefix tone are compatible: The root mora has a low register tone, and the prefix a low register and low melody tone. The two registers could fuse, the floating one could dock vacuously, or one of the register tones could be deleted.[69] The same is not true for the GV shape, where a low tone, precisely the low melody tone, will be in a conflict with the high melody tone

[69] Another option would be to meddle with the proposed underlying representations and assume that the habitual allomorph for class 3 is only a low melody tone. That would make then even such a repair unnecessary.

on the only mora of the root. I assume that it is a MAX-RIGHTMOST-TONE constraint, given in (154), that protects the last tone from being overwritten. The same constraint will trigger overwriting in the imperative. It does not matter whether this constraint protects tonal root nodes or only melodies.

(154) MAX-RMST-T
Count a violation for a tonal root node that is at the right edge in the input and has no correspondent in the output.

The tableau in (155) then derives the habitual for a GV root like !bwá. The winner b. deletes the prefix tone which is preferred to deleting the root tone due to the linear order; candidate a. is out because it leaves a floating tone and candidate c. loses because it deletes the more protected tone to the right. In addition, there must be a constraint *CONTOUR (Yip 2002), omitted from the tableau, which prevents the root mora from hosting both tones.

(155) *Stem level derivation of e.g. !bwá*

	L !µ́	*FLOAT	MAX-RMST-T	MAX-LMST-T
a.	L !µ́	*!		
b. ☞	!µ́			*
c.	µ̀		*!	

In the negative, progressive and future, class 3 verbs select a zero allomorph. Since class 3 does not have completely toneless TBUs, this zero allomorph does not create syllables with completely toneless TBUs either. Instead, these verbs leave the stem level just as they have entered it. The prefix for class 2 is a low tone and behaves just as in the habitual. The prefix for class 1 is not a regular high tone as in the habitual, but a downstepped high tone. Otherwise, it docks in exactly the same fashion as the regular H tone in the habitual.

The past and imperative involve some overwriting and also, in the past, some non-tonal, namely moraic, affixes. The tonal shape I assume is a low tone prefix and suffix for both the imperative and the past, but the moraic affixes are different between the two TAMP categories. In the imperative, there are no moraic affixes. This leads to overwriting: The rightmost tone is the low suffix tone, so it must be preserved, due to MAX-RMST-T introduced above. The preservation of the prefix can be handled by a mirrored MAX-LMST-T, as in (156), or by some other constraint, such as *SHIFT. (156) shows the derivation of an imperative such as kàè 'remember!' from underlying !kaé.

(156) *Derivation of overwriting in the imperative, e.g. kàè*

	L !μμ́ L	*Float	Max-rmst-T	max-lmst-t	Max-T
a.	L !μμ́ L	* ! *			
b.	μ̀μ́		*!		*
c.	μ́μ̀			* !	*
d. ☞	μ̀μ̀				*

Candidate a. violates *Float twice and is thus out. Candidate b. docks the prefix tone, which is not problematic, but it preserves the root tone instead of the suffix tone, violating so Max-rmst-t. Candidate c. docks the suffix tone, and preserves the full tone of the root by shifting it left. This fatally violates, next to other faithfulness constraints, Max-lmst-T. The winner, candidate d., deletes the root tone which is not at any edge and thus does not enjoy any special protection.

For the past, I assume the same tonal affixes, but there is no overwriting. This is because the past has, unlike the imperative, also a suffix mora, and the suffix low tone can dock on this mora. The prefix tone docks at its usual position, the empty mora. Differently from other prefix L tones, this tone is realised on GV verbs, by turning the glide into a vowel and creating so a new mora, e.g. bòáà for underlying ꜜbwá. I derive this by assuming that the moraic past morpheme has an allomorph with a prefix with GV roots. This is the only non-tonal allomorphy in the TAMP markers, and the only one that does not coincide with the classes I propose. The tableau that derives this pattern is in (157). In the input, the first and the last mora are both contributed by the past. Segmentally, the last mora copies the features of the next vowel, whereas the first mora vocalises the glide. Both offer a place for the floating tones to dock without overwriting anything. The ! mark indicating the downstep is absent from the winner b., because downstepped high tones and regular high tones are neutralised after a low tone.

(157) *Docking of prefixed L- in the past of GV verbs, e.g. bòáà*

	L μ!μ́μ L	*Float	Max-rmst-T	max-lmst-t	Max-T
a.	L μ!μ́μ L	* ! *			
b. ☞	μ̀μ́μ̀				

Having discussed both docking and overwriting, we can now turn to the perfect. The perfect does not introduce anything new. In class 1 and 2, there is a zero allomorph. Because the first mora is completely unspecified in these classes, it remains so. This is because at the stem level, the constraint Specify that demands morae to be associated with a tone is ranked low; crucially lower than any constraint that could cater the morae with some tone, e.g. Dep against insertion or *Spread against spreading. The only way for an empty mora to get a tone at the stem level is getting hold of a floating tone supplied by the lexicon via concatenation.

In class 3, the prefix is a downstepped high tone (or just a high melody tone). It has no effect on GV verbs, which have no empty mora and can lose their tones only if there is a more important suffix. On VV verbs, the prefix tone is again compatible with the low register, leading to the formation of a downstepped high tone.

The output of the stem level is segmentally equivalent to the root, but tonally and moraically not always. It is, and this will be crucial, wrapped in some prosodic domain. For the purpose of this work, it is not essential what domain this is, so I will just call it D, as mentioned above in 4.2.2. This creation of D is triggered by a prosodic constraint like the one in (158) (copare Selkirk 2011; Elfner 2015), which must outrank some constraint against prosodification.

(158) Match (X°,D)
Count a violation for every maximal X° that is not matched with prosodic domain D.

The constraints discussed above together with (158) and their ranking give us the following schematic outputs of the stem level for the respective verb class and TAMP categories, compare (159). Partially and fully unspecified morae are marked in boldface. We find partially unspecified morae, that is morae associated with a low register tone but no melody tone, on bimoraic class 3 roots in the progressive, future and negative; and fully unspecified morae in the perfect of class 1 and 2 roots.

(159) *Overview of Stem level outputs*

	Class 1		Class 2	Class 3	
Underlying	μ	μμ̀	μμ́	!μ́	!μμ́
HAB	(μ́)$_D$	(μ́μ̀)$_D$	(μ̀μ́)$_D$	(!μ́)$_D$	(μ̀μ́)$_D$
PROG,FUT	(μ́)$_D$	(μ́μ̀)$_D$	(μ̀μ́)$_D$	(!μ́)$_D$	(!**μ**μ́)$_D$
NEG	(!μ́)$_D$	(!μ́μ̀)$_D$	(μ̀μ́)$_D$	(!μ́)$_D$	(!**μ**μ́)$_D$
PRF	(**μμ**)$_D$	(**μ**μ̀)$_D$	(**μ**μ́)$_D$	(!μ́)$_D$	(!μ́μ́)$_D$
PRF.NEG	(!μ́)$_D$	(!μ́μ̀)$_D$	(!μ́μ́)$_D$	(!μ́)$_D$	(!μ́μ́)$_D$
PAST	(μ̀μ̀)$_D$	(μ̀μ̀μ̀)$_D$	(μ̀μ́μ̀)$_D$	(μ̀μ́μ̀)$_D$	(μ̀μ́μ̀)$_D$
IMP	(μ̀)$_D$	(μ̀μ̀)$_D$	(μ̀μ̀)$_D$	(μ̀μ̀)$_D$	(μ̀μ̀)$_D$

4.2.4.4 Word level

The word level is rather uneventful in my analysis. The verbal prefixes are added here. I will ignore all the segmental processes that presumably happen at the word level as well and focus on the prosodic and tonal structures that are built. Prefixes can use almost the entire pantry of underlying tonal shapes: Some are low, some are high, some are toneless and one is partially specified and has only a low register tone. No actual tonal processes happen on the word level, and no floating tones need to be docked. We see thus a combination of the underlying tones of the segmental prefixes and the result of tone docking from the stem level. A prosodic category, presumably the prosodic word ω, is build around the prosodic domain D and the prefixes. See (160) for the outputs of the word level. Toneless and partially specified morae are again bold. The root internal un(der)specified morae remain the same as above, but are joined by prefix morae.

(160) *Overview of word level outputs*

	Class 1		Class 2	Class 3	
HAB	$((\acute{\mu})_D)_\omega$	$((\acute{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\acute{\mu})_D)_\omega$	$((!\acute{\mu})_D)_\omega$	$((\grave{\mu}\acute{\mu})_D)_\omega$
FUT	$(\acute{\mu}(\acute{\mu})_D)_\omega$	$(\acute{\mu}(\acute{\mu}\grave{\mu})_D)_\omega$	$(\acute{\mu}(\grave{\mu}\acute{\mu})_D)_\omega$	$(\acute{\mu}(!\acute{\mu})_D)_\omega$	$(\acute{\mu}(!\boldsymbol{\mu}\acute{\mu})_D)_\omega$
PROG	$(!\boldsymbol{\mu}(\acute{\mu})_D)_\omega$	$(!\boldsymbol{\mu}(\acute{\mu}\grave{\mu})_D)_\omega$	$(!\boldsymbol{\mu}(\grave{\mu}\acute{\mu})_D)_\omega$	$(!\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(!\boldsymbol{\mu}(!\boldsymbol{\mu}\acute{\mu})_D)_\omega$
NEG	$(\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu}\grave{\mu})_D)_\omega$	$(\boldsymbol{\mu}(\grave{\mu}\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\boldsymbol{\mu}\acute{\mu})_D)_\omega$
PRF	$(\boldsymbol{\mu}(\boldsymbol{\mu})_D)_\omega$	$(\boldsymbol{\mu}(\boldsymbol{\mu}\grave{\mu})_D)_\omega$	$(\boldsymbol{\mu}(\boldsymbol{\mu}\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu}\acute{\mu})_D)_\omega$
NEG.PRF	$(\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu}\grave{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu}\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu})_D)_\omega$	$(\boldsymbol{\mu}(!\acute{\mu}\acute{\mu})_D)_\omega$
PAST	$((\grave{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\grave{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\acute{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\acute{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\acute{\mu}\grave{\mu})_D)_\omega$
IMP	$((\grave{\mu})_D)_\omega$	$((\grave{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\grave{\mu})_D)_\omega$	$((\grave{\mu}\grave{\mu})_D)_\omega$

4.2.4.5 Phrase level

At the phrase level, the picture changes. SPECIFY, the constraint that demands every mora to be associated to a tone, is now highly ranked, and it enforces that every TBU has both a register tone and a melody tone. However, as we have seen, not every TBU is equipped with such features in the input to the phrase level. Some morae are completely unspecified — some prefixes and the first mora of the perfect forms of classes 1 and 2, while other have only a low register tone, but no melody tone. In addition to SPECIFY, faithfulness constraints for existing tones are ranked very high: No mora that is associated to some tonal feature in the input loses this association. We can only add, by spreading or epenthesis, but not take away.

Let us first look at the toneless prefix morae, before we turn to toneless root morae. The completely unspecified prefix morae copy without exception the tone from the left, that is, the last tone of the subject. The subject may either be a pronoun or a free noun. This copying is modelled with three simple constraints: DEP against tone insertion, and *SPREAD-L against spreading from the right outranking *SPREAD-R against spreading from the left, for the definition see (161).[70] The tableau in (162) shows the derivation for a toneless prefix between a high-toned subject and a low-toned verb root. In this case, candidates c. and b. are superficially identical, but candidate b., the winner, spread the subject tone onto the prefix, indicated by the underline, whereas candidate c. inserted a new tone. Candidate d. spreads the tone of the root onto the prefix, however, rightward spreading is preferred.

[70]The naming may be somewhat confusing: SPREAD-L penalises spreading *towards* the left, from the target perspective this is *from* the right.

(161) a. *SPREAD-R(IGHT)
Count a violation for a tonal root node that is associated in the input to a TBU and whose rightmost association line in the output has no correspondent in the input.

b. *SPREAD-L(EFT)
Count a violation for a tone that is associated in the input and whose leftmost association line in the output has no correspondent in the input.

(162) *Phrase level derivation of e.g. ésí ńdàné*

	µ́(µ(µ̀µ́))	SPEC	*SPREAD-L	DEP	*SPREAD-R
a.	µ́(µ(µ̀µ́))	* !			
b. ☞	µ́(µ́(µ̀µ́))				*
c.	µ́(µ́(µ̀µ́))			*!	
d.	µ́(µ̀(µ̀µ́))		*!		

The progressive prefix has a low register tone, but no melody tone. Since no tonal features are deleted, it can only show up as either a low tone or a downstepped high tone. In fact, it shows up as a low tone in most cases, but as a downstepped high if it is both preceded (by the subject) and followed (by the initial verb tone) by a high tone. This configuration can only be yielded in verb class 1, since the tone on the initial mora in the other cases is either low, or a downstepped high.

If spreading would apply just as in the case seen above, we would expect a downstepped high tone whenever there is a preceding high tone. However, we get mostly an epenthetic low tone instead.[71] I derive this by postulating a constraint against downstepped high tones (163) outranking DEP, see the tableau in (163) for the derivation.

(163) *!H
Count a violation for a tonal root node associated to a +H melody and a –h register.

(164) *Phrase level derivation of e.g. ésí !ìdàné*

	µ́(!µ(µ̀µ́))	*!H	DEP	*SPREAD-R
a.	µ́(!µ́(µ̀µ́))	*!		*
b. ☞	µ́(µ̀(µ̀µ́))		*	

Candidate a. spreads the melody tone, a subset of the winning strategy in (163), however, this creates a downstepped tone (there, the entire tonal root node was spread). The winner, candidate b., inserts a low melody feature.

However, we cannot say that the tone of the progressive prefix is generally low,

[71] It could also be analysed as spreading from the right. Since epenthesis will be necessary anyway and there is no compelling need for spreading from the right, I will treat it as epenthesis here.

because it does show up as a downstepped high if it occurs in between two high tones. Here, some constraint must outrank *!H, and this is the constraint in (165). This constraint may seem cumbersome, but the markedness of this structure is cross-linguistically well attested (see Cahill 2007b and Kisseberth & Odden 2003 for an overview), and plateauing rules or constraints are common, see e.g. Yip (2002); Cahill (2007a,b); Melick (2012) in addition to Paster (2010). PLATEAU does not lead to general plateauing, unlike Paster's rule, because it cannot alter fully specified low tones – faithfulness is higher ranked. Whether a low tone succumbs to plateauing or not is lexically specified, a fact that is modelled here by differentiating between fully specified low tones, which do nota alter, and lonely low register tones, which do alter.

(165) PLATEAU
Count a violation for a L melody tone that is left and right adjacent to a H melody tone and associated to one and only one TBU.

The tableau in (166) shows the derivation of plateauing for a progressive such as /ꜜi-tɔ́/: Inserting a low melody violates PLATEAU, so the high tone is spread instead. Candidate a. violates the constraint against a downstepped high tone, but its contender candidate b. violates the higher ranked constraint against a plateau.

(166) *Derivation of melody H insertion on -h prefix*

		µ́(!µ̱(µ́))	PLATEAU	*!H	DEP	*SPREAD-R
a.	☞	µ́(!µ́(µ́))		*		*
b.		µ́(µ̀(µ́))	*!		*	

Let us now turn to the not (fully) specified tones on the first mora of the root. In verb class 3, those are the negatives and the progressive/future, where the first mora has a low register but no melody tone. This TBU behaves exactly like the progressive prefix seen above: Downstepped high if sandwiched between two Hs, otherwise L. However, I cannot adopted exactly the same analysis, because I must assume that spreading into the domain D (the roughly root-sized domain) is not an option. This assumption, as lined in section 4.2.2, is crucial for deriving the polarity in the perfect. Therefore, the first mora of the domain D must obtain its tone always by epenthesis, even if spreading from the left would deliver the correct result. The already introduced CRISP-EDGE constraint is defined in (167).

(167) CRISP-EDGE(T-D)
Count a violation for any tonal root node, melody or register that is associated to a mora in D and to a mora that precedes D.

The tableau in (168) derives the negative for a VV verb like /ŋ-ꜜkaé/ . Candidate a. spreads twice, violating the CRISP-EDGE constraint; candidate b., the winner, spreads only to the prefix and inserts on the root, and candidate c. inserts twice.

(168) *Phrase level derivation of e.g. yàw ŋ̀kàé*

		µ̀(µ(!µµ́))	Crisp-Edge	Plateau	*!H	Dep	*Spread-R
a.		µ̀(µ̀(µ̀µ́))	*!				**
b.	☞	µ̀(µ̀(µ̀µ́))				*	*
c.		µ̀(µ̀(µ̀µ́))				**!	

In order to derive the negative of the same verb but with a high toned subject correctly, we must refine the Dep constraints. As the constraints are defined and ranked right now, we wrongly predict that a candidate that inserts two low tones, on the prefix and on the first root mora, wins, see the tableau in (169).

(169) *Failed derivation of intended ésí ŋ́ꜜkáé*

		µ́(µ(!µµ́))	Crisp-Edge	Plateau	*!H	Dep	*Spread-R
a.		µ́(!µ́(!µ́µ́))	*!		*		**
b.		µ́(µ́(µ̀µ́))		*!		*	*
c.	☞	µ́(µ̀(µ̀µ́))				**!	
d.	✄	µ́(µ́(!µ́µ́))			*!	*	*

However, the low tone insertions onto the two morae in candidate c. in (169), the undesired winner, are not entirely identical: For the partially specified mora in domain D, it is only a L melody that is inserted, for the fully unspecified mora in the prefix it is a tonal root node and a register tone are epenthesised as well. We can thus easily distinguish between Dep-○ against insertion of a tonal root node and Dep-M against inserting a melody tone. The former Dep constraint outranks *!H, whereas the latter is dominated by it. The tableau in (170) shows how we can now derive the desired winner. Candidate aa., the winner in (169), is out because it inserts an entire root node. Candidate b. spraeds the tone onto the prefix and inserts a low melody tone in the root, creating a violation of Plateau. The winner candidate c. spreads onto the prefix and inserts a high tone in the root, violating the constraint against downstepped high tones.

(170) *Successful derivation of ésí ŋ́ꜜkáé*

	µ́(µ(!µµ́))	DEP-○	PLATEAU	*!H	DEP-M	*SPREAD-R
a.	µ́(µ̀(µ̀µ́))	*!			**	
b.	µ́(µ́(µ̀µ́))		*!		*	*
c. ☞	µ́(µ́(!µ́µ́))			*	*	*

We now have the tools to turn to the countercyclic pattern, the perfect with verb classes 1 and 2. The gist is clear: Due to CRISP-EDGE, the tone cannot spread across the D boundary, and due to an OCP constraint for register tones in (171), the inserted tone must be polar.

(171) OCP [±h]
Count a violation for two adjacent +h or -h features on the register tone tier.

This constraint did not have any effect until now, because there was no insertion of register tones up to this point: They were either spread from a preceding tone, or they where already specified in the input. The tableaux in (172) and (173) show the case of a monomoraic class 1 root in the perfect, e.g. /a-tɔ/, preceded by a high toned and a low toned subject respectively. Candidates a. violate the CRISP-EDGE constraint and are therefore out. Candidates b. spread the subject tone to the prefix and insert a tone on the root mora, which happens to be featural identical to the prefix. These candidates are out because they violate the OCP constraint in (171). Candidates c., the winners, spread to the prefix and insert the polar tone onto the toneless mora in D.

(172) *Derivation of polar low tone*

	µ́(µ(µ))	CRISP-EDGE	DEP-○	OCP	DEP-M	*SPREAD-R
a.	µ́(µ́(µ́))	*!				**
b.	µ́(µ́(µ́))		*	*!	*	*
c. ☞	µ́(µ́(µ̀))		*		*	*

(173) *Derivation of polar high tone*

	µ̀(µ(µ))	CRISP-EDGE	DEP-○	OCP	DEP-M	*SPREAD-R
a.	µ̀(µ̀(µ̀))	*!				**
b.	µ̀(µ̀(µ̀))		*	*!	*	*
c. ☞	µ̀(µ̀(µ́))		*		*	*

This analysis works well for class 1, where there is either only one mora in the root, or the second mora is low. However, in class 2, the second mora is high. Insertion of the low tone here creates a HLH sequence that violates PLATEAU. This sequence is fine, as long as the sandwiched low tone is (fully) underlying, but this is not the case here — there is no underlying tone. Thus, we expect a repair to H!HH.[72] *!H cannot rule out this insertion because we know that it is outranked by PLATEAU. I propose that there are specific DEP constraints against the insertion of specific melodies, and a constraint against inserting downstepped high tones like the one in (174) is ranked high. For a precedent of such specific DEP constraints compare i.a. Pulleyblank (2002).

(174) DEP-!H
Count a violation for an epenthetic tonal root node that is associated with a +H melody and a -h register.

This constraint crucially does not penalise the insertion of a high melody tone that creates a !H on an already existing, not epenthetic root node, which we have seen in VV verbs in class 3. DEP-!H outranks PLATEAU, indeed, it is never violated: Downstepped high tones are either underlying or created by spreading or inserting a high melody onto a root node specified with a lonely -h register tone. The tableau in (175) derives the output of a class 2 verb like /a-dané/ in the perfect following a high toned subject. It only compares the candidates that do not violate CRISP-EDGE and that spread the tone of the subject to the prefix.

(175) *Derivation of e.g. ésí ádànè*

	µ́(µ(µµ́))	DEP-H!	OCP	PLATEAU	*H!
a.	µ́(µ́(µ́µ́))		*!		
b.	µ́(µ́(!µ́µ́))	*!			*
c. ☞	µ́(µ́(µ̀µ́))			*	

Candidate a. inserts a high tone on the first root mora, which creates a violation of the OCP, since there are now two adjacent +h register tones. Candidate b. inserts a downstepped high tone. The OCP is fine with this, but the constraint against the insertion of high tones is highly ranked, ruling this candidate out. Candidate c. inserts a low tone. This violates PLATEAU, but because all options that would satisfy PLATEAU are suboptimal compared to c., it is the winner. However, one type of polar tones can still not be accounted for: The tone inserted between two different tones, e.g. the polar tone in a phrase like /yàw a-dané/. The derivation of this data point is not trivial and touches on a deep problem for OT, namely directionally asymmetric assimilation and dissimilation.

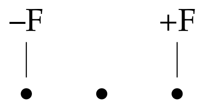
[72] This seems to be the correct prediction for the language of some speakers of Akan, who produce a downstepped high tone in this configuration (Joana Serwaa Ampofo (p.c)). Those speakers will have a slightly different ranking than Paster's informants.

4.2.4.6 Directionally asymmetric dissimilation in OT

Directionally asymmetric assimilation poses a general problem for OT, known as the 'sour grapes' problem (Wilson 2003; McCarthy 2004). The conundrum is the following: A target cannot assimilate to both its neighbours, so, in practice, it assimilates to a specific neighbour, to the left or the right, determined by the linear order of the segments. OT predicts that it should remain faithful, because the constraints demanding assimilation will be violated either way. For the sour grape problem, a wide array of solutions have been proposed, such as Headed Spans (McCarthy 2004), Harmonic Serialism (McCarthy 2011; Kimper 2011b), Targeted Constraints (Wilson 2003) or directionally evaluated constraints (Finley 2009). With the exception of hard-coding directionality directly into the constraints or even the evaluation itself as proposed by Finley (2009), none of these approaches translates unproblematically to directionally asymmetric dissimilation.

Imagine the configuration in (176). There is no way to specify the middle node via insertion for [±F] without violating an OCP constraint OCP[±F],[73] compare the tableau in (177).

(176)



(177) *Directional dissimilation is not derived*

		+FØ–F	SPECIFY-F	OCP[±F]	*+F	*–F
a.		+FØ–F	*!			
b.	☞	+F–F–F		*		*
c.		+F+F–F		*	*!	

The OCP cannot decide which feature value is inserted, this decision is delegated to lower ranked general markedness constraints. In the case of (177), –F is less marked and thus inserted. Crucially, this depends not on the order: A /–FØ+F/ input would also insert –F, yielding [–F–F+F].

The configuration in (176) is exactly the configuration that we find in the Akan perfect of bimoraic class 1 and 2 verbs, if the tone of the subject and the tone of the second mora do not coincide, see (178). However, there is no default insertion here, instead, the inserted tone is polar with respect to the preceding tone, ignoring the following tone completely. In (178a), the preceding tone is high, the following tone is low, and the inserted tone is low. In (178b), the preceding tone is low, the following tone is high and the inserted tone is high, in both instances violating the OCP to the right.

[73] It does not matter whether the OCP is defined symmetrically for ±F or for only one feature value.

(178) *Polarity in Akan is directional*

a. ésí a-nom̀ → ésí án**ò**m̀

b. yàw a-dané → yàw àd**á**né

In the Akan case, there is a solution to this problem. I do not claim that this is a general solution to the directional dissimilation problem. The idea behind the analysis is that in case of violation of the OCP, the default tone is not static, but depends on the wider context, specifically the following tone. If the following tone is low, the default tone is low, too, and if it is high, the default tone is high. This cannot be modelled with an assimilation constraint, which would be in direct conflict with the OCP. Instead, this outcome can be achieved by layering the costliness of tone distribution.

As discussed, the less costly mean of bestowing a toneless mora with a tone in Akan is via spreading of both the melody tone and the register tone from the left. If this is not possible, due to CRISP-EDGE, the melody tone must be inserted, because it cannot spread from the right. If the subject tone is identical to the second mora tone, in a $\acute{\mu}(\mu(\mu\acute{\mu}))$ or a $\grave{\mu}(\mu(\mu\grave{\mu}))$ configuration, the register tone must be epenthetic as well because spreading the register tone from the right would violate the OCP. If however the configuration is such that the OCP must be violated, either with the right or left tone, we can spread the register tone onto the toneless mora from the right, which is less costly than register tone insertion. If this is done, the melody tone must have the less marked feature with respect to that register tone, in order to avoid a violation of *!H or *[–H,+h]. The last constraint must be very highly ranked, because such a tone does not exist in Akan. To model this, we need a ranking of DEP-reg, which is violated by the insertion of a register tone, over *SPREAD-L-reg, which is violated by spreading a register tone. leftwards.

In the tableau in (179), candidates that violate CRISP-EDGE or create the impossible mid-tone are omitted. Candidate e. is the only one that does not violate the OCP, because it spreads the rightmost tone completely to the empty mora. This is ruled out because of an undominated constraint against spreading of melody tones from the right. Candidates a. and c. insert both a melody and a register tone, either both high or both low. These candidates are out because they violate DEP-reg, a rather lowly ranked constraint that can be violated if it helps to avoid a violation of the OCP. Candidates b. and d. spread the register tone from the rightmost syllable and insert a melody tone. Candidate b. inserts a high tone, which creates the marked downstepped tone. It is therefore suboptimal with respect to candidate d., which inserts a low melody tone. Keep in mind that the low tone is not generally less marked than high, but it becomes so in context of the spread register tone.

(179) *Derivation of directional OCP in Akan, HØL input*

		μ́(μ(μμ̀))	*SPRD-L-M	OCP	*!H	DEP-M	DEP-reg	*SPRD-L-reg
a.		μ́(μ́(μ́μ̀))		*		*	*!	
b.		μ́(μ́(!μ́μ̀))		*	*!	*		*
c.		μ́(μ́(μ̀μ̀))		*		*	*!	
d.	☞	μ́(μ́(μ̀μ̀))		*		*		*
e.		μ́(μ́(μ̀μ̀))	*!					*

The tableau in (180) shows the same derivation for a low toned subject preceding the perfect of a class 2 verb, which has an empty mora followed by a high toned mora. Here it is the high tone that is optimal.

(180) *Derivation of directional OCP in Akan, LØH input*

		μ̀(μ(μμ́))	*SPRD-L-M	OCP	*!H	DEP-M	DEP-reg	*SPRD-L-reg
a.		μ̀(μ̀(μ̀μ́))		*		*	*!	
b.		μ̀(μ̀(!μ́μ́))	*!	*	*		*	
c.		μ̀(μ̀(μ́μ́))		*		*	*!	
d.	☞	μ̀(μ̀(μ́μ́))		*		*		*
e.		μ̀(μ̀(μ́μ́))	*!					*

As a last remark on the OCP, the ranking of DEP-∘ over the OCP constraint is important. If the ranking was reversed, we would get the insertion of a polar tone on a toneless prefix if that prefix appears between two identical tones.

4.2.4.7 The downstep algorithm

A lot of the literature on Akan has been dedicated to downstep, its distribution, representation and computation, compare i.a. Stewart (1965, 1993); Dolphyne (1994); Genzel (2013); Genzel & Kügler (2011); Kügler (2017). Downstep interacts with the tonal processes discussed here, and an analysis of the countercyclic interaction must be compatible with an analysis of Akan downstep. While a full analysis is outside the scope of this dissertation, I will briefly argue that this is the case for the analysis proposed above.

Akan has two types of downstep, called automatic (a high tone is downstepped after an overt L tone) and non-automatic (a high tone is downstepped at a lexically or syntactically specified position after a high tone, analysed as induced by a floating low tone (Stewart 1965)). Dolphyne (1994) argues that the two types of downstep are phonetically distinct. This would not be unexpected: Whereas automatic downstep can be interpreted as the result of phonetic interpretation rules, non-automatic downstep is phonemic and necessitates thus clearly a phonological representation. However, Genzel & Kügler (2011) disagree on the data, they do not find any phonetic difference between automatic and non-automatic downstep. Genzel (2013) however finds that automatic downstep is also phonetically indistinguishable from a general downward trend that affects sequences of only high and only low tones. She argues that downstep and declination are the same phonetic process, which lowers one tone after the other. She derives the pattern by associating register features to the edges of an intonational phrase. Crucially, in order to account for non-automatic downstep, she must assume that the phonetics can access and interpret floating (lexical) tones. She and Kügler (2017) argue that an algorithm based on register tones à la Snider (1988, 1998); Snider & van der Hulst (1993) cannot derive the observed pattern. I accept that argument, however i reject the conjecture that there is thus no place for register features in Akan lexical and morphological tones: Sub-tonal features have been proposed independently from processes like downstep and downdrift, see e.g. Yip (1980); Snider (1999); McPherson (2010); Meyase (2021). Genzel's phonetic algorithm can derive the correct tone contour even with the representations I propose, with the addendum that the downdrift is increased if a [+H−h] tone is encountered directly after a tone with [+H]. This does not increase the computational power of the algorithm, since it has a window of two tones anyway, cf. Genzel (2013: 142). It remains to be seen whether the cyclic analysis I propose can be replicated with floating tones instead of complex tonal features.

4.2.5 Summary

What this reanalysis of the Akan perfect shows is that even a very complex, nonmodular and countercyclic attested pattern can be analysed as cyclic and modular if the representations are only slightly enriched, in this case by prosody and a richer representation of tone. The default mechanism for specifying a mora with tone on the phrase level is spreading from the left, however, a tone cannot spread across the boundary of a D domain, which aligns with the left edge of a root. If the first mora in that domain is fully toneless — it has neither a melody nor a register tone — spreading cannot be employed. Instead, a tone is inserted that is polar with respect to the preceding tone. In order to make this analysis work, I had to make assumptions on the underlying specifications that deviate significantly from Paster. I assume that there are three verb classes. 1 has a toneless mora followed optionally by a mora with a low tone. 2 has a toneless mora followed by a mora with high tone. 3 has a mora with a low register tone followed by a high tone or, if it is monbosyllabic, a downstepped high tone. Morphological root tones that mark TAMP categories are added at the stem level. Some do not distinguish between classes and have only one morph (PRF.NEG, Past, Imp), whereas others have allomorphs indexed separately fora all three classes (Neg, Prog, Fut), some group class 1 and 2 (Prf) and some 2 and 3 (HAB) together. I also take a very different approach on the representation of tones: I adopt register tone theory (Snider 1988, 1998, 1999; Snider & van der Hulst 1993), where tones have a register and a melody feature, in addition to a tonal root node. I can thus recur to a wider array of underlying tones, distinguishing between a regular high tone, a regular low tone, a downstepped high tone and a plateauing tone, which lacks a melody feature, and a completely unspecified mora.

4.3 Hijazi Bedouin Arabic

A well known example for a language that is allegedly not analysable in a cyclic framework is the dialect of Hijazi Bedouin Arabic spoken by the Harb tribe to the West and Southwest of Medina, Saudi Arabia (henceforth: HBA), as described by Al-Mozainy (1981). Al-Mozainy himself claims that the data is not compatible with a cyclic analysis (Al-Mozainy 1981: 270). McCarthy (2007b) argues that HBA is not compatible with a cyclic constraint based grammar, i.e. Stratal OT, and Andersson (2020) makes the same claim, albeit more implicitly, for rule based frameworks. HBA has found considerable attention in the phonological literatur, however, most attention has been devoted to its opacities in general, which are not all incompatible with a cyclic analysis (i.a. Kirchner 1996; McCarthy 2003b; Nazarov 2019) but pose a challenge for standard Optimality Theory.[74] I will first introduce the core pattern and propose my cyclic reanalysis with PaC, before discussing residual issues such as the chain shift (section 4.3.2.1), vowels that do resist syncope (section 4.3.2.2 and 4.3.3) and on-context interaction of syncope and raising in section 4.3.2.3.

4.3.1 Puzzle

The conundrum, summarised from the interpretation of the processes by Al-Mozainy, is the following: There are two processes P and Q, and P counter-feeds Q. Consequently, Q should precede P. However, Q is a phrasal process and P is word bound. Within a cyclic architecture, hence, P should precede Q, which is clearly paradox. The first process, Q, in HBA is syncope of high vowels. High vowels[75] in open syllables are deleted (181)[76], including, crucially, if the syllable is only opened due to phrasal resyllabification (182).

(181) *syncope applies inside words*

a. ħæːkʲim ‘ruling.M.SG’ (HM81:50)

b. ħæːkʲmin ‘ruling.M.PL’ (HM81:50)

(182) *Syncope applies across word boundaries*

a. kʲæːtib ‘having written’ (HM81:50)

b. kʲæːtb alʒuwaːb ‘having written the letter’ (HM81:50)

c. ʃaːrib ‘he has been drinking’ (HM81:73)

d. ʃaːrb alma ‘he has been drinking water’ (HM81:73)

[74] I will address one of these opacities, the chain shift, but I will leave out another challenging process, namely low vowel deletion and its interaction with syncope and a-raising. The low-vowel deletion data is compatible with the analysis proposed here, if low vowel deletion is analysable (at least partially) as a stem-level process. Given the evidence in Al-Mozainy (1981), I do not see strong arguments for or against this.

[75] HBA has three high vowels, i, u, ɨ. The distribution is mostly but not entirely allophonic. I omitted [ɨ] from the transcriptions, but not [u]. As a shorthand, I use i for all high vowels.

[76] Unless otherwise indicated, data is from Al-Mozainy (1981).

The second process, process P, is raising of the low vowel /a/ to a high vowel in (most)[77] open syllables (183). The quality of the high vowel is determined by the surrounding consonants. This process is word bound, it is not triggered by phrasal resyllabification (184).

(183) *a-raising applies inside words*

a. sam.ʕat 'she heard' (HM81:52)

b. si.miʕ 'he heard' (HM81:52)

(184) *a-raising is blocked across words*
ʕa.ba.dalˤ.lˤah
/ʕabad alˤlˤah/
worship-PRF god
'he worshipped God' (McCarthy 2007b)

The prediction of cyclicity is that pre-phrasal a-raising feeds phrasal i-deletion. However, this is not the case as can be seen in (185). The underlying /a/ is raised, at the word level, to [i], and enters thus the phrase level as a high vowel in an open syllable. As we have seen, high vowels in open syllables are deleted on the phrase-level, but this vowel resists.

(185) /sa.miʕ/ → /si.miʕ/ */smiʕ/ 'he heard'

McCarthy (2007b) takes this data point as a strong argument against Stratal OT. He exempts rule-based architectures from this critique, as they could employ the strict cycle condition in order to enforce the blocking of the chain shift a→i→∅ across strata. However, the strict cycle condition is independently problematic (see discussion in chapter 2.3.2 or Kiparsky 1993; Gleim 2023)and is not always adopted for the phrase level, not even within rule-based approaches. Also, the claim that the Strict Cycle Condition is fundamentally incompatible with OT seems to be rather unsubstantiated. The Strict Cycle Condition was abandoned (Kiparsky 1993) at the time OT gained popularity (Prince & Smolensky 1993), so the fact that there was at the time of McCarthy's writing no serious attempt to integrate the Strict Cycle condition into a cyclic version of OT is an artefact of historical circumstances, not because of some principled incompatibility.

4.3.2 Reanalysis

The core of the reanalysis relies on splitting high vowel syncope into two different processes. The first is true syncope, which applies before the phrase level. It fits Al-Mozainy's description and targets every high vowel in an open syllable. This

[77] a raising is blocked if the low vowel is adjacent to a pharyngeal, uvular or pharyngealised consonant, or if it is followed by another a across a sonorant. These exceptions to not bear on the interaction in a meaningful way.

process is cyclically counter-fed by pre-phrasal a-raising (in section 4.3.2.1, I will discuss how this counter-feeding works). The second process of syncope, which is triggered at the phrase level, is different: It does not target syllable-final high vowels, but word-final ones. Due to my assumption (Chapter 3) that a syllable cannot be contained by two non-recursive words, a word-final high vowel is necessarily syllable final, that is, in an open syllable. This second process of syncope, or rather, apocope, is not counter-fed by a-raising on the previous levels, it is simply not fed. a-raising can never apply to a final syllable, because at the time at which it applies, there is still a coda consonant which closes the syllable, so that the context of a-raising is not met. The tableau in (187) shows the derivation of syncope at the word level. Syncope is triggered by the constraint *i. in (186) a constraint against high vowels in short open syllables (cf. Kirchner 1996). This constraints outranks faithfulness constraints for the high vowel, which in return are ranked so that deletion is the preferred repair.

(186) *i.
Count a violation for a syllable that dominates only one mora, which dominates a high vowel.

(187) *Word level derivation of syncope*

		hæː.kʲi.min	*i.	ID[+high]	MAX
	a.	hæː.kʲi.min	*!		
☞	b.	hæː kʲ.min			*
	c.	hæː.kʲa.min		*!	

At the phrase level, *i. is not the constraint that is responsible for syncope, but $*i]_\omega$. This constraint is identical to $*V]_\omega$ seen in the analysis of C'Lela (chapter 4.1), albeit restricted to high vowels. Another important constraint is ONSET, which triggers the resyllabification of the word final consonant.[78] The tableau in (188) derives phrasal high vowel deletion: candidates b. and c. resyllabify the final consonant in order to satisfy ONSET, which brings, in candidate b., the high vowel in a syllable final position, violating $*i]_\omega$. The winner is thus candidate c., who satisfies both constraints.

[78] Al-Mozainy (1981) assumes that resyllabification is preceded by deletion of a word initial glottal stop, i.e. /ʔalʒuwaːb/. This glottal stop shows up if there is no consonant that could resyllabify, e.g. at the beginning of a phrase. There is some evidence for underlying glottal stops that indeed behave this way, but I am not convinced that an analysis where all word initial glottal stops are epenthetic is impossible. However, underlying glottal stops should not be problematic for the analysis at hand: Deletion of a glottal stop triggered by a high ranked constraint against post-consonantal glottal stops can feed resyllabification in a (partially) parallel framework.

(188) *Phrase level derivation of syncope*

		[kʲæː.tib.]$_\omega$ [al.ʒu.waːb.]$_\omega$	Onset	*i]$_\omega$	FAITH-ω	MAX-σ	MAX-i
	a.	[kʲæː.tib.]$_\omega$ [al.ʒu.waːb.]$_\omega$	*!				
	b.	[kʲæː.ti.]$_\omega$ [bal.ʒu.waːb.]$_\omega$		*!	*		
☞	c.	[kʲæː t.]$_\omega$ [bal.ʒu.waːb.]$_\omega$			*	*	*

Raising of /a/ is a word-level process, and is triggered by a constraint *a., parallel to *i. Here, the higher ranked faithfulness constraint is MAX, so that raising is preferred to deletion (189).[79]

(189) *Word level derivation of raising*

		sa.miʕ	MAX	*a.	ID[-high]
	a.	sa.miʕ		*!	
☞	b.	si.miʕ			*
	c.	smiʕ	*!		

At the phrase level, the derived high vowel in [si.miʕ] is trivially not targeted by phrasal syncope (190), because syncope only cares about word final high vowels, and the derived high vowel can never end up in a word final position via resyllabification.

(190) *Word level raising does not feed phrase level syncope*

[si.miʕ]$_\omega$	Onset	*i]$_\omega$	FAITH-ω	MAX-σ	MAX-i
[si.miʕ]$_\omega$	*!				
[smiʕ]$_\omega$				*!	

4.3.2.1 Chain-Shift

McCarthy (1993) argues that the chain Shift in Hijazi belongs to the set of opaque processes that are derivable in parallel OT. In his analysis, the low vowel is protected by a MAX[a] constraint that outranks an ID[a] constraint as well as markedness constraint against a, and a lower ranked markedness constraint against [i] in this position. Translated to the constraints that I use, a word level derivation for /samiQ/ looks like the tableau in (191).

(191) *Word level raising*

		sa.miʕ	MAX-a	*a.	*i.	MAX-i	ID[high]
	a.	sa.miʕ		*!			
☞	b.	si.miʕ			*		*
	c.	smiʕ	*!				

[79] As is, this ranking is not compatible with the one in (187). The Chain Shift is discussed in Section 4.3.2.1.

(192) *Word level syncope*

		ħæː.kʲi.min	MAX-a	*a.	*i.	MAX-i	ID[high]
	a.	ħæː.kʲi.min			*!		
☞	b.	ħæːkʲ.min				*	
	c.	ħæː.kʲa.min		*!			*

McCarthy's 1993b as cited on Kirchner (1996) analysis is fully parallel. It is straight forward to assume these constraints to be active at the word level, and integrate this chainshift thus into a model with Statal OT. This analysis of chain shifts in parallel is only available if it is a two step chain shift A→B→C and either C or A equals Ø(Kirchner 1996). Chain shifts in general can be derived in OT on a single stratum with additinal mechanisms, like local conjunction (Kirchner 1996) under containment (Popp 2019), with super-optimality (Kiparsky 2011) or with specific assumptions on underspecification (Reiss 2021). Chain shifts are thus different from most other opacities, as they are not necessarily predicted to be interstratal in Stratal OT, independently from the adoption of containment or correspondence.

4.3.2.2 Underlying word final i

Word final /i/ is not targeted by word level syncope, and (at leat phrase finally), neither by phrasal syncope (193a). Without any additions, all accounts discussed here – mine, Al-Mozainy's, McCarthy's and Andersson's, predict the deletion of these vowels. To solve this, Al-Mozainy assumes that these final high vowels are not underlyingly short, but get shortened in word final position, compare (193b) where the vowel is not phrase final and surfaces as long.

(193) *Final vowel shortening*

a. ðˤarabti 'you (F.SG) hit' (HM81:48)

b. ðˤarabtiːni 'you (F.SG) hit me' (HM81:48)

This is a pattern observed across various varieties of Arabic (McCarthy 2005a). Word-level syncope does not apply to these vowels because they are still long at that stage. It is possible, then, to analyse the failure of phrasal syncope in these cases as another chain shift: Underlyingly short vowels that lose their codas are deleted, underlyingly long vowels are shortened, but not deleted.[80]

[80] Without further specifications, this analysis predicts that underlying long vowels that lose their coda to resyllabification should be shortened, just as final long vowels that were never followed by a coda. There is no data in Al-Mozainy to prove or disprove this. However, even if it turns out that those vowels are not shortened, it is not fatal for the analysis proposed here: These vowels are necessarily stressed, whereas coda-less long vowels in the last syllable are never stressed. There is thus a way for phonology to distinguish between these vowels without recurring to their derivational history.

4.3.2.3 Interaction between raising syncope on context

As discussed above, Syncope is counterfed by raising on focus. But this is not the only interaction between the two processes: Syncope, by virtue of resyllabification of the former onset of the removed syllable into a coda, can destroy the context for raising, namely the openness of the open syllable. It thus has to bleed or counterbleed raising *on context*. A serial rule based theory, in which raising follows syncope (which it must, because of its on-focus interaction) predicts bleeding. A parallel theory like McCarthy's predicts bleeding as well, as it would need a special mechanism for the opacity. My approach within Stratal OT makes more nuanced predictions: Bleeding between word level applications of raising and syncope, counterbleeding between word level application of raising and phrasal application of word final high-vowel deletion. Intriguingly, the actual interaction of the two processes is yet more complex, we find both bleeding and counterbleeding, roughly but not exactly in the way the stratal approach predicts. In most cases of word level applications, we find indeed bleeding, see (194). Here the first /a/ would raise if it was not for the deletion of the /i/, which is responsible for the syllabification of the /r/ in the coda.

(194) *Word level syncope bleeds raising*
[ʃarbat]
/ʃarib-at/
drink.PRF-3SG.F
'She drank' (HM81:156)

For phrasal applications, Al-Mozainy is less explicit, we do find counterbleeding in the data, see the example in (195).[81] The underlying /a/ surfaces as [i] even though it is in a closed syllable. crucially, the syllable only gets closed at the phrase level, due to the deletion of the /i/ in the suffix triggered by phrasal resyllabification.

(195) *Phrasal syncope counterbleeds raising*
[miʕhaluður]
/maʕ-ih al-uðr/
PREP-3SG.M the-apology
'(It is not enough) to apologize to him' (HM81:51)

Until here, the data aligns with the predictions of the stratal approach. However, there is also a case of counterbleeding that does not involve phrasal syncope, but word internal syncope: If the 3rd person singular masculine object clitic *-ih* attaches to the third person masculine perfect form of verbs that happen to have a high vowel

[81] Al-Mozainy does not give glosses and gives the underlying vowel in the preposition as /i/. However, I assume that it is a for a reason aside from the fact that this assumption makes my analysis work: Al-Mozainy tends to gives underlying forms that have already underwent some process that is not under his focus at that point, especially raising (see e.g. page 51 for epenthesis, page 136 for raising). On page 133, he gives the preposition in question as maʕ in isolation. I contend thus that the reconstruction of the underlying representation with a low vowel is justified.

between the 2nd and 3rd radical, and a low vowel between the 1st and 2nd (i.e. /CaCiC-ih/), the first vowel is raised even if it ends up in a closed syllable due to the deletion of the second vowel, see (196).

(196) *Word-level syncope counterbleeds raising*
[ʃirbih]
/ʃarib-ih/
DRINK-3SG.M-3SG.M.OBJ
'He drank it' (HM81:234)

This counterbleeding interaction is not a general property of the suffix *-ih* see (197), where its affixation bleeds a-raising, nor of the perfect, as the example in (198) repeated from (195) shows.

(197) *syncope with -ih does not counterbleed raising generally* [tiħtarmih]
/t-iħtarim-ih/
3SG.F-respect.IPF-3SG.M.OBJ
'She respects him' (HM81:238)

(198) *raising in the perfect is not generally counterbled* [ʃarbat]
/ʃarib-at/
drink.PRF-3SG.F
'She drank' (HM81:234)

Even though Al-Mozainy's analysis is non-cyclic, this data is problematic for him, too, as he orders syncope before a-raising. His solution is to introduce some sort of cyclicity that he calls prosody.[82] The core of his analysis is that the agreement clitic falls sometimes in the first cycle, where it can bleed raising, and sometimes in a later cycle, where it is concatenated to late. This approach translates neatly into the framework presented here, it has strong parallels to my analysis of the Icelandic clitica in section 4.4: A type of clitic behaves as a word level affix with some hosts, and as a phrasal affix with others. In the case of HBA, the agreement clitica are word level affixes most of the time, but phrasal with the 3.sg masculine perfect.

4.3.3 Vowels that are immune to Syncope

There are four types of short high vowels that systematically are not deleted if they occur in the position for deletion. First, of course, the high vowels that derive from underlying /a/ or an underlying long vowel. These have been analysed in the

[82] Al-Mozainy insist that his analysis is not cyclic, but this seems to be more a question of denomination than essence. The algorithm that determines the sequentially ordered domains of rule applications is unusual and different from more standard cyclic approaches at that time. In the relevant case, he assumes that there is an empty suffix between the root and -ih, which triggers a cycle by virtue of being the first suffix. -ih can thus be inside the first cycle, if there is no empty suffix, or outside, if there is.

sections above. Second, vowels in syllables that have been opened because the coda consonants resyllabifies into a syllable whose nucleus is an epenthetic vowel, inserted via, in Al-Mozainy's parlance, 'surface epenthesis'. Epenthetic vowels are inserted between a consonant and a sonorant, if the sonorant is either followed by another consonant or the phrase edge. This context might be word internal, see (199a), word-internal created by syncope, (199b), or across word boundaries, created by concatenation, see (199c). The last example shows that surface epenthesis applies on the phrase level.

(199) *'Surface' epenthesis*

a. al-uðr → aluður
'Apology' (HM81:51)

b. mislim-iːn → misilmiːn
'Muslims' (HM81:228)

c. tˤarˤad ɣnam-ih → tˤarˤadiɣnimih
'he followed his sheep' (HM81:215)

In other Arabic dialects, this type of epenthesis is bled by phrasal resyllabification and is thus clearly only phrasal (Kiparsky 2003), there is no data in Al-Mozainy (1981) to verify whether this is true for HBA as well[83]. However, both my analysis and Al-Mozainy's make the prediction that there is no epenthesis phrase medially, if the word final sonorant can resyllabify into an onset. In a rule based system, epenthesis must follow syncope, because it counterfeeds syncope on context. This type of counter-feeding cannot be analysed parallelly in OT, in Stratal OT it is thus necessary to assume that epenthesis applies at a later level then syncope, that is, the phrase level.

Syncope also fails if its application would create a triple geminate, see (200) and (201). Al-Mozainy does not attempt to analyse these cases, they cannot be seen as a Duke-of-York application of syncope and epenthesis, because the high vowel surfaces at the wrong position for epenthesis.

In OT, the analysis is straight forward: A constraint against a triple geminate outranks the constraint that triggers syncope, *i., thus blocking it.

(200) *Triple geminate blocks syncope*

a. [jma**rrir**in]
/ji-marrir-in/
3-pass-FEM.PL
'they pass' (HM81:123)

b. [ʔaʒa**ddid** hannaxal haːða]
/ʔa-ʒaddid-ih al-naxal haːða/

[83]The data above only shows that epenthesis applies at the phrase level, it could, however, also apply before.

1SG-harvest-3SG.M.OBJ the-palm.trees these
'I will harvest these palm trees' (HM81:50)

The last type of vowels that resists syncope are so-called 'underlying epenthetic vowels', a process of epenthesis that applies in Al-Mozainy's analysis before other segmental rules, differently from the 'surface epenthesis' discussed above (Al-Mozainy 1981:219,272). This process of epenthesis is somewhat morphologically restricted, unlike surface epenthesis, which seems to be sensitive only to phonological information. The vowels inserted via 'underlying epenthesis' appear between a superheavy syllable, CVCC or CV:C, and a consonant-initial clitic, breaking thus a VCCCV or V:CCV sequence, but, as said before, only at stem-clitic boundaries and not whenever such a sequence arises (201). This is a problem for Al-Mozainy's analysis: If 'underlying' epenthesis is late, like phrasal epenthesis, access to the morpheme boundary should not be available. If it is early, as Al-Mozainy claims, then epenthesis should feed syncope on focus. Unlike with surface epenthesis, the epenthetic vowel here is itself in an open syllable. As we have seen, syncope is sometimes blocked by higher ranked constraints, however, this cannot be applied in these clusters, as the counterfactual would-be arising clusters are otherwise well attested.

(201) *'Underlying' epenthesis*

a. [ðˤarˤabt**u**kum]
/ðˤarˤab-t-kum/
hit.PRF-1SG-2PL.M.OBJ
'I hit you.M.PL' (HM81:10)

b. [ʃaːl**a**ha]
/ʃaːl-ha/
carry.PRF-3SG.F.OBJ
'he carried it' (HM81:6)

A potential solution that Al-Mozainy does not take, is to assume that these epenthetic vowels are low, and are subsequentially raised.[84] This is an elegant solution, but it is not transferable into OT: If the epenthetic vowels are epenthetic, they cannot be protected by MAX-a and are thus to be deleted. However, it is possible to assume that these vowels are not epenthetic, but part of an allomorph of the clitic. If this is the case, they are protected by the MAX constraint, compare the derivation in (202).

[84] A test case for this assumption would be the second person singular clitics -k and k_j. If 'underlying epenthesis' applies in front of these clitics, too, then the epenthetic vowels would appear in a closed syllable. If it was truly a high vowel that does not delete for some mysterious reason, it would show up as such here. It appears that this prediction is met: /ðˤarˤab-t-k/ 'I hit you' shows up as [ðˤarˤabtak] (pg 6).

(202) *Word level derivation of 'underlying epenthesis'*

		ðˤarˤabt-akum	Max-a	*a.	*i.
	a.	ðˤarˤabtakum		*!	
	b.	ðˤarˤabtkum	*!		
☞	c.	ðˤarˤabtukum			*

In the context of my analysis, this assumption makes a peculiar prediction: I assume that the clitica are phrasal if they attach to a 3rd person masculine singular perfect verb. For most cases, epenthesis is not predicted here, because the majority of verbs in this form does not have a super-heavy syllable. Super-heavy syllables are possible in the so called weak second radical stems, where the second radical fuses with the vowels into a long vowel. One example for this is (201b), where we can see that epenthesis does indeed apply. In my account this is not epenthesis, put the selection of the allomorph /aha/ over /ha/. Given that this applies on the phrase level, raising of a is not possible any more, it should always surface as [aha]. This prediction is met in (201b), but this example is not helpful: we expect an [a] here independently due to vowel harmony.

4.3.4 Summary

If on takes the two assumptions that syncope of high vowels, fed by word-internal resyllabification and by resyllabification across word-boundaries, is a single process; and that phonology is cyclic, BHA returns a paradox. McCarthy (2007b) (explicitly) but also Andersson (2020) draw from this the conclusion that phonology is non-cyclic, and given his rule-based framework, even counter-cyclic in Andersson's case. In this way, a uniform process accounts for all instances of high vowel syncope in BHA. However, if one abandons the first assumption instead, the paradox vanishes as well: Phrasal syncope is not triggered in any open syllable, but only in word final open syllables. High vowels that arose from underlying /a/ are never in the correct position for deletion, thus, they do not delete.

The BHA case is different from the cases of Akan and C'Lela: There, a prosodic domain that is isomorphic with a cyclic domain made it possible for a phrasal process to bleed or feed a process that seemed to be lexical. In BHA, the relevant prosodic domain, the phonological word, is not isomorphic with the word level string. This allows us to differentiate between high vowels in open syllables that undergo phrasal syncope from those that do not. However, this is not a mechanism for deriving counter-cyclic opacity: BHA only follows because it is re-analysed as a non-interaction.

In chapter 3.4.1, I discuss certain opaque countercyclic patterns that are derivable at the phrase level, the counterfeeding Chainshift in Hijazi falls into this category. The analysis that I propose is however not like that: While it relies on the same mechanisms that make this specific instance of countercyclic opacity derivable, it reanalyses the i-syncope as two processes, and we get a cyclic non-feeding interaction where a-raising counterfeeds word-final i-deletion. The reasons for this is not aesthetics: We have, as discussed in section 4.3.2.3, evidence for the ordering of a-raising before the phrasal instantiations of syncope, but not before the word-level instantiations. An account that would put a-raising at the phrase-level and block it word-finally would wrongly predict that all cases of syncope bleed all cases of a-raising on-context. The same holds for the opaque interaction of syncope with surface epenthesis: A Stratal OT account that puts all instances of syncope in the phrase-level could not drive the counterfeeding of syncope by the epenthetic vowel.

4.4 Icelandic: Resyllabification Bleeds and Counterbleeds Epenthesis

Another process interaction that has gathered considerable attention in the phonological literature and deemed a challenge, however, without being labelled countercyclic, is the interaction of epenthesis and resyllabification in Icelandic (Anderson 1969; Orešnik 1972; Kiparsky 1984, 1985; Felice 2022). Kiparsky (1985) derives a subset of the data in a cyclic fashion, this analysis crucially depends on the adoption of a specific version of the Strict Cycle Condition (SCC). This analysis is flawed in two important ways. First, the SCC in phonology is problematic, for a discussion see chapter 2.3.2 or Kiparsky (1993). Second, Kiparsky's 1985 analysis is based on a wrong generalisation of the data. Considering the entire data and an adequate generalisation, the analysis fails to derive the pattern correctly.

In the following, I will first present Kiparsky's 1985 analysis and show that it cannot derive the entire data set. After that, I will sketch out an analysis that doe account for the core data based on the assumption that some clitica are word-level, while others are phrase-level affixes. Then, in section 4.4.4, I argue that the stratal make-up that I assume for my analysis to work is justified. In the end, I will discuss some potential problems for my analysis.

The Icelandic data used here is extracted from the Beygingarlýsing íslensks nútímamáls [The Database of Modern Icelandic Inflection], in short, Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection], corpus, a corpus of over 300 000 Icelandic paradigms, the transcription from orthography is based on Árnason (2011). The translations are based on Sverrir Hólmarsson, Sanders, & Tucker (1989), Blöndal (1920-24), Ásgeir Blöndal Magnússon (1989), and the Íslensk nútímamáls orðabók. [The Dictionary of Modern Icelandic].

4.4.1 Core data

The central epenthesis process inserts a high lax front rounded vowel [ʏ], one of the three vowels allowed in native unstressed syllables, between a consonant and the trill [r] at the edge of a word. This happens when the r is part of an affix, as in (203), as well as if it is part of the root, as in (204). I argue in section 4.4.4, why this vowel should best be regarded as epenthetic and not as part of the underlying representation. This is, however, irrelevant for the discussion of (counter-)cyclicity.

(203) *Epenthesis between morphemes*

a. taɣ-r → taɣʏr 'day-NOM'

b. sœyð-r → sœyðʏr 'sheep-NOM'

c. cɛŋk-r → cɛŋkʏr 'go-2/3SG'

(204) *Epenthesis inside roots*

a. lɪvr → lɪvʏr 'liver'
b. hamstr → hamstʏr 'hamster'
c. setr → setʏr 'Institute'
d. cimpr → cimpʏr 'ewe lamb'

There are certain affixes in Icelandic that have been at times called clitics (e.g. Pétursson 1986), and I follow this tradition. In the nominal domain, these clitics are the definiteness markers which follow case/number exponents. If such a clitic attaches to a base so that a) it shows up with the epenthetic vowels if there is no clitic and b) the /r/ that caused the epenthesis in the first place can resyllabify with the clitic, we have potentially two options: Resyllabification of the /r/ could either bleed epenthesis, or it could counterbleed epenthesis. Problematically, both happens in Icelandic. (205) shows counterbleeding, while (206) shows bleeding.

(205) *Atricle counterbleeds epenthesis*

a. taɣ-r=ɪn → taɣʏrɪn 'day-NOM-DEF.M.NOM'
b. hamstr=ɪn → hamstʏrɪn 'hamster-DEF.M.NOM'

(206) *Article bleeds Epenthesis*

a. lɪvr=ɪn → lɪvrɪn 'liver-DEF.F.NOM'
b. sɛtr=ɪð → sɛtrið 'institute-DEF.N.NOM'
c. cimpr=ɪn → cɪmprɪn 'ewe lamb-DEF.F.NOM'

Kiparsky's generalisation of these data is that epenthesis is counterbled if the triggering /r/ belongs to a different morpheme than the root, and bled if the /r/ is root internal. This ignores data like (205b), and I will show that his analysis cannot be extended to these data in the next section. The more accurate generalisation of the data is that resyllabification of masculine clitics counterbleeds epenthesis, whereas resyllabification of non-masculine clitics bleeds it.

4.4.2 Kiparsky's (1985) analysis

Kiparsky (1985) assumes that a) nominative affixation precedes cliticisation and b) Kiparsky (1985) introduces a new version of the Strict Cycle Condition (207). Like Kiparsky's 1984 version it only holds with cyclic, stem-level processes, but unlike the older version it excludes non-overt morphological material from triggering stem-level cycles.

(207) Strict Cycle Condition (Kiparsky 1985: 89)
If W is derived from a lexical entry W', where W' is nondistinct from XPAQY and distinct from XPBQY, then a rule A→B / XP __ QY cannot apply to W until the word-level.

Under this new version of the SCC, every process that affects monomorphemic domains must be word-level or above. Further, language specific, assumptions of his are that the clitica are word-level affixes[85] and that epenthesis is both a stem- and a word-level process.

With these assumptions, the derivation of counterbleeding is straightforward, see the derivation adapted from Kiparsky (1985: 91) in (208).

(208) *Kiparsky's derivation of counterbleeding*

	/taɣ-r/	/taɣ-r/	*Stem level*
Syllab.	/taɣ-r./	/taɣ-r./	
EPEN	/taɣʏr./	/taɣʏr./	
	/taɣʏr	taɣʏr-ɪn/	*Word level*
Syllab.	ta.ɣʏr.	ta.ɣʏ.rɪn.	
EPEN	–	–	

The derivation of bleeding on the other hand requires the new version of the SCC. The SCC blocks every process in monomorphemic stem-level domains, and delays thus necessarily epenthesis in roots like /lɪvr/. It is delayed to the word-level, where it can be counterbled by resyllabification.

(209) *Kiparsky's Derivation of Bleeding*

	/taɣ-r/	/taɣ-r/	/lɪvr/	/lɪvr/	*Stem level*
Syllab.	/taɣ-r./	/taɣ-r./	/lɪvr./	/lɪvr./	
EPEN	/taɣʏr./	/taɣʏr./	*blocked by SCC*		
	/taɣʏr	taɣʏr-ɪn/	lɪvr	lɪvr-ɪn	*Word level*
Syllab.	ta.ɣʏr.	ta.ɣʏ.rɪn.	lɪvr.	lɪv.rɪn.	
EPEN	–	–	lɪvʏr	–	

As said before, Kiparsky's (1985)[86] analysis ignores some central data: roots like /hamstr/ that do show epenthesis before clitics. If we just pluck these roots into the analysis, the wrong output is derived because they cannot be treated any different from roots like /lɪvr/.

[85]For the core data, an analysis of the clitica as regular stem-level affixes would be extensionally identical. If more data of the language is considered, analysing the clitica as stem-level becomes complicated.

[86]Kiparsky (1984) mentions these types of data in passing, and argues that in these roots, the vowel is underlying and ins deleted via syncope. In section 4.4.6.2 I argue that such an analysis is problematic.

(210) *Derivation of counterbleeding inside roots fails*

	/taɣ-r/	/taɣ-r/	/lɪvr/	/lɪvr/	/hamstr/	/hamstr/
Syllab.	taɣ-r.	taɣ-r.	lɪvr.	lɪvr.	hamstr.	hamstr.
EPEN	taɣʏr.	taɣʏr.		*blocked by SCC*		
	/taɣʏr	taɣʏr-ɪn/	lɪvr	lɪvr-ɪn	hamstr	hamstr-ɪn
Syllab.	ta.ɣʏr.	ta.ɣʏ.rɪn.	lɪvr.	lɪv.rɪn.	hamstr.	hams.trɪn.
EPEN	–	–	lɪvʏr	–	hamstʏr	–
Output	ta.ɣʏr.	ta.ɣʏ.rɪn.	lɪvʏr.	lɪv.rɪn.	hamstʏr.	***hams.trɪn.**

If the language specific assumption that a.) the clitica belong to an outer cycle and b.) epenthesis applies before that cycle, are correct, and the SCC is thus not an adequate tool to derive the data, the Icelandic pattern constitutes a countercyclicity problem: Epenthesis is blocked — at least sometimes — if it would be counterbled at a later cycle.

4.4.3 My analysis in a nutshell

Kiparsky's analysis works for a subset of the data by fixing the concatenation of clitica at the word-level and making epenthesis variable, so that it regularly applies at the stem-level but might be delayed to the word-level. My reanalysis is a reverse of this: Epenthesis is fixed (at the word-level) and cliticisation is variable, at the phrase or word-level, depending on the morphosyntactic features of the clitic. The table in (211) gives an overview of the gist of the analysis: At the stem-level, Cr. clusters are not repaired. At the word-level, Cr. clusters are repaired by epenthesis, but only if the /r/ cannot resyllabify with a following vowel. The feminine and neuter clitics are merged on the word-level, so if they are vowel-initial, they can bleed epenthesis. The masculine clitics, however, are not merged yet, so epenthesis applies in all masculina. At the phrase level, the masculine clitics are added, but they come too late to bleed epenthesis.

(211) *Gist of the reanalysis*

Stem level		
Input	/hamstr/	/lɪvr/
syllabification	hamstr.	lɪvr.
Word level		
Input	hamstr.	lɪvr.-ɪn
Resyllabification	—	lɪv.rɪn
Epenthesis	hamstʏr	—
Phrase level		
Input	hamstʏr-ɪn	lɪ.vrɪn
Resyllabification	ham.stʏ.rɪn	—
Output	ham.stʏr.ɪn	lɪ.vrɪn

In the literature on Icelandic, there has been a long-standing debate on whether the vowel that appears before r is epenthetic (Anderson 1969; Orešnik 1972; Kiparsky 1984, 1985; Svenonius 2012) or underlying (Orešnik 1976, 1978; Árnason 2011; Ingason 2013); and whether the clitica are regular affixes (Árnason 2011), or belong to a different stratum (Kiparsky 1984, 1985). In the following, I will re-examine the evidence for two strata and epenthetic ʏ, largely following (Orešnik 1972) and (Kiparsky 1984). Whereas the Stratal affiliation is crucial for my analysis, the fact whether the ʏ is epenthetic is less crucial.[87] After that, I will refine my proposal laid out here, before finally coming to the complications that might argue against my proposal.

4.4.4 Arguments for the stratal organisation

There are three processes in Icelandic, namely hiatus resolution, glide deletion and U-Umlaut, that argue for a serial application of phonology with inner affixes and outer affixes, the latter being the clitica. The epenthetic vowel patterns with the clitica in U-Umlaut and glide deletion, but has a different pattern in hiatus resolution. This is in no way surprising if we analyse it as an epenthetic vowel. Nonetheless, it is not possible to put epenthesis and clitica in the same stratum generally, because, as we have seen, there are instances of epenthesis that are counterbled by concatenation of the clitic. In the following, I will go through the three processes and show how they are different with affixes, clitics and epenthetic vowels.

[87] If the ʏ in ʏr and in the roots is underlying, the analysis would be the following: At the stem level all case/number affixes are merged, except for the ʏr nominative. Also, idiosyncratically syncopating vowels (see section 4.4.6.2) are deleted, but not root final ʏr. sequences. Glide deletion (section 4.4.4.2) and U-Umlaut (section 4.4.4.3) are stem-level processes. At the word level, a the nominative ʏr is merged, as well as the feminine and neuter articles. Syncope of ʏ before rV is a more generall process, that affects root-internal ʏ and the vowel of -ʏr. The masculine article comes to late to feed syncope. This analysis can account better for cases like ciɣʏrɪn mentioned in section 4.4.6.5, however it wrongly predicts the genitive plural of derived nouns in -ar-ɪ to be --*rʏm instead of -ʏrʏm. This might be a surmountable problem.

4.4.4.1 Hiatus resolution

Hiatus resolution in Icelandic has featured in the literature (Orešnik 1972; Kiparsky 1984; Árnason 2011) but has, compared to the other processes discussed here, obtained much less attention in theoretical phonology. Hiatus between two unstressed lax vowels is not tolerated and is resolved by the deletion of a vowel. In the inflectional domain, and as far as I can oversee also in derivation, the deleted vowel is the left, root final vowel, compare (212).

(212) *First vowel deletes*

a. laikni-a → laikna 'doctor-GEN.PL'
b. laikni-ʏm → laiknʏm 'doctor-DAT.PL'
c. nira-ʏm → nirʏm 'kidney-DAT.PL'
d. kʰatla-ʏm → kʰœtlʏm 'call-1.PL'
e. kʰatla-ɪð → kʰatlɪð 'call-2.PL'

The exception to this are the definiteness markers on nouns, which start mostly with the lax high vowel -ɪ. If they are added to a vowel-final stem the affix vowel is deleted, see (213), whereas the root or stem final vowel perseveres.

(213) *second vowel deletes*

a. laiknɪ=ɪn → laiknɪn 'doctor-DEF.M.ACC.SG'
b. nira=ɪð → nirað 'kidney-DEF.NEU.NOM.SG'
c. nira-ʏ=ɪn → nirʏn 'kidney-PL-DEF.NEU.NOM.PL'

The vowel ʏ of the -ʏr affixes does not appear after an unstressed vowel. If it is epenthetic, this is expected – there is no reason for insertion here. If we assume this vowel to be an underlying part of the affix, this affix patterns with the clitica and not with the other case/number affixes on nouns, or inflectional affixes on verbs, see (214).[88]

(214) *No ʏ after vowel*

a. laiknɪ-ʏr → laiknɪr 'doctor-NOM.SG'
b. taimi-ʏr → taimɪr 'judge-2/3.SG'
c. kʰatla-ʏr → kʰatlar 'call-2/3.SG'

Monosyllabic vowel final roots generally[89] tolerate hiati produced both by case/number inflection (215) as well as clitica (216). These hiati are different from the ones discussed above, because the first vowel is stressed and can come from the full range of Icelandic vowels and diphthongs.

[88] In the following examples, I will include the epenthetic vowel ʏ in the underlying forms, to make its behaviour as a vowel more transparent.

[89] Some nouns of that shape show deletion of affix vowels, but not necessarily for all case/number affixes. /kʰu-ʏm/ → [kʰum] 'cow-DAT.PL' but /kʰu-a/ → [kʰua] 'cow-GEN.PL

(215) *Hiatus after stressed vowel with suffix*

a. pu-ʏm → puʏm 'house-DAT.PL'
b. sjou-ʏm → sjouʏm 'sea-DAT.PL'
c. tʰɛ-ɪ → tʰɛɪ 'Tea-DAT.SG'
d. sjau-ʏm → sjauʏm 'see-1.PL'

(216) *Hiatus after stressed vowel with clitic*

a. pu=ɪð → puɪð 'house-DEF.NEU.NOM.SG'
b. sjou=ɪn → souɪn 'sea-DEF.M.ACC.SG'
c. tʰɛ=ɪð → tʰɛɪð 'Tea-DEF.NEU.NOM.SG'

The feminine dative and accusative singular clitics are exceptions to this and show vowel deletion, see (217). These are the only bisyllabic clitics that can potentially attach to vowel-final stems. The only other bisyllabic clitic, the singular genitive feminine -ɪnːar, always attaches to consonant-final stems.

(217) *Some clitic vowels delete after stressed vowels*

a. θrou=ɪn → θrouɪn 'cistern-DEF.F.NOM.SG'
b. θrou=ɪna → θrouna 'cistern-DEF.F.ACC.SG'
c. θrou=ɪnːɪ → θrounːɪ 'cistern-DEF.F.DAT.SG'
d. θrou-ar=ɪnːar → θrouarɪnːar 'cistern-DEF.F.GEN.SG'

The epenthetic vowel is absent after stressed vowels.[90] This is of course expected if it is correctly analysed as epenthetic.

(218) *No ʏ after stressed vowels*

a. sjou-ʏr → sjour 'sea-NOM.SG'
b. tei(j)-ʏr → teir 'die-3.SG'
c. sjɛ-ʏr → sjɛr 'see-3.SG'+

Summarised, a hiatus between two unstressed vowels is always resolved by deletion. Which vowel is deleted depends on the type of affix – the stem vowel is deleted before 'regular' affixes and the clitic vowel is deleted in clitics. If the first vowel is stressed, the hiatus is generally tolerated, but there is some idiosyncratic behaviour both with regular affixes and clitics. The ʏ of the r-affixes never shows up after any vowel. Its behaviour is unique but follows if it is assumed to be epenthetic and inserted between a consonant and /r/. As mentioned, this is in line with Orešnik (1972); Kiparsky (1985); Svenonius (2012); Þráinsson (2017) but contra Orešnik (1978); Árnason (2011); Ingason (2013), who assume that it is underlying.

[90] The only exception to this in the Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] is <góur> [kouʏr] 'do-gooder', which derives from /kouð/ 'good', adding nominal inflection to the otherwise adjectival root and mockingly deleting the dental fricative.

4.4.4.2 Glide deletion

Coda glides are not tolerated in Icelandic, but have been postulated to exist in underlying forms Orešnik (1972); Kiparsky (1984). The glides are deleted unless they can resyllabify as an onset.[91] This happens to root-final glides in nouns with the palatal glide, (219), and with the labio-dental glide (220), as well as to the thematic consonant -j in the present tense of verbs that take it, see (221).

(219) *Deletion of j*

a. skɛlj-ar → skɛljar 'shell-GEN.SG'
b. skɛlj-ʏm → skɛljʏm 'shell-DAT.PL'
c. skɛlj → skɛl 'shell'
d. pɪlj-ɪ → pɪljɪ 'blizzard-ACC.PL'
e. pɪlj-s → pɪls 'blizzard-GEN.SG'
f. pɪlj → pɪl 'blizzard-ACC/DAT.SG'

(220) *Deletion of w*

a. sœŋkw-ar → sœŋkʋar 'song-NOM.PL'
b. sœŋkw-s → sœŋks 'song-GEN.SG'
c. sœŋkw → sœŋk 'song-ACC/DAT.SG'

(221) *Deletion of thematic consonant j*

a. t^hɛl-j-a → t^hɛlja 'count-TC-INF'
b. t^hɛl-j-ið → t^hɛljɪð 'count-TC-2PL'
c. t^hɛl-j-Ø → t^hɛl 'count-TC-1SG'

Even though a glide could theoretically resyllabify with vowel-initial clitics, this does not happen. Glide deletion is thus counterbled by the affixation of vowel initial definiteness markers, compare (222).

(222) *Deletion overapplies before clitic*

a. skɛlj=ɪn → skɛlɪn 'shell-DEF.F.NOM.SG'
b. pɪlj=ɪn → pɪlɪn 'blizzard-DEF.M.ACC.SG'
c. sœŋkw=ɪn → sœŋkɪn 'song-DEF.M.ACC.SG

The epenthesis of ʏ with r-affixes, too, counterbleeds the application of glide deletion, see (223).

(223) *Deletion overapplies before epenthetic* ʏ

a. t^hɛl-j-ʏr → t^hɛlʏr 'count-TC-2/3.SG'

[91] This is more obvious for the palatal glide. For the labio-dental glide, there are exceptions aplenty, such as [aulv] 'elf.ACCUSATIVE'. Historically, the non alternating 'v's derive from fricatives and not from glides (Kiparsky 1984). Since this analysis does not vilify abstract inputs, I contend that accepting distinct inputs for these forms such as /v/ or /f/ vs. /w/ which are later partially neutralised is not problematic.

b. pɪlj-ʏr → pɪlʏr 'blizzard-NOM.SG'
c. sœŋkw-ʏr → sœŋkʏr 'song-NOM.SG

As expected if glide deletion precedes epenthesis, glide deletion bleeds the insertion of the vowel of r-affixes, see (224). If glide deletion was to apply after epenthesis, we would expect e.g. *nijʏr instead of nir.

(224) *Glide deletion bleeds epenthesis*
a. teij-ʏr → teir 'die-3.SG'
b. nij-ʏr → nir 'new-M.NOM.SG'

Whereas hiatus resolution just argues for two different rule-blocks, because hiati are resolved differently depending on the affix in question, glide deletion also gives evidence for ordering: resyllabification of regular affixes bleeds glide deletion, and should therefore precede or coöccur with it. Resyllabification of clitics as well as epenthesis counterbleed glide deletion, and should thus be ordered after its application.

4.4.4.3 U-Umlaut

The process of so called u-umlaut (Orešnik 1972, 1977b; Ingason 2013)[92] turns an /a/ into [œ] or [ʏ], if followed by [ʏ]. It becomes [œ] if stressed, (225a), and [ʏ] if unstressed, see (225b). Keep in mind that [œ] must be stressed in native Icelandic vocabulary.

(225) *U-Umlaut*
a. jak-ʏl-r → j**œ**kʏtl
ice.floe-DIM-NOM
'glacier'
b. vɛkj-ar-ʏm → vɛkj**ʏ**rʏm
wake-NMLZ-DAT.PL
'alarm clocks'

U-umlaut is iterative, but stops if it reaches an /a/ that can turn into an œ. With native vocabulary this is always the first non-prefix vowel, the canonically stressed position, but it might be elsewhere in loans, see (226c).

[92]Like with all other lexical processes in Icelandic, there is debate whether U-Umlaut should be analysed as a phonological process. Árnason (2011) argues that it is morphological alternation, because it is not surface true and phonetically unnatural. Ingason (2013), who otherwise agrees with Árnason (2011) that epenthesis is not a process of Icelandic, disagrees because U-Umlaut is not blocked by intervening consonantal morphemes, given his DM-based view thus, U-Umlaut must be a process. U-Umlaut is furthermore fully productive and extended to loanwords and nonce words (Þráinsson 2017). In my view, the arguments for it being not a phonological process are much weaker compared to the arguments regarding glide deletion and epenthesis, consequently I will not consider it in section 4.4.6.

(226) *Iterative U-Umlaut*

a. pak-ar-YM → pœkYrYm
bake-NMLZ-DAT.PL
'bakers'

b. að-prat:-Y → aθprœt:Y
PRFX-steep-NEU.DAT.SG
'steep'

c. apstrakt-YM → apstrœktYm
abstract-DAT.PL
'abstracts'

Other vowels block u-umlaut, if they intervene. In (227), the initial /a/ stays as it is, because it is separated from the trigger /Y/ by vowels that are themselves resistant to umlaut, as seen in (227).

(227) *Blocking of U-umlaut*

a. aðɪlj-YM → aðɪljYm
member-DAT.PL
'members'

b. aθɛn-Y → aθɛnY
Athens-DAT/ACC/GEN
'Athens'

U-Umlaut is triggered by all regular inflectional affixes that contain the front rounded vowel Y, in the verbal, nominal and adjectival domain, see (228). It is also triggered by almost all non-compound-like derivational affixes, for the one exceptional non-trigger '-YS' see ((230)).

(228) *U-umlaut with diverse suffixes*

a. t^hal-t-Y → t^hœltY 'count-PST-3PL.PST'
b. kat-Y → kœtY 'street-ACC/DAT/GEN.SG'
c. vakr-ast-Y → vœkrYstY 'smooth.gaited-SUP-PL.WEAK'

U-Umlaut is also induced without an overt trigger in two morphosyntactic constructions, the feminine singular non-genitive, (229c-d), and the neuter plural accusative and nominative, (229a-b) in the strong inflection respectively.

(229) *U-umlaut without overt trigger*

a. lamp-[+rd] → lœmp 'lamb-NOM/ACC.PL'
b. lamp-Ø → lamp 'lamb-NOM/ACC.SG'
c. xvat-[+rd] → xvœt 'motivation-NOM/ACC/DAT.SG'
d. xvat-ar → xvatar 'motivation-GEN.SG'

This seems to be general in the strong declension, that is with paradigms that have zero segmental affixes. The only exceptions I encountered in Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] are all feminina that end in [xt] (orthographically <kt> or <gt>) and two of the three feminina ending in [-rt], but interestingly, the neutra do not show similar restrictions.

In monomorphemic domains, there are a few exceptions to u-umlaut, most of them are proper names ending in -ʏs, such as julianʏs 'Júliánus' or pʰilatʏs 'Pílatus'. A few general nouns have a similar shape, namely pʰartʏs 'leopard', kʰaktʏs 'cactus', pampʏs 'bamboo', statʏs 'status' and pʰarːʏk, an obsolete word for wig.

The only non-compoundlike derivational affix that does not trigger U-umlaut is -ʏs, a hypocoristic for proper masculine names (Ingason 2013), an example is given in (230). These forms are not contained in the Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection].

(230) *No U-umlaut with -ʏs*

hrapn-ʏs → hrapnʏs 'Hrafny'

In sum, both monomorphemic and derivational exceptions to U-Umlaut are found almost exclusively in the domain of proper names, the general nouns that are in use and do not have U.Umlaut share the atypical -ʏs ending with the proper names.[93]

The clitica on the other hand systematically do not trigger U-Umlaut in the stems they attach to, compare (231).

(231) *No U-umlaut with clitica*

a. nira=nʏ → niranʏ 'kidney-DEF.DAT.NEU.SG'
b. stað=nʏm → staðnʏm 'site-DEF.DAT.M.SG'
c. katla=ðʏ → katlaðʏ 'call.IMP-2SG'

Similarly, the epenthetic ʏ does not trigger U-Umlaut, see (232).

(232) *Epenthesis counterfeeds U-umlaut*

a. hamstr → hamstʏr 'hamster'
b. akr → akʏr 'field'
c. vakr-rɪ → vakʏrːɪ 'smooth.gaited-DAT.SG.F.STRG'
d. stað-r → staðʏr 'site-NOM'
e. taɣ-r → taɣʏr 'day-NOM'

This cannot be checked for the verbal -r suffix (2/3SG.PRES.IND), since all verbs that have a non-vocalic thematic element undergo i-umlaut in this environment, which bleeds u-umlaut, compare (233).

[93] Proper names are not generally exempt from Umlaut, e.g. /aɣat-ʏ/ → [aɣœtʏ] 'ɑgata'

(233) *i-Umlaut bleeds (potential) U-umlaut*

a. tʰal-j-r → tʰɛlʏr 'count-TC-2/3SG'

b. tʰal-j-ʏm → tʰɛljʏm 'count-TC-1PL'

In short, with U-Umlaut we see the same familiar pattern again: 'regular' affixes show a certain behaviour by triggering umlaut, and clitics and the epenthetic vowel show another, namely not-triggering it. Importantly, in this case the behaviour of the epenthetic vowel does not follow from it being epenthetic, it must follow from it being inserted at a stage where u-umlaut is not applied any more.

Summarised we can say that clitica behave differently from affixes in three morphophonological alternations – they resolve hiatus differently, bleed vs. counterbleed glide deletion, and trigger or do not trigger U-Umlaut. The epenthetic vowel behaves like the clitica for U-Umlaut and glide deletion, but has a yet different pattern for hiatus deletion. This behaviour follows if we assume that it is an epenthetic vowel inserted in the stratum in which the clitica are added.

4.4.5 Analysis

In an analysis in Stratal OT, Kiparsky's stratal organisation cannot be maintained, because we find intrastratal opacity: Epenthesis counterbleeds glide deletion and counterfeeds U-Umlaut. If the latter processes are stem-level, and I will assume that they are, epenthesis must belong to a later stratum. I argue that this stratum should be the word-level. (234) gives an overview over the stratal affiliation of processes I assume.

(234) *Stratal Architecture in Icelandic*

	Stem level Stratum	Word level Stratum
Morphology	'regular' affixes	clitica
Phonology	Hiatus deletes first vowel U-Umlaut Glide-deletion	Hiatus deletes 2nd vowel Epenthesis

First, let us look at the processes that apply at the stem-level but not at the word-level, namely glide-deletion[94] and u-umlaut. For the former, we need a triggering constraint that prohibits coda glides. Depending on the assumptions on the featural make up of glides and the structure of syllables, such a constraint could take various forms. I will adopt the rather brute version in (235), for the sake of easier exposition.

(235) *j.

Count a violation for a glide in a coda.

[94] Technically, we have no evidence whether glide deletion applies at the word-level as well, because there are no contexts that arise at the word-level where it could apply. Importantly, it has to apply at the stem-level to be counterfed later at the word-level.

This constraint must outrank a MAX constraint against the deletion of consonants. Constraints that prohibit other potential repairs, such as inserting a vowel following the glide, must outrank the MAX-C constraint as well. (236) shows the tableau that derives glide deletion.

(236) *Glide deletion Stem level*

	pɪlj	DEP-V	*j.	MAX-C
a.	pɪlj		*!	
b.	pɪl			*
c.	pɪljʏ	*!		

There are various approaches to U-Umlaut in OT (McCarthy 1995; Karvonen & Sherman 1997; Gibson & Ringen 2000; Ingason 2013). I assume here a licensing approach (Walker 2004), where harmony is triggered by the constraint in (237).

(237) LICENSE [+rd]/Stress
Count a violation for a [+rd] feature that is not associated to the stressed syllable

This constraint is ranked with respect to faithfulness constraints so that it triggers rounding of the low vowel, and not de-rounding of the affix, see (238).

(238) *U-umlaut Stem level*

	hamstr-ʏm	ID[+rd]	LIC	ID[-rd]
a.	hamstrʏm		*!	
b.	hœmstrʏm			*
c.	hamstrɪm	*!		

The ranking in (238) does not account for the entire array of U-Umlaut data. It erroneously predicts rounding of non /a/s as well, so e.g. **pʏljʏm* instead of *pɪljʏm 'blizzard*-DAT.PL'; and if this blocking is accounted for, the myopic nature of U-Umlaut — it affects intermediate vowels even if the stressed vowel is unavailable — must be accounted for, too. However, a thorough analysis of U-Umlaut is outside the scope of this work, so I refer again to the literature discussing this process cited above.

Let us now turn to hiatus resolution at the stem-level. Here, the triggering constraint is (239), which penalises a hiatus unless one of the participating vowels is stressed.[95]

(239) *V̆V̆
Count a violation for a sequence of two stressless vowels.

[95] Or tense – since a final vowel is either stressed and tense, or unstressed and lax, this amounts to the same outcome.

This markedness constraint triggers the deletion. The faithfulness constraints which decide over which vowel is deleted can be formalised in many ways, most of which violate my assumptions on reference via referring to morpheme-initiality or root-status (Casali 1997). An alternative that does not refer to morphological features for Icelandic is to assume that the affix vowel is protected because it is the rightmost vowel at this stage (MAX-RMST), parallel to the MAX-RMST-T-constraint I propose for tone in Akan in section 4.2.4.3. See the derivation in (240): candidate a. violates the constraint against two unstressed vowels in a sequence. Candidate b. and c. each delete a vowel, for candidate c. this is the vowel of the prefix, violating so the directional MAX constraint. The winner b. deletes the root vowel, which avoids a violation of said constraint.

(240) *Hiatus resolution Stem level*

		laiknɪ-ʏm	*V̆V̆	MAX-RMST	MAX
	a.	laikniʏm	*!		
☞	b.	laiknʏm			*
	c.	laiknɪm		*!	*

Finally, we need to make sure that epenthesis does not yet apply at the stem-level. For this, the epenthesis triggering constraint (241) needs to be outranked by all relevant faithfulness constraints, so that the structure is not repaired. The tableau in (242) selects the desired winner, candidate a. which does not epenthesise.

(241) *Cr.
Count a violation for a complex coda where the second element is a trill.

(242) *No epenthesis at the stem level*

		taɣ-r	DEP-V	MAX-C	*Cr.
☞	a.	taɣr.			*
	b.	ta.ɣʏr	*!		
	c.	taɣ		*!	

The only constraints that are necessary for more than one stem-level process are DEP-V and MAX-C, which play a role in blocking of epenthesis and glide deletion, and their ranking is compatible. Having discussed the stem level, let us now turn to the word level.

At the word level, epenthesis is no longer blocked — it is preferred to Cr. codas. Therefore a re-ranking of DEP-V and *Cr. is necessary, as shown in the tableau in (243), which selects candidate b. with epenthesis as the winner.

(243) *Epenthesis at the word level*

		taɣ-r	*Cr.	MAX-C	DEP-V
	a.	taɣr.	*!		
☞	b.	ta.ɣʏr			*
	c.	taɣ		*!	

Also, U-Umlaut is not longer active, which can be modelled by a demotion of the licensing constraint. This will not be further illustrated. Crucially different from the stem-level is hiatus resolution. Now, it is the second vowel that is deleted, not the first one. This is because the first vowel is already syllabified (for precedence, compare e.g. Jesney 2011; Šurkalović 2013), whereas the affix vowel is not, see the derivation in (245). Candidate a. is faithful and violates the constraint against hiatus. candidate b, deletes the otherwise protected rightmost vowel, but it is still the winner because candidate c., which deletes the stem-final vowel is worse as the vowel it deletes was already syllabified.

(244) MAX-.V.
Count a violation for an input vowel dominated by a syllable not present in the output.

(245) *Hiatus resolution at the Word level*

		ni.ra.-ɪð	*V̆V̆	MAX-.V.	MAX-RMST	MAX
	a.	ni.ra.ɪð.	*!			
☞	b.	ni.rað.			*	*
	c.	ni.rɪð.		*!		*

For deriving the difference between stem-level hiatus and word-level hiatus, the stratal component that is necessary is not re-ranking, but cyclicity: The constraint in (244) can protect the stem final vowel only after it has been syllabified, that is, after the stem-level.

This simple analysis in Stratal OT captures most of the characteristics of epenthesis in Icelandic and derives a good chunk of the data, including the underapplication of epenthesis in feminine and neuter nouns with underlying /Cr/, compare the tableau in (246). candidate a. is (except for syllabification) faithful, and the winner. Candidate b. epenthesises the ʏ, but this does nothing but incur a gratuitous violation of *DEP.

(246) *Word level: epenthesis is bled by resyllabification*

		cimpr.-ɪn	*Cr.	MAX-C	DEP-V
☞	a.	cim.prin.			
	b.	cim.pʏ.rin.			*!
	c.	cim.pin.		*!	

However, as it stands, it fails to derive the overapplication of epenthesis with the masculine clitic, see (247). There is nothing yet in the derivation that could distinguish the masculine clitica from the non-masculine clitica above.

(247) *Wrong prediction: Bled epenthesis with masculina*

		taɣ-r-ɪn	*Cr.	Max-C	Dep-V
☞	a.	taɣ.rɪn.			
✄	b.	ta.ɣʏ.rɪn.			*!
	c.	ta.ɣɪn.		*!	

The OT based approach to the Icelandic puzzle reverses the problematic case with respect to Kiparsky's rule based approach: Here, the neutra and feminina with underlying /Cr/ follow without complications, whereas the masculina, be it with mono- or hetero-morphemic /Cr/ fail to be derived. In the next section, I will lay out my analysis of these data points, which will not alter the phonological grammar developed above, but will manipulate assumptions of the morphological affiliation of the relevant morphemes. Crucially, I will assume that the masculine articles do not take part in the computation of word-level phonology.

4.4.5.1 Proposal

The feminine and neuter clitica are word-level affixes, and at least in the nominal domain, the only inflectional word-level affixes. The masculine clitica, however, are not word-level affixes, but phrasal affixes. A phrasal affix a is structure that is merged at the phrase level but is in some way prosodically deficient so that it gets integrated into an already existing prosodic word. This deficiency and integration can be modelled in multiple ways compare Selkirk (1995); Peperkamp (1996); Bermúdez-Otero & Luís (2009). For the time being, I will assume that the clitic did not undergo any prosodification up to this point and gets integrated into the preceding phonological word simply by purely phonological constraints. However, note that it is possible given my assumptions to presume more specific constraints that take the morphosyntactic relation between the article and its host into account – under the current implementation of the Indirect Reference Hypothesis, prosodic constraints can refer to (some) morphosyntactic features. The tableau in (248) shows the integration of a clitic into a prosodic word. The winning candidate b. only violates the faithfulness constraint against integrating material to the right, however, this constraint is lower ranked than the constraints against epenthesis of further prosodic words, violated by candidate c. or leaving the clitic outside any prosodic word, violated by candidate a.

(248) *Prosodic integration*

		(pɪl)$_\omega$ɪn	DEP-ω	HAVE-ω	*INTEGRATE-ω
	a.	(pɪl)$_\omega$ɪn		*!	
☞	b.	(pɪlɪn)$_\omega$			*
	c.	(pɪl)$_\omega$(ɪn)$_\omega$	*!		

With this in place, cases such as [hamstʏrɪn] are straightforwardly accounted for. At the word level, the clitic is not yet present, because, unlike its feminine and neuter sister clitics, it is indexed for the phrase level. At the word level thus, epenthesis applies unless it is bled by the presence of a stem-level affix, see (249). It is necessary, that at least at this point the structure gets mapped unto a prosodic word, with the constraints in (248) that means that HAVE-ω outranks DEP-ω. Candidate a. is suboptimal for two reasons: It has not built a prosodic word, and it has an ill-formed syllable with a Cr. cluster. Both properties alone would be fatal. Candidates b. and c. built a prosodic word and avoid the cluster, candidate b. wind because it violates lower ranked DEP-V instead of MAX-C.

(249) *Epenthesis applies in definite masculina at the word level*

		hamstr.	*Cr.	MAX-C	HAVE-ω	DEP-V	DEP-ω
	a.	hamstr.	*!		*!		
☞	b.	(hams.tʏr.)$_\omega$				*	*
	c.	(hamst.)$_\omega$		*!			*

At the phrase level, then, the epenthetic vowel is already in the input and there is no benefit in deleting it. The clitic vowel syllabifies too late to prevent epenthesis, see (250).

(250) *Resyllabification on the phrase level counterfeeds epenthesis*

		(hams.tʏ.r.)$_\omega$ɪn	DEP-ω	HAVE-ω	FAITH-ω	MAX-V
☞	a.	(hams.tʏ.rɪn)$_\omega$			*	
	b.	(hams.trɪn.)$_\omega$			*	*!

MAX-V is important, but cannot be high ranked – the clitic initial vowel is still deleted, if it follows an unstressed vowel. For this deletion to apply it is crucial that the clitic integrates into the prosodic word, unstressed vowels across word boundaries are not deleted. There is further evidence that the clitic integrates into the prosodic word: It triggers palatalisation on preceding velars, which is otherwise blocked across word boundaries (c.f. Ingason 2016).

This analysis derives the data and is compatible with my assumptions, but it clearly begs the question of why the masculine clitic is phrasal, whereas the feminine and neuter are word-level. My answer to this may not be satisfying, but it is principled: Stratal affiliation of morphological material is under the assumption of Stratal OT and LMP, a diacritic and thus essentially arbitrary. In the case of Icelandic, very similar feature bundles are expressed either by phrasal or word-level material. This is really not novel in the LMP and Stratal OT œuvre, consider for example the case of German plural, for which Wiese (1996: 139) argues that most plural exponents belong to a non-final lexical level whereas the exponent /-s/ belongs to the final word level.

4.4.6 Complications

There are five data points that are potentially problematic for the analysis proposed above: Glide deletion is partially idiosyncratic; Syncope blurs the arguments for epenthesis and so do a small class of derived words that may end in Cr. or Cj.; Palatalisation does not apply before the supposedly word level affix -ɛnt but before the articles; and most importantly, I make predictions on the behaviour of the -r suffix in non-masculina, which are not met. I discuss each of them and argue that none of them are fatal for this proposal.

4.4.6.1 Unexpected overapplication of j-deletion

There are some stem-level affixes that unexpectedly do trigger glide deletion of /j/ in some cases, namely i-initial case/number affixes. Those are the dativ singular affix -ɪ (251a), the plural nominative and accusative of the i-declension (251b), namely -ɪ and -ɪr, as well as the -ɪ nominative of 'weak' masculina (251c). The first two suffixes are restricted to coöccur with the palatal glide, we do not find these endings after underlying /w/. The dative, -ɪ, is the most general, it always leads to an overapplication of glide-deletion.

(251) *Unexpected underapplication of j-deletion*

a. pɛrj-ɪ → pɛrɪ 'berry-DAT'
b. rɪvj-ɪr → rɪvɪr 'reef-PL'
c. scɪlj-ɪ → scɪlɪ 'separator-NOM'

The dative -i is in these cases restricted to neuters. Since the neuter plural nominative and accusative is zero, the dative is the only i-initial case/number affix available for these roots. For the i-plural, overapplication seems to depend on the specific roots. Of the 9 entries in Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] that have glide deletion and an i-plural, 5 have overapplication, (252a), 3 do not have overapplication, (252b) and 1 has optional overapplication, (252c).

(252) *Lexical idiosyncrasies of j-deletion*

a. rɪvj-ɪr → rɪvɪr 'reef-PL'
b. pɪlj-ɪr → pɪljɪr 'storm-PL'

c. hɪlj-ɪr → hɪljɪr ~ hɪlɪr 'deep place in a river-PL'

For velar final nouns, such as /vɛkːj/ 'wall', overapplication cannot be assessed, since both /kjɪ/ and /kɪ/ would ultimately be realized as [cɪ].

(253) *No idiosyncrasies after a velar*

a. vɛkːj-ʏr → vɛkːʏr 'wall-NOM'
b. vɛkːj-ɪr → vɛcːɪr 'wall-PL.NOM'
c. vɛkːj-ʏm → vɛcːʏm 'wall-PL.DAT'

The singular nominative -i of weak masculina has a similar pattern – it blocks j-deletion with some roots but not with others, see (254). Since all other affixes in the weak declension start with a back vowel, it is the only case where glide-deletion can possibly apply. Notably, the root here is bound, it must always coöccur with an affix.

(254) *Idiosyncratic underapplication of j-deletion with bound roots*

a. scɪlj-ɪ → scɪlɪ 'separator-NOM'
b. scɪlj-a → scɪlja 'separator-GEN'
c. nɪðj-ɪ → nɪðjɪ 'descendant-NOM'
d. nɪðj-a → nɪðja 'descendant-GEN'

There are no weak masculine nouns that show a Ci – Cva alternation, however, there are plenty that have a stem ending in Cv throughout. Orthography mostly distinguishes fricatives deriving from historic glides, <v>, from historic fricatives, <f>, so we can conclude that historically, /w/-deletion did not apply before nominative -i. Whether those former underlying /w/s have been reanalysed as /v/ is however impossible to tell, as they never alternate with Ø.

Glide deletion never overapplies before i-initial suffixes in the verbal domain. (255) shows a range of i-initial suffixes after /tʰɛlj/, I did not find a single verb which has a [j] before affixes that start with a back vowel but not in front of ɪ.

(255) *No overapplication of j-deletion with verbs*

a. tʰɛlj-ɪð → tʰɛljɪð 'count-PRS.IND.2PL'
b. tʰɛlj-ɪr → tʰɛljɪr 'count-PRS.SBJV.2SG'
c. tʰɛlj-ɪst → tʰɛljɪst 'count-PRS.SBJV.MID.3PL'

If we now take only the dative neuter -i and its behaviour, it would be tempting to say it counterbleeds glide deletion because it is a word-level suffix. For the processes discussed in the current work, this would not be a problem: It does not appear after vowels, so we cannot test for its behaviour with hiatus-resolution; as an unrounded vowel, it does not trigger U-Umlaut; and as a word-level suffix or stem-level suffix it would bleed epenthesis, which it does, so we could not use this to distinguish its affiliation. On the other hand, dative -i may trigger I-Umlaut (256), a rather idiosyncratic fronting process. Depending on the analysis, it might be opportune to keep all potential triggers of I-Umlaut in the stem-level.

(256) *I-Umlaut with dative -ɪ*

a. taɣ-ɪ → tɛɣɪ 'day-DAT'
b. kafl-ɪ → kaflɪ 'gabel-DAT'
c. trau^{h}t-ɪr → trai^{h}tɪr 'draw-NOM.PL'
d. tal-ɪr → talɪr 'dale-NOM.PL'

Such an analysis cannot work for the i-plurals and the i-nominative, since their failure to bleed glide-deletion depends on the root. In this sense, overapplication of j-deletion is a doubly morphologigally conditioned phonological alternation (Zimmermann to appear) similar to Umlaut in German or, as the data in (256) shows, i-Umlaut in Icelandic: Some affixes seem to be strong triggers (the dative -i) and induce it always, whereas others (the plural and nominative -i(r)) only work their effects with appropriate roots. There are several ways to model this see i.a. Sande (2020); Trommer (2021); Zimmermann (to appear). I will briefly sketch an analysis that is compatible with my general assumptions and the analysis of the Icelandic data.

Icelandic generally only allows for three vowels in completely unstressed positions, ɪ, ʏ, a. This characteristic has long been exploited for different behaviours of certain affixes, that cannot be reduced to stratal affiliation. Anderson (1969), e.g., assumes that umlauting ɪ derives from high vowels, whereas non-umlauting instances derive from /ɛ/ that is later neutralised with the high lax vowel. Such an idea can be used to differentiate between i-suffixes that obligatorily, optionally or never trigger j-deletion. I assume that suffixes with overapplication of j-deletion are underlying starting with a tense vowel /i/, whereas affixes that do not show j-deletion are underlyingly starting with the lax vowel /ɪ/. A constraint *ji[96] active on the stem-level induces the deletion of j preceding a tense vowel, neutralisation of unstressed tense and lax high vowels on the word-level is too late and counterbleeds j-deletion. Compare the derivation in (257): candidate a. concatenates the tense -i, which fatally violates the constraint against this sequence. candidate c. laxes the vowel, which violates a faithfulness constraint that is highly ranked at this stage (later, it will be demoted since the vowel will be lax at the surface). Candidate b., the winner, deletes the consonant.

[96] This constraint is not completely ad hoc: Monomorphemically, ji sequences are restricted to a few non-nativised loanwords such as jujitsu 'Jujitsu' and two names from the bible. jɪ on the other hand , while not being frequent, does occur in native vocabulary. Similar constraints have been proposed several times for other languages, for example for German (Hamann 2003)

(257) *Stem level: Overapplication of j-deletion with the dative*

	pɛrj-i	ID[−tense]	*ji	MAX-C
	a. pɛrji		*!	
☞	b. pɛri			*
	c. pɛrjɪ	*!		

This implementation gives us the affixes that obligatorily lead to an overapplication (dative) and the ones that necessarily block j-deletion (verbal affixes), but it does not derive the affixes that show root-specific behaviour. We can account for those under the assumptions that these specific roots contain a floating [+tense] feature that associates to an underlying lax affix vowel, tensening it and leading thus to the deletion of the /j/ in case the affix vowel is high. This is illustrated with the tableau in (258), where canidate a. is out because it deletes the floating feature, candidate b. is out because it creates a *ji* sequence, and the winner, c, again deletes the glide. At the word level, again, tense and lax unstressed vowels are neutralised.

(258) *Stem level: Overapplication of j-deletion with specific roots*

	rɪvj[+tense]-ɪr	MAX[+tense]	ID[−tense]	*ji	MAX-C
	a. rɪvjɪr	*!			
	b. rɪvjir		*	*!	
☞	c. rɪvir		*		*

This approach also captures nicely the general non-overapplication in the verbal domain: The root final /-j/ here is not actually a part of the root, but a stem forming suffix in the consonantal regular verb class. If it is a single morpheme with a single underlying representation, we do indeed expect a uniform behaviour, which is exactly what we get.

A question that this analysis unavoidably begets is, whether the analysis of glide deletion could be reduced to the underlying representation, getting rid of the stratal part of the analysis completely. I contend that this is not the case: The concatenation of the articles lead to an over-application not only of j-deletion, but also of w-deletion, for which an analysis with a *ji constraint is untenable.

In summary, the somewhat idiosyncratic over-application of j-deletion can be accounted for by a simple and motivated constraint *ji and two assumptions, somewhat abstract underlying representations and floating elements. I reckon that these assumptions are anyway necessary in a modular approach to phonology like the one I am proposing, compare among other Trommer (2011); Bermúdez-Otero (2012).

4.4.6.2 Syncope

Another complication for my proposal comes from syncope. Some bisyllabic noun and adjective roots of the shape C(C)V(C)CVR, where R is a coronal non-obstruent (l,n,r,ð), lose their second vowel (since this is a canonically unstressed position, one of the three vowels licit here: a,ɪ,ʏ) if combined with a vowel-initial suffix, see (259).

(259) *Syncope within nouns*

a. jœtʏn-ɪ → jœtnɪ 'giant-DAT'
b. jœkʏl-ɪ → jœklɪ 'glacier-DAT'
c. hœvʏð-ɪ → hœvðɪ 'head-DAT'
d. mɛɣɪn-ɪ → mɛknɪ 'main part-DAT'
e. cɪmpɪl-ɪ → cɪmplɪ 'male lamb-DAT'
f. kaman-ɪ → kamnɪ 'fun-DAT'
g. hʏmal-ɪ → hʏmlɪ 'hop-DAT'
h. hʏmar-ɪ → hʏmrɪ 'lobster-DAT'

Not only nouns, adjectives too can exhibit this pattern (260).

(260) *syncope within adjectives*

a. ɛðal-ʏm → ɛðlʏm 'noble-DAT.SING.M.STRNG'
b. sœɣʏl-ʏm → sœklʏm 'talkative-DAT.SING.M.STRNG'
c. vɛrkɪðɪn-ʏm → vɛrkɪðnʏm '?-DAT.SING.M.STRNG'

There are various reasons to not treat this unstable vowels as epenthetic: First, the quality of the vowel is arbitrary, it can be any of the vowels allowed in native unstressed syllables. Second, except for Cr (and *mn), the coda clusters prevented by the vowel are generally acceptable, compare (261).

(261) *Licit consonant clusters*

a. vatn 'water'
b. hœrkl 'Bump in a frozen but not snow covered road'
c. hnʏθl 'little knot'
d. lɛifθ 'permission'
e. œyθn 'Wasteland'
f. mɛkn 'main part'
g. k^hʏml 'pagan grave'

On the reverse, it is also not easy to claim that this is a general phonological process of syncope. There are two arguments against syncope as a process: First, not all root vowels in a second syllable preceding a coronal sonorant delete, if the sonorant re-syllabifies (262). And second, if the structure is created by affixing a sonorant-initial affix to a vowel-final stem, syncope never applies (263).

(262) *Syncope does not apply in all roots*

a. θœɣʏl-ʏm → θœɣʏlʏm 'quiet-DAT.SING.M.STRNG'
b. ʏnað-ɪ → ʏnaðɪ delight-DAT
c. prɛhkʏmɛɣɪn-ɪ → prɛhkʏmɛjɪnɪ Hangside-DAT

d. pɪkar-a → pɪkara beeker-ACC.PL
e. koural-ɪ → kouralɪ corall-DAT
f. θjouðan-ɪ → θjouðanɪ king-DAT
g. totlar-ʏm → totlʏrʏm dollar-GEN.PL

(263) *No syncope with inflection*

a. lɔva-ðɪ → lɔvaðɪ 'promise-PST'
b. ram-ar-ɪ → ramarɪ COMP-DAT.SING.M

Two words have additional stem changes besides syncope. In alɪn 'ell', the a diphthongises to [au] in the syncopated forms, and in litɪl 'little' the /i/ becomes lax in the syncopated forms.

(264) *Syncope + other stem changes*

a. alɪn-ar → aulnar ell-GEN
b. litɪl-a → lɪtla little-ACC.F.STRNG

Even though some sub-regularities can be found[97], they do not lend themselves for a purely phonological analysis. The morphosyntactic conditions predict syncope much better.

First, the vast majority of syncopating nouns is of masculine gender, only three are neuter (kaman, hœvʏð, sumar)[98] and four are feminine (alɪn, touhtɪr, mouðɪr, sɪstɪr)[99]. The somewhat opaque and probably unproductive affixes -ɪl (object nominaliser, (265b)) and -ʏl (originally diminutive, (265a)) do undergo syncope, whereas the less opaque derivational suffix -an (action nominaliser, (265c)) does not undergo syncope. One inflection affix, namely the past participle of strong verbs -ɪn, does undergo syncope (265d).

(265) *(No) Syncope with derivation*

a. jak-ʏl-ɪ → jœklɪ ice.floe-DIM-DAT 'glacier'
b. vɪnt-ɪl-ɪ → vɪntlɪ wind-NMLZ-DAT 'Cigar'
c. afpak-an-ɪr → afpakanɪr distort-NMLZ-PL 'distortions'
d. lɛk-ɪn-ɪr → lɛknɪr lie-PTCP-PL.M 'lied'

[97] All masculine strong nouns in -ir (n=5) and in -ɪn, -ʏn (n=8) undergo syncope; No neuter noun in -Vl undergoes syncope (n=7), whereas most masculine nouns in -Vl do undergo syncope, but not all. The same holds for masculine nouns in -ar. There only a few nouns in -an not derived by the feminine derivational suffix, two undergo syncope (kaman 'fun', aftatn 'afternoon' and two (rather obsolete ones) do not bjarkan 'b-rune' θjouðatn'king'). Other words in -an do not show syncope, but here the a is arguably stressed, as it umlauts to [œ] and not to [ʏ], eg. likan, likanɪ, likœnʏm 'model'. For adjectives, all adjectives in -ɪn have syncope, whereas most in -Vl do not have syncope with a few exceptions (sœɣʏtl 'talkative' and ɛðatl 'noble'; θœɣʏtl 'silent' and compounds with sœɣʏtl as a head undergo syncope optionally). The only element that has syncope before /ð/ is hœvʏð.

[98] meɣɪn also undergoes syncope *alone*, but not in composita. pʰɛntamɛtɛr 'pentametre' and hɛxsamɛtɛr 'hexametre' also undergo syncope, but at least the latter has the alternative pʰɛntamɛtʏr. Other forms which are loans from Greek -metr are not listed with syncope in Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection].

[99] All of those are very irregular

Now, if some mechanism for syncope is needed anyway, it might be tempting to assume that the oscillating 'ʏ' in words such as 'cɪmpʏr' belongs to the same category. However, the two groups of vowels are both phonologically and distributionally different. Distributionally, nouns in -Cʏr are very frequent and occur in all genders.[100] Most syncopating nouns on the other hand are masculine, many of them derived by the afore mentioned derivational suffixes. Phonologically, as already mentioned, clusters 'repaired' by the syncopating vowel are mostly not ungrammatical, whereas Cr. is. Also, the syncopating vowel interacts differently from the epenthetic vowels with respect to some processes. That cannot be shown with glide deletion or vowel hiatus, due to the position of the syncopating vowel, it is never vowel adjacent. No syncopating vowel is adjacent to a glide, but it is impossible to argue whether this is glide deletion or a lexical coincidence. However, we can make an argument from U-Umlaut: The syncopating -ʏl affix does trigger it (266a), whereas the epenthetic ʏ does not (266b).

(266) *Syncope counterbleeds u-umlaut*

a. jak-ʏl-r → jœkʏtl
   ice.floe-DIM-NOM
   'glacier'

b. taɣ-r → taɣ-ʏr
   day-NOM
   'day'

Another fundamental difference is that the syncopating vowel is not bled by the addition of clitica, not even in the feminine and neuter (267).

(267) *Resyllabifcation with clitica counterbleeds syncope*

a. hœvʏð-ɪð → hœvʏðɪð
   head-DEF.N.NOM/ACC
   'the head'

b. sʏmar-ɪð → sʏmarɪð
   summer-DEF.N.NOM/ACC
   'the summer'

c. alɪn-ɪn → alɪnɪn
   ell-DEF.F.NOM
   'the ell'

[100] Kiparsky (1984) assume that all the masculina in ʏr are syncopating, whereas the non-masculina are underlyinly /Cr/ and employ epenthesis. For this, he assumes that the SCC blocks U-Umlaut if the ʏ is part of the root, but not if it is part of the derivational affix. This reduces the very clear cut difference between overapplication of epenthesis in the masculina vs. no overapplication in the other genders to a lexical accident. Also, it makes wrong predictions for *cimpʏr*: If very semantically opaque affixes can be analysed as such synchronically, than *cɪmpʏr* and *cɪmpɪtl*, female and male lamb respectively, should be derived from the same root *cɪmp*. In that case, the epenthetic ʏ should be inserted at the stem level in *cimpʏr*, and thus not be bled by the article.

I propose therefore that the syncopating vowel is present underlyingly, and is differentiated from non-syncopating vowels by virtue of being mora-less. At the stem-level, a mora is inserted if this avoids clusters — as we have seen, a full vowel is never inserted to avoid clusters at the stem-level, otherwise, the vowel is deleted. The fact that a syncopating ʏ still manages to Umlaut, even if it is deleted, is problematic for a parallel approach, but not fatal, see McCarthy (2007b) for a parallel account of a similar counterbleeding configuration.

4.4.6.3 De-verbal nouns

A certain class of de-verbal nouns allows otherwise illicit consonant clusters, namely Cr.[101] and Cj.[102] This class has been used as an argument that epenthesis and glide deletion are not phonological processes (Orešnik 1978; Hansson 2019).[103] Kiparsky (1985) argues that the formation of these forms, which is derived by subtracting a root final -a from certain verbs, takes place at the word-level. This analysis is of course incompatible with my approach, as I put epenthesis at the word-level. However, there are some peculiarities about those forms: Epenthesis is optionally possible, so for a form flœɣr there is also a form flœɣʏr. According to Þráinsson (2017), the forms with epenthesis are preferred. If the form with the cluster is chosen, the final part of the cluster is always voiceless (Þráinsson 2017). The difference in voice for sonorants is phonemic in Icelandic, but neutralised in most positions except word initially (Árnason 2011), see (268) for minimal pairs.

(268) *Phonemic voiceless sonorants*

a. joul 'Christmas'
b. j̥oul 'wheel'
c. rutʏr 'bus.PL'
d. r̥utʏr 'ram'

This phonemic difference can be taken advantage of for my analysis: If we suppose that the subtractive morphology not only subtracts the root final -a but also devoices preceding sonorants, the devoiced Cr. and Cj. clusters will be exempt from deletion

[101] In Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection], there are 8 nominalisations that result in a Cr. cluster; pœɣr, flœɣr, amr, klamr,k^{h}ʏmr, sivr, k^{h}lɪvr, p^{h}ɛðr. For all of them, Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] notes that they are predominantly used in the dative (where it would be indistinguishable from the regular form with epenthesis) or with an article, that is, when the cluster is able to resyllabify.

[102] There are only two instances of Cj. nominalisations, 'ɛmj' and 'krɛnj' in Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection]. For both, Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] notes that they are mostly used with the article, so that the cluster does not surface. However, Hansson (2019) argues that the formation of these nouns is productive.

[103] The proposed alternative to glide deletion as a process is to assume that the respective nouns, adjectives and verbs belong to separate classes in which the glide is part of the selected affix, for an implementation see Orešnik (1978). Such accounts have at least difficulties with the verbal theme -j-, which needs a Ø allomorph for the cases in which glide deletion would apply, which are phonologically motivated and not morphologically.

and epenthesis at the word-level. For this, the constraint *Cr. has to be redefined as *C[+rhotic, +voice] and *Cj. accordingly as *C[+approx,+voice]. In case a speaker has contextual neutralisation of voiced and voiceless sonorants at the word-level, those forms will undergo epenthesis. If neutralisation is restricted to the phrase level, these forms can escape it.

4.4.6.4 Palatalisation

Velar palatalisation and its challenging underapplication with the agent nominalisation -ant / -ɛnt has been a long discussed topic (i.a. Orešnik 1977a, 1980; Ingason & Sigurðsson 2015; Ingason 2016). Most recently, Felice (2022) has argued these data to posit a problem for the stratal account in Kiparsky (1985). By extension, this problem should also exist for my proposal. The argument is the following: -ɛnt does not cause palatalisation, whereas later affixes such as the clitica do. I will contend that this relies on both specific analysis of palatalisation as a single process, and the adoption of the strict domain hypothesis, a mechanism of LMP that is a) a stipulation, and b) cannot be transferred to Stratal OT. Felice is aware of the reliance of her arguments on the strict domain hypothesis, but does not question her analysis of palatalisation as a single process. If palatalisation is split into two, the problem evaporates: palatalisation triggered by the high vowels i, ɪ is active at the word-level, the stem-level and the phrase-level (inside phonological words), whereas palatalisation triggered by ɛ is only active at the stem-level. This is not just a stipulation, since ɛ- and i-palatalisation do have indeed different properties: i-palatalisation is fully general within morphemes and is triggered by all i-initial affixes. It is blocked across word boundaries. E-palatalisation mostly applies morpheme-internal, but there are exceptions,such as tɪskɛʰta 'floppy disk' (Ingason & Sigurðsson 2015), ɔrɣɛl 'organ' or frœkɛn 'waitress' (Orešnik 1977a). E-initial suffixes are rare, since ɛ is in general restricted to stressed positions. Next to the plural of the agent nominalisation, there is another nominalisation -ɛlsɪ. -ɛlsɪ triggers palatalisation with some roots (269) (Ingason & Sigurðsson 2015), but not with others, (270) (Orešnik 1977a).

(269) *Palatalisation with -ɛlsɪ*
fauŋk-ɛlsɪ → fauɲcɛlsɪ
catch-NMLZ
'prison'

(270) *No palatalisation with -ɛlsɪ*
paʰk-ɛlsɪ → paʰkɛlsɪ
bake-NMLZ
'baked good'

There is an implicational hierarchy of palatalisation triggers: If it is triggered by non-high vowels then it is also triggered by high vowels, but not the reverse, compare

Chen (1973); Bateman (2007); Kochetov (2011). Splitting palatalisation into two different processes at the stem and word-level is compatible with this typological picture: At the stem-level, palatalisation is general and is triggered by any non-round front vowel, at the word-level it is restricted and only triggered by high vowels. Orešnik (1977a) goes a step further and claims that palatalisation before -ɛ is not a phonological process at all, and root internal alternations such as kav~cev 'gave'~'give' are a 'consonantal ablaut' outside phonology.

For this analysis to work, it is necessary to assume that at least the plural *-ɛnt* is a word-level suffix. (Ingason & Sigurðsson 2015; Ingason 2016) claim that such an analysis is arbitrary, because it would 'make -end the only potentially palatalising affix that is a level 2 suffix'. However, this is not the case: plenty of level two suffixes are palatalising and do indeed palatalize, however, they are not ɛ-initial. Also, the only other e-initial affix is *-ɛlsɪ*, and it too is not a reliable palataliser.[104]

At first glance, there remains a problem for both the stratal and the phase based approach: *-ɛnt* bleeds glide-deletion: The stem-forming /-j/ always appears in front of this suffix. This is unexpected for a level 2 affix in my account, but also unexplainable (and unexplained) by Ingason (2016) and Felice (2022).

(271) *ɛnt bleeds glide-deletion*
t^hɛlj-ɛnt-ʏr → t^hɛljɛntʏr
count-NMLZ.PL-NOM.PL
'counter'

I propose that *-ɛnt* attaches to the infinitive and not to the verb root, e.g. /*t^hɛlja-ɛnt-ʏr*/. The infinitive a- is then deleted. This is compatible with my approach, even though generally the second vowel is deleted at the word-level: Unlike all other vowel initial suffixes, *ent* is (secondarily) stressed. This secondarily stressed vowel is retained in favour over the infinitive -a.

My approach does not assume the strict domain hypothesis nor can it generate it. However, I would like to mention that with this splitting of palatalisation into two processes, the strong domain hypothesis is actually maintained: E-palatalisation is switched of after the stem-level, whereas i-palatalisation is not. This means that the data that Felice assumes to be problematic for Stratal accounts is in fact not problematic even for traditional LMP.

4.4.6.5 Feminina with -ʏr nominative

Last but not least, my proposal makes predictions: feminina or neutra that take an ʏr-suffix in the nominative should have the same pattern as the underlying Cr nouns.

[104] *ɛlsɪ* is in its semantics rather arbitrary: It can mean any sort of nominalisation, the result of an action (*bakkelsi*), the place of an action (*fangelsi*) or the instrument of an action (*reykelsi*). According to I and F then, the affix should attach to the root and always trigger palatalisation, but this is not the case. In a framework where an affix is arbitrarily assigned a level, some instances of *-ɛlsɪ* can be word and some stem-level, deriving the pattern.

There is indeed a very small class of feminina that take such an affix.[105] Crucially, they do not pattern like underlying feminine /Cr/ roots, but like the masculina, see (272c).

(272) *Feminina with -ʏr nominative*

a. pruðʏr 'bride-NOM'
b. pruðɪ 'bride-ACC/DAT'
c. pruðʏrɪn 'bride-NOM-DEF.F.NOM.SG'

It is of course possible that the vowel portion of this affix is not epenthetic, but underlying, just as the -ʏr that marks nominative plural in (mostly weak) feminina. An underlying vowel should behave differently with hiatus resolution, gliding and u-umlaut. Unfortunately, none of these tests is fully conclusive. For U-Umlaut, we need to find either a word that shows an [a] throughout, or an [a]-[œ] change in the root. Neither type of noun exists.

Hiatus resolution can be tested on vowel final feminine nouns that take this nominative. Four such nouns do exist, all of them are monosyllabic and end in a stressed vowel. With these nouns, the [r] attaches directly to the root without the vowel.

(273) *No ʏ after a stressed vowel*

a. c^{h}ir 'cow-NOM'
b. sir 'sow-NOM'
c. air 'ewe-NOM'
d. mair 'mother-NOM'

All of them are highly irregular and involve some stem changes. They also belong to the group of vowel final roots that show deletion of affix vowels throughout with the exception of the genitive plural. The paradigm for air is given in (274).

(274) *Paradigm of 'ewe'*

	Singular	Plural
Nom	air	air
Acc	au	air
Dat	au	aum
Gen	air	aua

[105]There are 18 feminine roots that have a nominative in -ʏr. 6 of them have a somewhat mythological meaning (vjɛ^{h}tʏr 'hidden being', vai^{h}tʏr 'hidden being', œyðʏr 'witch', riɣʏr 'troll woman', ciɣʏr 'troll woman', kriðʏr 'troll woman'), the remaining contain many poetic and archaic words (Marked as *skáldamál* 'poetic', *gamalt* 'old' or *úrelt* 'obsolete' in Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection] or any of the dictionaries: hɪltʏr 'battle', kʏðʏr 'battle', kʏnnʏr 'battle' fɪtlʏr 'sea', fɛstʏr*, ʏnnʏr 'wave', reiðʏr 'trout', ɪlkʏr 'she-wolf', veiðʏr 'catch', ɛlvʏr 'big river'). This leaves , flaiðʏr 'flood' (most likely obsolete too), heiðʏr 'Cyananthus', pruðʏr 'bride', aiðʏr 'eider' and nœyðʏr 'necessity'.

Keep in mind that for strong feminina the genitive singular is normally -ar. The plural in the casus rectus with -ar or -ir, and the dative plural in any inflection class with -YM. In the feminine nouns that have an r-nominative, the dative and accusative singular is formed with -I, see (272). The absence of the [Y] in the nominative is thus not necessarily a consequence of it being epenthetic, but it can also be just as well an effect of the affix-vowel deletion triggered by these particular roots.

Regarding U-Umlaut and Hiatus-resolution thus it is impossible to judge whether the Y is underlying or not. However, there are two roots that end in a glide /j/. Both of them show glide deletion in front of the nominative affix, as is expected with an epenthetic vowel, see (275).

(275) *Nominative counterbleeds j-deletion*

a. ciɣYr 'troll woman-NOM'
b. riɣYr 'troll woman-NOM'
c. cijYm 'troll woman-DAT.PL'
d. rijYm 'troll woman-DAT.PL'

Both of those words mean 'troll woman' or 'ogress', are homophonous with masculine nouns[106] and are somewhat poetic and obsolete. I contend therefore that those forms are exceptional and fully lexicalised and do not pose a serious problem for the analysis. The small class of feminina in Yr can be analysed with an underlying Y in the affix.

4.4.7 Summary

In Icelandic, affixation of the articles bleeds epenthesis to break up Cr clusters, except if the article is masculine, in which case affixation counterbleeds epenthesis. With PaC, this peculiar pattern can be derived: The masculine article is phrasal, whereas the other articles attach earlier. The prosodic structure is necessary to derive the fact that the masculine article does not behave like an independent word, but like an affix for certain properties, like vowel deletion and palatalisation.

[106] In the case of the masculine ciɣYr, it has the same meaning of 'troll woman', in the case of riɣYr it has a different meaning.

4.5 Chamorro: A Case of Countercyclic Opacity

Chung's 1983 paper on the interaction of stress with several segmental processes in Chamorro was a notable early proposal of a framework that contains explicit anticyclic components in the form of transderivational rules. Her work though does not imply a total abandonment of cyclicity, she relies on both cyclic and anticyclic mechanics. Since then, aspects of the Chamorro patterns described by Chung have been reanalysed multiple times (Halle & Vergnaud 1987; Crosswhite 1998; Klein 2000; Kaplan 2008, 2011a). Halle & Vergnaud (1987) reanalyse these patterns without transderivational rules, however they crucially rely on the countercyclic rule of 'Stress Copy', which can reconstruct previously deleted stresses, as well as on the Strict Cycle Condition. Crosswhite (1998) takes the opposite approach and reanalyses the data without seriality but with transderivational constraints, namely Output-Output Correspondence.[107] Klein (2000) proposes a fully parallel analysis without intermediate representations or transderivational constraints, whereas Kaplan (2008) has a cyclic approach in Stratal OT, which is the most similar to the one proposed here. The latter two make crucial reference to morphological information. The approaches in OT have in common that they tend to analyse not the entire data, Crosswhite (1998) and Kaplan (2008) do e.g. not account for the distribution of stress, and Klein (2000) analyses stress only partially, omitting the competition between prefix- and suffix-induced stress patterns. It is not trivial to extend the respective analyses to the segments of the data that they do not discuss. My aim for this section is thus the following: I propose a cyclic analysis that does not employ any transderivational mechanism and derives both the distribution of stress as well as its interaction with cyclic processes.

This section is structured as follows: I will first lay out the core countercyclic puzzle, the interaction of phrasal umlaut with lexical stress. After that, in section 4.5.2, I sketch out the reanalysis in a nutshell. After that, I go through each of the core processes, presenting first the data before giving an analysis. In section 4.5.3, the distribution of stress is discussed, some stress processes are analysed as occurring at the stem and others at the phrase level. Though Chamorro has been a famous argument for *cyclic* stress, the basic accentuation principle is analysed non-cyclically here. After that, I discuss another relevant process that belong to the stem level, namely gemination in section 4.5.4. Thereafter, in section 4.5.5, we finally turn to umlaut, which is analysed as a word level process. After that, I discuss two processes whose order with respect to each other and the other processes is relevant in order to argue for the stratal architecture of Chamorro that I am proposing, namely degemination in section 4.5.6 and vowel height adjustment in 4.5.7.

The data that I use is mostly from Chung (1983) and Chung (2020), abbreviated in

[107] Klein (2000: 100) points out that Crosswhite's (1996) analysis (which is not available to me) cannot derive all instances of umlaut, because there are not always adequate bases available. Crosswhite (1998), which analyses lowering, to my judgement, does not suffer from the same problem.

the examples as SC83 and SC20 respectively, and occasionally other sources, namely Topping & Dungca (1973) and Stolz (2012).

4.5.1 The puzzle

According to Chung (1983), Chamorro has two processes — vowel lowering and umlaut, that apply obligatorily if their conditions, principally main stress, are met on the surface, but optionally if their conditions are met in a cyclically contained form.

Chamorro stress deletion – a stress is deleted if its syllable is left-adjacent to the main stressed syllable – is arguably word based[108] but counterbleeds optional phrasal Umlaut (276d)[109] – a stressed vowel fronts if it is right-adjacent to a set of function words with front vowels (276a-b). At the same time, some instances of secondary word stress (namely, stress that does not derive from underlying stress) counterfeeds phrasal umlaut, see (276c).

(276) *Obligatory, optional and impossible umlaut*

a. /i gúmaʔ/→i gímaʔ
'the house' (SC83:45)

b. /i gúmaʔ-níha/→i gìmaʔníha ~ i gùmaʔníha
'our house' (SC83:45)

c. i pulónnun-ɲa→i pùlulónɲa
'his trigger fish' (SC83:46)

Without the prosodic word, both stress manipulating processes — stress deletion and secondary stress assignment — must be lexical in order to correctly identify the domain in which they apply. The assignment of the umlauting functional affixes to the phrase level is more arbitrary, the arguments for this are mostly syntactic in nature: Elements such as the definite article /i/ precede the entire noun phrase not just the head noun, compare (277).

(277) *The umlaut trigger is phrasal*

a. i manámkuʔ na istudiánti
the old.AGR EZ student
'the mature students' (SC20:159)

b. i mɑs dáŋkulu na sóŋsuŋ
the most big EZ village

[108] In order to truly verify this claim, a $\grave{\sigma}]_\omega[\acute{\sigma}$ sequence must be shown to conserve its secondary stress. Such a situation is constructible, but not considered in any of the sources available to me. Nonetheless, I will assume that destressing is word bound.

[109] Note on transcription: Main stress is marked with acute accent on vowels, secondary stress with grave accent. Chamorro distinguishes two low vowels, a front vowel <a> and a back vowel <å>. Phonetic transcriptions vary greatly in how they render this difference. I follow Chung (2020) and transcribe them as [a] and [ɑ] respectively. The affricates <c> and <y> vary in their realisation, depending on context, between alveolar and palatal. I will transcribe them as [ts] and [dz] throughout. Geminates are indicated by consonant doubling.

'the biggest village' (SC20:159)

A cyclic anaylsis without prosody could work, if umlaut was a stem level process, followed by the word-level stress processes. However, there are phonological arguments for not assigning it to the stem level: There is a second process of stress-blind umlaut triggered by prefixes and infixes (Klein 2000), which is different from the anticyclic umlaut that has been the focus of most theoretical works on Chamorro umlaut.

In a Stratal OT framework, however, just shifting the functional morphemes to the word level does not suffice: The interaction of destressing and secondary stress are still opaque and cannot be derived on the same stratum. This is less of a problem for rule-based approaches, where intrastatal opacity can be derived. However, this would necessitate stress rules to follow segmental rules on a given stratum, an ordering that is otherwise not found, compare Rusyanova & Rasin (2023).

4.5.2 Reanalysis

The cyclic reanalysis of Chamorro relies on two assumptions, namely that the umlauting affixes and their morphophonological effect are earlier then expected – word level instead of phrase level, and that rhythmic secondary stress and stress deletion are phrase-level processes that are sensitive two the phonological word, which is roughly equal to the stem-level morphology. The basic stress pattern is established at the stem level and is itself not cyclic.

As mentioned in passim before, the proposed analysis of Chamorro is an instantiation of the '3-level-language', see discussion in chapter 3.4.2. This is the one opaque pattern that PaC can generate.[110] It abstractly works by establishing a stem-level sized prosodic structure at the stem level, applying some word-level process at the word level, and having a phrasal process, which is restricted to the stem-level sized domain, counterfeed or counterbleed the word level process. This is illustrated for counterfeeding of umlaut by phrasal stress in Chamorro in (278). This is not the only opaque interaction with umlaut, another phrasal process of destressing counterbleeds (optional) umlaut.

[110] Next to the limited instances of self destructive feeding and counterfeeding on focus.

(278) *Schema of cyclic analysis*

Stem level	
pulúnnun-ɲa	Input
[pulónnunɲa]$_\omega$	Prosodic word is built
[pulùnnúnɲa]$_\omega$	Stress shift

Word level	
i [pulùnnúnɲa]$_\omega$	Input
—	Stress sensitive umlaut
i [pulùlónɲa]$_\omega$	Degemination
i [pulùlónɲa]$_\omega$	Vowel lowering

Phrase level	
i [pulùlónɲa]$_\omega$	Input
i [pululónɲa]$_\omega$	Destressing (ω bound)
i [pùlulónɲa]$_\omega$	Stress insertion (ω bound)

Before we come to the data and analyses in detail, I will introduce some vocabulary to adequately discuss Chamorro stress with respect to its interaction with other processes. Syllables in a given Chamorro word can have different 'stress-status' that correlate with their participation in several processes, one of which is umlaut. The others are gemination, degemination and vowel height adjustment. The table in (279) gives an overview over the interaction.

(279) *Stress type and segmental processes*

	PS	MSS	DSS	RSS	ØS
Umlaut	yes	opt	opt	no	no
Gemination	yes	no	no	no	no
De-Gemination	no	no	yes	?	?
Lowering	Yes	yes	opt	opt	no

Primary stressed (PS) syllables are carriers of the main stress in the word on the surface. Morphologically secondarily stressed syllables (MSS) is asyllable that has a secondary stress on the surface that is related to a primary stress of a hypothetically contained word form. Destressed syllables (DSS) that are not stressed at all in the output, but related to a primary stress in a cyclically contained form. Rhythmic secondarily stressed syllables (RSS) carry a secondary stress that is assigned by a phonological process, it is crucially not related to a primary stress in a contained form. Zero stress, at last, is a syllable that is not eligible for any stress, either in the output or in a cyclically contained form. This characterisation is not a statement over the representations, it serves alone the purpose to facilitate the discussion of the patterns.

In the following, I will go through the relevant processes and develop the analysis continuously. In the next section, we will discuss the basic stress distribution in

Chamorro, in the terms introduced above, the loci of PS, MSS and DSS, which will be located at the stem level. After that I analyse stress insertion, the process that creates RSS, and stress deletion, the two processes that crucially counterfeed and counterbleed umlaut which I assign to the phrase level. In section 4.5.4, we turn to gemination, a rather unique process that also interacts with stress: Like umlaut it is counterfed by phrasal stress insertion, and counterbled by phrasal stress deletion. Thereafter, in section 4.5.5 we turn to umlaut, analysed here as a word-level process triggered by a word-level prefix. This is followed by the discussion of two further relevant processes that interact with stress, degemination in section 4.5.6 and vowel height adjustment, which raises and lowers vowels according to their stress status, in section 4.5.7.

4.5.3 Stress

4.5.3.1 Data and generalisations

Monomorphemic words in Chamorro have lexical stress, obeying a 3 syllable window to the right. The majority of words has stress in the penult position (280a-b) stress in the antepenult exists in native words (280c) and loans (280d), whereas final stress in plurisyllabic words is restricted to (otherwise nativised) loans (280e-f).

(280) *Underlying stresses*

a.	maléffa 'forget'	(SC83:43)
b.	mantíka 'fat'	(SC83:40)
c.	mámati 'reef'	(SC83:38)
d.	píkaru 'sly'	(SC83:38)
e.	kurasón 'heart'	(SC20:661)
f.	sjudá 'city'	(SC83:38)

Chamorro has a vast array of prefixes, infixes and suffixes. Infixes and many prefixes do not change the underlying stress, consider the data in (281) for prefixes and (282) for infixes. The position of the root stress does not play a role, compare e.d. (281a-c) for antepenult stress, (281d-e) for penult and (281f-g) for final stress.

(281) *Stress non-changing prefixes*

a.	kádada 'short'	(SC83:40)
b.	naʔkádada 'shorten'	(SC83:40)
c.	manaʔkádada 'to be shortened'	(SC83:40)
d.	insaláda 'salad'	(SC20:627)
e.	faʔinsaláda 'make into salad'	(SC20:627)
f.	atrasáw 'be late'	(SC20:662)
g.	manatrasáw 'be late.REAL.PL'	(SC20:662)

(282) *Stress non-changing infixes*

a. sapátus 'shoe' (SC20:630)

b. sinapátus 'wear shoes' (SC20:630)

c. dáŋkulu 'big' (SC20:662)

d. dumáŋkulu 'become big.REAL.SG/DL' (SC20:662)

Some prefixes are inherently stressed. If they are concatenated, main stress is on the prefix, the root stress gets demoted to secondary stress. This is shown with the prefixes *á-* and *mí-* in (283), but it is true for many other prefixes.

(283) *Stress attracting prefixes*

a. mímantìka
mí-mantíka
PRFX-fat
'abounding in fat' (SC83:40)

b. ádìŋu
á-díŋu
RECP-leave
'to leave one another' (SC83:40)

Suffixes shift the main stress towards the penult. Given that penult stress is the default in Chamorro, cf. Klein (2000), one could say that lexical stress patterns here are overwritten with the default. The penult is either part of the suffix itself, if it has two syllables, or the last stem syllable, if the suffix is monosyllabic. The underlying stress, again, is demoted to secondary stress.

(284) *Prestressing suffixes*

a. [dàŋkulóɲɲa]
/dáŋkulu-ɲa/
big-CMP
'bigger' (SC83:39)

b. [òttimóɲɲa]
/óttimu-ɲa/
end-3SG
'end' 'her end' (SC83:48)

(285) *Stress attracting suffixes*

a. [inèŋŋuluʔníha]
inéŋŋuluʔ-niha
peeping-3PL
'their peeping' (SC83:39)

b. [gùmaʔníha]
/gúmaʔ-niha/

house-3PL
'their house' (SC83:47)

If the underlying stress ends up in the new antepenult, so that it is directly adjacent to the new primary stress, it is deleted instead of demoted, see (286).

(286) *Stress deletion*

a. [nanáhu]
/nána-hu/
mother-1SG
'my mother' (SC83:39)

b. [bapotníha]
/bapót-niha/
'their ship' (SC83:39)

Chung (1983) argues that if a word has multiple affixes, it is always the cyclically outermore that determines stress. If we have two strong prefixes, it is the leftmost that is stressed (287), for two suffixes, the reverse holds (288); the primary stress is determined by the rightmost suffix.

(287) *Between two strong prefixes, the leftmost wins*
man-á-naʔ-á-tsátgi → manánaʔàtsàtgi
AGR-REC-CAUS-REC-laugh
'they made each other laugh at each other' (Topping & Dungca 1973)

(288) *Between two suffixes, the rightmost wins*
⟨in⟩tátti-dzi-ɲa→tinattidzíɲa
'follow.INFL' (SC20:688)

If we look at prefixes and suffixes together, the situation is more complex. Prefixes win against the verbaliser/applicative suffix, see (289), but lose against agreement suffixes and the comparative *-ɲa*,[111] see (290).

(289) *Prefix wins over suffix*

a. kwéntus 'to speak (SC83:41)
b. kwentúsi 'to speak to' (SC83:41)
c. **á**kwentùsi 'to peak to another' (SC83:41)

(290) *Suffix wins over prefix*

a. mantíka 'fat' (SC83:40)
b. mímantìka 'abounding in fat' (SC83:40)
c. mìmantik**á**ɲa 'more abounding in fat' (SC83:41)

[111] This lists exhausts the suffixes that are discussed by Chung (1983). There are a few more in Chung (2020) whose behaviour regarding stress is not given. Most though seem to be only marginally productive. The analysis I propose makes no prediction on their behaviour.

However, Chung (1983) does not provide data that shows unambiguously that the cyclic ordering must be the decisive factor. Such hypothetical data would involve scope reversal: Let us assume we have a prefix A, a root, and a suffix B; and the prefix can scope over the root and B; or the suffix can scope over the root and A. It is very well possible that Chamorro syntax cannot generate such data. If there was such a construction, Chung's (1983) analysis predicts that the two A-root-B sequences have a different stress pattern depending on scope, whereas the analysis that I propose below makes the prediction that both constructions receive the same stress. Given the available data, the cyclic analysis of stress is only one possibility.

Not all secondary stresses derive from primary stresses via demotion. Some must be inserted by a phonological process, in word forms that have enough space. The data and description in Chung (1983) and the interpretation of it in Crosswhite (1998) is somewhat inconclusive on the exact nature of this process. In a word form where the main stress is on the third syllable from the left, the first syllable gets secondary stress, see (291). This applies in morphologically simple words as well as in derived word forms.

(291) *Secondary stress with two unstressed syllables*

a.	bìlimbínis 'star fruit'	(SC20:663)
b.	kìmasón 'to burn'	(SC83:43)
c.	màgagúɲa 'his clothes' cf. magágu	(SC83:43)
d.	bàpotníha 'their ship' cf. bapót	(SC83:43)
e.	mànaʔádada 'to be shortened' cf. kádada	(SC83:43)

If there are more syllables between the leftmost stress and and the left edge, two patterns are found: Either, trochees are built from right to left (292a), or the first syllable is stressed regardless of distance, see (292b).

(292) *Secondary stress with three unstressed syllables*

a.	eŋkìsifwési 'no matter'	(SC83:663)
b.	pùtamunéda 'wallet	(SC83:45)

Chung (1983) bases her analysis on the first pattern, and assumes a trochee-assigning rule. However, the form in (292b) is the only one that Chung offers for this pattern, without discussing its divergence explicitly. Crosswhite (1998) on the other hand takes it as the base case, and devices a constraint that demands the initial syllable to be stressed, outranked by a constraint against clashes. In Chung (1983) and Crosswhite (1998), syllables that follow the last stress are not mentioned, and they are not targeted by the secondary stress assigning rules or constraints. In Chung (2020) however, she offers data that at least some post-tonic syllables may receive secondary stress, again in an alternating pattern, see (293).

(293) *Posttonic secondary stress*
á?pakà? 'white' (SC20:663)

I base my analysis on the assumption that the pattern in (292a) is the regular pattern, and pùtamunéda an exception. The question how this exception is to be derived will not be delved into. This assumption is not a core component of the analysis. If the initial stress pattern turns out to be general, the analysis can be easily adapted. Also, whether rhythmic secondary stress is purely pretonic, or posttonic as well, is irrelevant for the interactions discussed here and does not bear on the analysis.

4.5.3.2 Analysis

This section shows that it is possible to derive the stress pattern without recurring to cyclicity. The entire stress system with the exception of the rhythmic secondary stress and destressing is derived at the stem level. In order to make this work, I assume that all roots in Chamorro have one (and at most one) foot. Feet come in two fashions: regular feet, and strong feet. A strong foot is the locus of primary stress, and due to CULMINATIVITY (294) there must be one and no more than one in a given word. Regular feet are interpreted as secondarily stressed.

(294) CULMINATIVITY
Count a violation for every word that does not have a head foot or more than one head foot.

Feet in Chamorro are always trochaic, so there must be a high ranked constraint TROCHEE that enforces this. This constraint and candidates that violate it will be omitted from the analysis.

In the entire stem level, there is no deletion of feet nor is there insertion, MAX-FT and DEP-FT are thus highly ranked. Candidates that violate these constraints are omitted, as well.

Furthermore, I assume that the default stress pattern in Chamorro is a final trochee, yielding penult stress; even if there is underlying stress for every root. The constraints that derive this default stress, FOOT-BIN and HDFT-RIGHT must be outranked by some faithfulness constraint that preserve final and antepenult stress. This can be achieved by the constraint in (295), which penalises an input head-syllable that is demoted to a regular syllable.

(295) ID-HDσ
Count a violation for every head syllable in the input that is not a head syllable in the output.

The tableaux in (296) and (297) show how these faithfulness constraints prevent the default stress patterns if another stress is specified. (296) shows this for an underlying antepenult stress, and (297) for final stress.

(296) *Promotion of underlying foot*

		(etti)$_{Ft}$gu	CULM	ID-HDσ	ID-FT	FT-RIGHT
	a.	(etti)$_{Ft}$gu	*!			*
	b.	et(tigu)$_{Ft}$	*!	*		
☞	c.	(etti)$_{HdFt}$gu			*	*
	d.	et(tigu)$_{HdFt}$		*!	*	

(297) *Promotion of underlying non-binary foot*

		kura(son)$_{Ft}$	CULM	ID-HDσ	ID-FT	FT-BIN
	a.	kura(son)$_{Ft}$	*!			*
	b.	ku(rason)$_{Ft}$	*!	*		
☞	c.	kura(son)$_{HdFt}$			*	*
	d.	ku(rason)$_{HdFt}$		*!	*	

The faithful candidate, a. in both tableaux, is suboptimal in both derivations because it violates CULMINATIVITY since there is no head foot in the output. Candidates b. have the unmarked stress distribution, but still violate CULMINATIVITY. Candidates c. and d. do not violate CULMINATIVITY as they have converted the underlying foot into a head foot. This violates the lower ranked constraint ID-FOOT defined in (298).

(298) ID-FT
Count a violation for every foot in the input that is a head foot in the output and vice versa.

Candidates d., even if they have the default stress pattern, violate the faithfulness to head syllables. Therefore, the almost faithful candidates c. win.

These constraints derive the rather uneventful stem level for monomorphemic inputs, as well as for infixes and prefixes that come along without foot structure of their own: Underlying feet are conserved but promoted to head-feet in order to satisfy CULMINATIVITY.

Now, let us turn to the affixes that influence the stress pattern: strong prefixes and all suffixes. We will start with the latter. I assume that there are two types of suffixes, weak suffixes which carry a foot, and strong suffixes that carry a head foot. Both give the same result, if combined only with a root without any prefixes: Stress shifts to the penult, which might be part of the suffix or of the stem. We will look at the weak suffixes first. The only weak suffix discussed in detail by Chung is the applicative/verbaliser with its allomorphs-*i* and *-dzi*, but there are arguably more, compare Chung (2020). The representation of the postconsonantal allomorph of the applicative is given in (299).

(299) Ft
i

The allomorph consists of the vowel /i/ on the segmental tier, and a foot, which are not associated. Linearly, I will represent this as $()_{\text{Ft}}$i to save space.

The tableau in (301) shows the derivation of the penult stress in context of this affix. The two stresses compete for the main stress, which must be assigned due to CULMINATIVITY. Both feet are underlyingly regular feed, so assigning the head foot status to either does not incur a different profile of violations of faithfulness constraints. The arbitrating constraint is the one in (300), which prefers headfeet to be to the right.

(300) HEAD-FOOT RIGHT
Count a violation if there is at least one foot in between a head-foot and the right edge of the word.

Therefore, candidate c. which promotes the foot of the suffix is preferred over candidate b which promotes the root foot.

(301) *Competion of two equal feet*

		$(\text{kwentus})_{\text{Ft}}()_{\text{Ft}}$i	CULM	ID-FT	HDFT-RIGHT
	a.	$(\text{kwen})_{\text{Ft}}(\text{tusi})_{\text{Ft}}$	*!		
	b.	$(\text{kwen})_{\text{HdFt}}(\text{tusi})_{\text{Ft}}$		*	*!
☞	c.	$(\text{kwen})_{\text{Ft}}(\text{tusi})_{\text{HdFt}}$		*	

The tableau in (301) shows only candidates where this foot is associated with syllables, this is due to a high ranked constraint against floating feet. Again, deletion of feet is not an option because of high ranked MAX-FT.

Another candidate, not given above, must be ruled out: Final stress on the affix. This can be ruled out by introducing a FT-BIN constraint relativised to head feet in addition to the general constraint, see the tableau in (302).

(302) *Head foot is binary*

		$(\text{kwentus})_{\text{Ft}}()_{\text{Ft}}$i	HDFT-BIN	FT-BIN
☞	a.	$(\text{kwen})_{\text{Ft}}(\text{tusi})_{\text{HdFt}}$		*
	b.	$(\text{kwentu})_{\text{Ft}}(\text{si})_{\text{HdFt}}$	*!	*

Whether the winning candidate violates some faithfulness constraint depends on the assumption of the underlying form; (kwentus) vs. (kwen)tus. Anyhow, this constraint can be ranked sufficiently low.

If strong suffixes (agreement markers and the comparative) are combined with roots, the outcome is the same. I assume that these suffixes carry underlyingly a head foot. Thus, HDFT-RIGHT and the already established ID-FT prefer the stress to be to the right, realised on the penult in this case.

Prefixes come in two forms, too: They can be invisible for stress altogether, or they attract stress onto themselves. I assume that the former do not carry any foot, and that the latter carry a head-foot. Unlike for strong suffixes, the two contstraints

HEAD-FOOT-RIGHT and ID-FT do not work in the same direction in this case: ID-FT prefers the stress to be on the prefix, whereas HEAD-FOOT-RIGHT prefers the stress on the stem. Since the prefix wins against roots, the faithfulness constraint must be higher ranked. The derivation is given in (303).

(303) *Competition between two unequal feet*

		$(mi)_{HdFt}man(tika)_{Ft}$	CULM	ID-FT	HDFT-RIGHT	MAX-FT
☞	a.	$(miman)_{HdFt}(tika)_{Ft}$			*	
	b.	$(miman)_{HdFt}(tika)_{HdFt}$	*!	*		
	c.	$(miman)_{Ft}(tika)_{HdFt}$		*!*		

Now, let us turn to the more interesting aspect, the competition between affixes. We have three relevant types of competition: Between strong prefix and weak suffix, between strong prefix and strong suffix, and between strong affix and strong affix on the same side of the stem. In a conflict between affixes of the same type, prefixes and suffixes respectively, the outermost wins. For suffixes, that follows from the already established constraint HEADFOOT-RIGHT, which prefers the outer suffix since it carries the rightmost foot. However, this constraint is not adequate for multiple prefixes, because every prefix foot is not the rightmost foot. In this case, the effects of a lower ranked HEADFOOT-LEFT constraint can be observed, see the derivation in (304).

(304) *Competition between two prefixal head-feet*

		$man(a)_{HdFt}na\text{ʔ}(a)_{HdFt}$ $(tsatgi)_{FT}$	CULM	ID-FT	HDFT-RIGHT	HDFT-LEFT
☞	a.	$man(ana)_{HdFt}(\text{ʔ}a)_{Ft}$ $(tsatgi)_{FT}$		*	*	
	b.	$man(ana)_{Ft}(\text{ʔ}a)_{HdFt}$ $(tsatgi)_{FT}$		*	*	*!

For the competition between prefixes and suffixes, the established constraints and the ranking of ID-FT over HEAD-FT-RIGHT suffice. If the prefix competes with a strong suffix, only HEAD-FT-RIGHT differentiates between them, making the candidate with the suffix-stress optimal, see the derivation in (305).

(305) *Competition between prefixal and sufixal head-foot*

	$(mi)_{HdFt}man(tika)_{Ft}$ $()_{HdFt}$ɲa	CULM	ID-FT	HDFT-RIGHT
a.	$(miman)_{HdFt}(ti)_{Ft}(ka\text{ɲ}a)_{Hdft}$	*!		
b.	$(miman)_{Ft}(ti)_{Ft}(ka\text{ɲ}a)_{hdft}$		*	
c.	$(miman)_{HdFt}(ti)_{Ft}(ka\text{ɲ}a)_{Ft}$		*	*!

If it competes with a weak prefix, however, the higher ranked ID-FT is decisive: It prefers the more faithful candidate, even if the stress is to the left, see the evaluation in (306).

(306) *Prefixal head foot wins over suffixal regular foot*

	$(a)_{HdFt}(kwentus)_{Ft}\ ()_{Ft}i$	CULM	ID-FT	HDFT-RIGHT
a.	$(a)_{HdFt}(kwen)_{Ft}(tusi)_{Ft}$			*
a.	$(a)_{Ft}(kwen)_{Ft}(tusi)_{HdFt}$		*!*	

This concludes the basic stress patterns, the distribution of main stresses (head feet) and morphologically conditioned secondary stresses (regular feet that were there underlyingly or got demoted). Stress deletion and rhythmic secondary stress are not part of the stem-level stratum and will be discussed after a brief excurs on Richness of the Base, the assumption that there are no morpheme structure constraints that is typically adopted in OT frameworks (Prince & Smolensky 1993). The analysis I propose is somewhat problematic from a Richness of the Base perspective: There are three types of morphemes, stems, prefixes and suffixes, and three types of underlying stress: Head foot, foot or no foot. However, the morpheme types are restricted on which type of foot they may have. The table in (307) gives an overview: roots can only carry a regular foot, suffixes a weak or strong foot, and prefixes (and infixes) a strong foot or no foot.

(307) *Distribution of foot types in URs*

	Prefix	Stem	Suffix
Ø	Yes	No	No
Foot	No	Yes	Yes
Head foot	Yes	No	Yes

All other combinations would lead to unattested patterns: A stem with a head foot would win against a strong prefix. A stem with no footing would look in isolation like a penult stressed stem, but there would be no secondary stress on that syllable under stress shifting conditions, that is, with affixation.[112] A suffix with no footing would not influence the stress pattern of the stem. And a prefix with a regular foot would show an idiosyncratic, unpredictable secondary stress. This distribution is unproblematic for suffixes, because they are a rather small closed class, however my assumption on prefixes and especially roots is not compatible with Richness of the Base. The assumption of an additional root level that derives morpheme structure constraint effects (cf. Trommer 2011) could remedy this issue for roots, but nor for prefixes.

[112]For roots that have a low vowel in an open penult and that cannot take stress shifting prefixes, such a representation is arguably possible because there are no phonological processes that could refer to underlying stress here.

Two more processes influence the distribution of secondary stresses: Stress deletion and rhythmic secondary stress (RSS). I assume that both apply at the phrase level, because they counterfeed/bleed umlaut that I will argue belongs to the word level. On the word level thus, the stress patterns established above will remain intact.

As discussed above, the exact conditions of RSS are somewhat murky. I follow Chung's (1983) description that RSS is assigned in trochees to the left of the main stress. This is triggered by a constraint against unfooted syllables, PARSE-FT, see (308). This constraint must outrank a constraint against the insertion of feet, DEP-FT. The tableau in (309) shows these constraints at work.

(308) PARSE-FT
Count a violation for every syllable not dominated by a foot.

(309) *Derivation of rhythmic secondary stress*

bilim(binis)$_{\text{HDFT}}$	CLASH	PARSE-FT	DEPFT
a. bilim(binis)$_{\text{HDFT}}$		*!*	
b. (bilim)$_{\text{FT}}$ (binis)$_{\text{HDFT}}$			*

If there are not enough syllables to form a trochee, a syllable remains unfooted. This is derived by ranking a constraint against adjacent head syllables, CLASH (310).

(310) CLASH
Count a violation for every pair of directly adjacent head syllables.

(311) *No RSS is assigned if it would clash*

pu(lonnun)$_{\text{HDFT}}$	CLASH	PARSE-FT	DEPFT
a. pu(lonnun)$_{\text{HDFT}}$		*	
b. (pu)$_{\text{FT}}$ (lonnun)$_{\text{HDFT}}$	*!		*

Depending on whether the description of posttonic RSS in Chung (1983) or Chung (2020) are correct, footing is blocked to the right of the main stress. Both patterns are easily derivable with the motivated constraints: If RSS is blocked, HD-FT-RIGHT dominates PARSE-FT at the phrase level. If parsing extends to the right, the ranking is the opposite.

The other stress process on the phrase level is stress deletion. A secondary stress that directly precedes a main stress is deleted. A secondary stress adjacent to another secondary stress, or following a primary stress, is however not deleted. The condition of deletion are therefore somewhat different of the conditions of blocking of RSS, albeit overlapping. I propose a directional constraint against clashes with primary stress, in (312). For a motivation for this constraint, see the discussion in Kaplan (2011a: 642) and sources cited therein.

(312) CLASH-HEAD
Count a violation for any head syllable directly preceding a head syllable dominated by a head foot.

The two clash constraints 'sandwich' MAX-FT, so that only the higher ranked one (CLASH-HD) leads to the deletion of feet, but both block the insertion of new feet. The tableau in (313) shows the deletion of a secondary stress.

(313) *Derivation of stress deletion*

		$(\text{ne})_{\text{FT}}(\text{nehu})_{\text{HDFT}}$	CLASH-HD	MAXFT	CLASH	PARSE-FT
	a.	$(\text{ne})_{\text{FT}}(\text{nehu})_{\text{HDFT}}$	*!	*		
☞	b.	$\text{ne}(\text{nehu})_{\text{HDFT}}$		*		*

The CLASH-HEAD constraint is directional, it therefore targets only secondary stresses preceding a main stress, not the ones following it. In (314), thus, no foot is deleted.

(314) *No stress deletion if main stress precedes*

		$(\text{mi})_{\text{HDFT}}(\text{batku})_{\text{FT}}$	CLASHHD	MAXFT	CLASH	PARSE-FT
☞	a.	$(\text{mi})_{\text{HDFT}}(\text{batku})_{\text{FT}}$			*	
	b.	$(\text{mi})_{\text{HDFT}}\text{batku}$		*!		*

Foot deletion can feed rhythmic stress insertion, that is, foot deletion can feed foot insertion if the deleted defective foot is preceded by an unfooted syllable.[113] This is shown by the tableau in (315).

(315) *Interaction of stress deletion and insertion*

		$\text{tin}(\text{ta})_{\text{FT}}(\text{goʔta})_{\text{HDFT}}$	CLASHHD	MAXFT	CLASH	PARSE-FT	DEPFT
	a.	$\text{tin}(\text{ta})_{\text{FT}}(\text{goʔta})_{\text{HDFT}}$	*!		*		
	b.	$\text{tinta}(\text{goʔta})_{\text{HDFT}}$		*		*!*	
☞	c.	$(\text{tinta})_{\text{FT}}(\text{goʔta})_{\text{HDFT}}$		*			*
	d.	$(\text{tin})_{\text{FT}}(\text{ta})_{\text{FT}}(\text{goʔta})_{\text{HDFT}}$	*!		**		*

The faithful candidate a. in (315) has the fatal clash. If its foot would survive, there would be no space to insert an epenthetic foot, as that would violate the lower ranked general CLASH twice, see candidate d. However, inserting a new, trochaic foot (candidate c.) is more optimal than leaving the two syllables unfooted, see candidate b.[114]

[113] This feeding is problematic for Halle & Vergnaud (1987): They order the rule of clash deletion after the alternator, the rule that assigns secondary stress (Halle & Vergnaud 1987: 76), predicting counterfeeding instead of the observed feeding interaction.

[114] An equivalent solution would be to move the left edge of the left foot leftward, and, given that

Summarised, most of the stress assigning processes happen on the stem level. If two lexical stresses compete, the stronger wins. If they have equal strength, the rightmost one wins. If none is rightmost, the leftmost wins as a last resort. The non winning stresses are demoted, the winning one is promoted, if necessary. At the word level, the stresses stay unaltered. At the phrase level, unfooted syllables are parsed, assigning rhythmic secondary stresses, as long as it does not come into conflict with higher ranked constraints such as CLASH. A higher ranked constraint CLASH-HEAD triggers the deletion of specific clashing secondary stresses.

4.5.4 Gemination

4.5.4.1 Data and generalisations

The suffixes *-hu, mu ɲa ta* geminate to *-kku, mmu ɲɲa tta* – that is, almost all productive monosyllabic consonant-initial suffixes, with the exception of -dzi discussed below – under very peculiar circumstances. If the stressed syllable of the un-affixed form would be heavy, closed either by a regular coda-consonant or a geminate, then the affix geminates, making so the newly stressed syllable heavy as well. This is true independently of whether the base stress is not realised (316a-b), or demoted to secondary stress, as in (316c-d).

(316) *Gemination after closed stressed syllable*

a. kánta-hu→kantákku
'my song' (SC83:43)

b. maléffa-mu→maleffámmu
'your forgetting' (SC83:43)

c. dáŋkulu-ɲa→dàŋkulóɲɲa
'bigger' (SC83:44)

d. éttigu-ɲa→èttigóɲɲa
'shorter' (SC83:48)

If there is no heavy syllable in the base of affixation, the affix does not geminate, see (317).

(317) *No gemination after open stressed syllable*
dúda-mu→dudámu
'my doubt' (SC83:48)

If there is a heavy syllable, but it is either not stressed at all, or only stressed due to rhythmic secondary stress insertion, the affix does not geminate, see (318).

TROCHEE is undominated, the head syllable as well. The faithfulness constraints preventing that shift must be dominated by CLASHHD but dominate CLASH.

(318) *No gemination after closed unstressed syllable*

a. sitbésa-ɲa→sìtbesá-ɲa
'his beer' (SC83:)

b. mí-mantíka-ɲa→mìmantikáɲa
'more abounding in fat' (SC83:41)

On the other hand, gemination does occur if the base has a secondarily stressed heavy syllable, that has obtained secondary stress via demotion. This can be seen in the cases in (319) where the underlyingly stressed heavy syllable is demoted not because of the suffix, but because of the strong prefix mí-, i.e. if there where no suffix, the stress on the closed syllable would be secondary.

(319) *Gemination after prefix induced stress shift*

a. mí-bátku-ɲa→mìbatkóɲɲa
'more abounding in ships' (SC83:44)

b. mí-tsóddɑ-ɲa→mìtsoddáɲɲa
'more abounding in green bananas' (SC83:44)

The data on whether a strong prefix with a closed syllable can induce gemination is somewhat murky. Chung does not discuss this scenario at all. Crosswhite (1998: 313) claims that both triggering and not-triggering examples are found, but gives only examples of the former. In (320), there is an additional example from Stolz (2012).

(320) *Gemination after stressed closed syllable in prefix*

gós-dzá-ɲa → gòsdzáɲɲa
INTENS-like-3SG
'liked very much' (Stolz 2012: 111)

This pattern will be derived without extra addition in my analysis, whereas the non-triggering pattern would warrant some amendments. Given the scarcity of the data, I refrain from a thorough discussion.

A last relevant pattern or gemination is to be encountered if a non-geminating suffix intervenes between the geminating suffix and a root with a closed syllable. Unfortunately, there is conclusive data for only one such affix, the verbaliser/applicative -i/dzi, and its behaviour is unexpected: -i is the allomorph that attaches to consonant-final bases, whereas -dzi is chosen after vowel-final bases. The -i allomorph always triggers gemination of following geminating suffixes, whether there is a closed syllable, or not (321a). If -dzi intervenes, however, there is never any gemination, also independently from the presence of heavy syllables in the root, see (321b).

(321) *Idiosyncratic (non) gemination with the applicative*

a. ⟨in⟩sáŋɑn-i-ɲa→sinaŋanéɲɲa

sangan.INFL-APPL-3SG
'tell.INFL' (SC20:688)

b. ⟨in⟩tátti-dzi-ɲa→tinattidzíɲa
tatti.INFL-APPL-3SG
'follow.INFL' (SC20:688)

4.5.4.2 Analysis

Gemination in Chamorro has encountered much less attention in the literature than the other processes, and as far as I can tell, the missapplication with -i/-dzi has not been analysed at all. The most fleshed out analysis is found in Crosswhite (1998), who proposes a new type of Output-Output Correspondence relations, namely between prosodically similar structures, to account for the data. Chung (1983) and Halle & Vergnaud (1987) device rules that are very close to the description of the facts. The reasons for this are obvious: Gemination is a very unusual process. I derive the process of gemination partly with a constraint, and partly with an assumption on the underlying representations of the relevant suffixes. I contend that this is justified, given that gemination is not really a general process that can be observed whenever stress shifts, it is tied to a small set of morphemes. Gemination in my analysis is a stem-level process. The constraint responsible is (322), which demands the head syllable of the head foot to be as heavy as the heaviest head syllable in the string.

(322) Heavy-HdFt (Heavy)
Count a violation if the head syllable of the head-foot is monomoraic and there is a bimoraic head syllable of another foot.

This constraint alone would overgenerate gemination to every instance of stress shifting: to non-geminating suffixes and prefixes. I assume that the geminating suffixes are representationally different in that they carry a floating mora. In the other cases, a constraint against mora-insertion that outranks the constraint in (322), favours candidates without gemination.

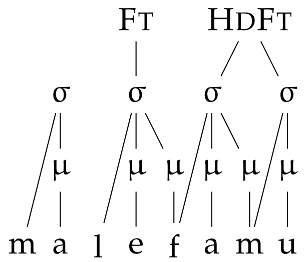
The tableau in (323) shows the derivation of gemination, if the conditions are right.

(323) *Derivation of gemination*

		ma(leffa)$_{Ft}$ ()$_{hdft}$ μ mu	Dep–μ	Heavy	Dep-C	*Gem	Max-μ
	a.	ma(lef)$_{Ft}$ (famu)$_{hdft}$		*!			*
☞	b.	ma(lef)$_{Ft}$ (fammu)$_{hdft}$				*	
	c.	ma(lef)$_{Ft}$ (faʔmu)$_{hdft}$			*!		

Candidate a., the candidate that does not link the mora, violates Heavy because the head syllable of the head foot .fa. is lighter than another head syllable, .lef. It also violates a contraint against the deletion of morae. Candidate b. is the winner, it avoids violations of Heavy and Max-μ by linking the mora to the onset of the affix and integrating into the head syllable. (324) shows the autosegmental representation of this candidate. By creating a geminate it trivialy violates a constraint against geminates, *Gem.

(324) *Representation of maleffammu*



The last candidate, c., saves the mora and avoids a violation of Heavy by inserting a default consonant, which is excluded by ranking Dep-C above *Gem, and vowel lengthening can be excluded accordingly.

As mentioned before, gemination is restricted to the co-occurence of a geminating suffix and a heavy head syllable. If either is absent, there is no gemination. The tableau in (325) shows an input with a geminating suffix but no heavy head syllable.

(325) *No gemination after light syllable*

		$(\text{duda})_{Ft}\ ()_{hdft}$ μ mu	Dep–μ	Heavy	Dep-C	*Gem	Max-μ
☞	a.	$(\text{du})_{Ft}\ (\text{damu})_{hdft}$					*
	b.	$(\text{du})_{Ft}\ (\text{dammu})_{hdft}$				*!	

Heavy cannot be violated by either candidate a. or b., because there are no heavy head syllables (outside the head foot). Ranking *Gem over Max-μ makes candidate a. optimal with respect to candidate b. The attentive reader will realise that the constraints and their ranking presented here would lead to degemination across the board:[115] *Gem outranks Max-μ and Heavy is not violated if the original geminate is deleted. This must be excluded by a higher ranked faithfulness constraint for geminates, like the one in (326).

(326) Id-Gem
Count a violation for a consonant associated to a mora in the input that is not associated to a mora in the output.

This creates a grandfather effect: Old geminates are grandfathered in, but new geminates cannot arise, unless facilitated by Heavy.

[115] Unless there is a heavy syllable due to a regular coda consonant. Only in this case, geminates created by gemination would be licit.

The next tableau (327) shows the absence of gemination with other suffixes: A high ranked constraint against mora-insertion makes a violation of HEAVY optimal.

(327) *No gemination with -i*

		$(\text{kwentus})_{Ft}$ $()_{ft}$ i	DEP–μ	HEAVY	DEP-C	*GEM	MAX-μ
☞	a.	$(\text{kwen})_{Ft}$ $(\text{tusi})_{hdft}$		*			
	b.	$(\text{kwen})_{Ft}$ $(\text{tussi})_{hdft}$	*!			*	

Lastly, let us turn to the behaviour of the applicative suffix. Its post-consonantal allomorph induces gemination irrespectable of the presence of heavy syllables, while the postvocalic version blocks any gemination. I suggest that both behaviours stem from their underlying representation. The postconsonantal allomorph carries a floating root node.

(328) i•

This root node is protected by a MAX-constraint against the deletion of consonants, ruling out the otherwise expected candidate a. in the tableau in (329).

(329) *Gemination overapplies after -i*

		si$(\text{naŋan})_{Ft}$ $()_{ft}$ i•μ$()_{HDFT}$ɲa	MAX-C	DEP-F	SPREAD-F	*GEM	MAX-μ
	a.	si$(\text{naŋa})_{ftFt}$$(\text{niɲa})_{HDFT}$	*!				*
☞	b.	si$(\text{naŋa})_{ftFt}$$(\text{niɲɲa})_{HDFT}$			*	*	
	c.	si$(\text{naŋa})_{ftFt}$$(\text{niʔɲa})_{HDFT}$		*!			

Candidates b. and c. conserve the floating consonant, and fill it differently: b. by creating a geminate, and c. by epenthesising consonantal features. The geminates formed in this context and under regular gemination have thus a slightly different structure: The 'normal' geminates have only one root node, the geminates created with *-i* have two root nodes linked to the same features.

The postvocalic allomorph has a different shape: It is the only (relevant) morpheme with an underlying long vowel,[116] as in (330).

(330) dziː

Because this syllable is heavy anyhow, its presence blocks any violation of HEAVY, see the tableau in (331).

[116] On the surface, all stressed vowels in an open syllable are long, cf. Crosswhite (1998). I assume that vowel length neutralisation happens later, either at the word or at the phrase level.

(331) *Gemination underapplies after -dzi*

		ti(natti)$_{Ft}$ ()$_{ft}$ dziː μ()$_{HDFT}$ɲa	HEAVY	ID-V:	*V:	*GEM
☞	a.	ti(nat)$_{Ft}$ (ti)$_{ft}$ (dziːɲa)$_{HDFT}$			*	
	b.	ti(nat)$_{Ft}$ (ti)$_{ft}$ (dziɲɲa)$_{HDFT}$		*!		*

A faithfulness constraint for long vowels must be ranked so that the long vowel is preserved, another constraint against long vowels must outrank *GEM so that vowel lengthening cannot outcompete gemination.

4.5.5 Umlaut

4.5.5.1 Data and generalisations

Chamorro umlaut has been discussed extensively in the literature and was the focus of Klein (2000) and Kaplan (2008, 2011a). It is, generally, a process where a back vowel fronts and potentially de-rounds, if it succeeds certain prefixes, infixes or function words. This process is given in (332).

(332) Umlaut vowel mapping

a. ɑ → a
b. o → e
c. u → i

The difference between the two low vowels is neutralised unless the low vowel receives primary stress, so it will be less relevant for the discussion here.

Umlaut triggered by different classes of prefixal elements does not behave identically. Umlaut triggered by infixes is completely stress blind: It applies to any back vowel, see (333).

(333) *Umlaut triggered by infix*

a. <in>dúlalak→dinílalak
'chase.ANTIP' (SC20:682)
b. <in>tutúhun→tinitúhun
'begin.ANTIP' (SC20:682)

For other prefixes, the data is unfortunately less conclusive, the sources disagree on which elements trigger umlaut. Chung (2020) gives a rather short list of productive elements that trigger umlaut[117], stating that other triggers are no longer productive, or do not trigger umlaut any more. According to Chung (2020), umlaut is disappearing from the language, but at least the umlaut triggered by the infix and by the proclitics like the article (which is the one that is relevant here) seem to be stable.

[117]Obligarory: <in>, many meanings; obligatory, stress sensitive: in= 1EXCL.PL, 2DU/PL, i= DEF, ni= ACC, gi= LOC; optional, stress sensitive?: gái- 'have', tái= not have, mí- 'full of' ki= PREP (Chung 2020: 681).

Also, some roots seem to be immune against umlaut, even if its trigger does not belong to the 'optional' class of triggers, see (334).[118] This fact is important for Klein's analysis, as he reduces most cases of failed umlaut to lexical properties of roots.

(334) *Lexical exceptions to umlaut*

a. i pútpitu→i pútpitu
'the pulpit' (Klein 2000: 88)

b. <in>bóta→bin**o**ta
'vote.ANTIP' (SC20:683)

I will not further discuss the type of umlaut triggered by the infix and assume that it happens on the stem level, when prefixes and infixes are merged. The type of umlaut of most interest in the discussion of Chamorro cyclicity is umlaut triggered by proclitics, such as the article i. From now on, I will use the term umlaut to refer to the umlaut triggered by these elements. Umlaut is obligatory, if the syllable adjacent to the trigger carries primary stress, see (335).

(335) *Umlaut triggered by the article*

a. /i ɡúmaʔ/→i ɡímaʔ
'the house' (SC83:45)

b. /i sóŋsuŋ/→i séŋsuŋ
'the village' (SC83:45)

c. /i hɑga/→i haga
'the daughter' (SC83:45)

Umlaut is optional if the syllable carries morphological secondary stress (336a-b) or if there would be secondary stress which is deleted due to adjacency (336c-d).

(336) *Umlaut is optional with MSS / DSS*

a. /i ɡúmaʔ-níha/→i ɡìmaʔníha ~ i ɡùmaʔníha
'their house' (SC83:46)

b. i kóbbli-nmámi→i kèbblinmámi ~ i kòbblinmámi
'our (exc.) money' (SC83:46)

c. /i sóŋsuŋ-ɲa/→i siŋsóŋɲa ~ i suŋsóŋɲa
'his village' (SC83:45)

d. i tsúpa-ɲa→i tsipáɲa ~ i tsupáɲa
'his cigarettes' (SC83:)

Umlaut is not triggered if the following syllable has zero stress, (337) (keep in mind

[118]The non-undergoers of umlaut are all loans, but they are otherwise nativised, consider the consonant and vowel changes from Spanish [púlpito] to Chamorro [pútpitu]. Other loans do undergo umlaut, even if they have phonological features only found in Spanish loans, such as a mid vowel in an open syllable. Consider [hobin] 'young' becoming [hineben] with umlaut at least for some speakers, compare Chung (2020: 683).

that this means a syllable that has no stress on the surface but also no underlying or morphologically assigned stress); but also not if it has rhythmic secondary stress (338).

(337) *No umlaut on zero stressed vowels*

a. i pulónnun→i pulónnun
'the trigger fish' (SC83:45)

b. i mundóŋgu→i mundóŋgu
'the cow's stomach' (SC83:45)

(338) *Rhythmic secondary stress does not trigger umlaut*

a. i pulónnun-ɲa→i pùlulóɲɲa
'his trigger fish' (SC83:46)

b. i mundóŋgu-ɲa→mùnduŋgóɲɲa
'the cow's stomach' (SC83:46)

c. i putamunéda→i pùtamunéda
'the wallet' (SC83:45)

Summarised, umlaut is strictly local and is obligatory with primary stress, optional with morphological secondary stress, whether on the surface or not, and impossible elsewhere.

4.5.5.2 Analysis

I crucially assume that the derivation of umlaut is part of the word level, and that, accordingly, the triggering proclitics are indeed word-level prefixes. This assumption is not new, in spite of the synatctic distribution of the proclitics, they have been analysed as lexical in all the serial analyses I am aware of (Chung 1983; Halle & Vergnaud 1987; Kaplan 2008). This is of course feasible in an analysis in LMP or a similar framework, such as Stratal OT, but it might be challenging in frameworks where morphosyntactic embedding is more directly translated into phonological cycles, such as phase-based approaches. The analysis proposed here is in its basic strokes very similar Kaplan (2008) and, umlaut is induced by a licensing constraint and optionality comes directly from reference to the status of stress, not from optional ordering of operations like in Chung (1983). The last idea was already proposed in Klein (2000).

As with gemination, umlaut is not a fully regular process and must thus be partially encoded by the representation of the umlaut triggering elements.[119] I will here pursue a rather brute force approach and assume that it is due to a frontness feature present on the triggers, in addition to the regular [–back].[120] This feature is

[119] Also, on the undergoers, since there are idiosyncratic non-undergoers of umlaut. I will ignore this aspect for the time being.

[120] There are many alternatives to this approach: The triggering vowels could be specified for [-back]

subject to the LICENSE- Constraint in (339), that demands the feature to be associated to a head-foot.

(339) LIC-HDFT
Count a violation for any [+front] feature that is not associated to a root node dominated by a head foot.

This constraint is ranked above general faithfulness constraints for backness, so that it can trigger umlaut, see the tableau in (340).

(340) *Derivation of obligatory umlaut*

		$\text{i}^{+\text{front}}$=(gumaʔ)$_{\text{HDFT}}$	NOGAP	BIN	LIC-HDFT	ID-[+BK]
	a.	i=(gumaʔ)$_{\text{HDFT}}$			*!	
☞	b.	i=(gimaʔ)$_{\text{HDFT}}$				*

The effects of the LICENSE constraints can be seen only locally. This is enforced by ranking two general markedness constraints above the textscLicense constraint: NOGAP against gapped spreading and BIN against association of a feature to more than two hosts. In the tableau in (341), candidate a., the faithful candidate and also the winner, violates the textscLicense constraint because the feature is not associated to a head foot. Candidate b. fronts the first vowel, still violating the license constraint because the first vowel is not part of the head foot and incurring thus a gratuitous violation of ID-[+bk]. Candidate c. spreads the feature to the head foot and the intervening syllable, violating the constraint against non-binary spreading, whereas candidate d. skips the intervening syllable, creating a gapped structure.

(341) *Umlaut fails before non-footed syllable*

		i=pu(lónnun)$_{\text{HDFT}}$	NOGAP	BIN	LIC-HDFT	ID-[+BK]
☞	a.	i=pu(lónnun)$_{\text{HDFT}}$			*	
	b.	i=pi(lónnun)$_{\text{HDFT}}$			*	*!
	c.	i=pi(lénnun)$_{\text{HDFT}}$		*!		*
	d.	i=pu(lénnun)$_{\text{HDFT}}$	*!			*

For the optionality, I will assume two potential rankings and thus two different grammars. This approach to optionality might not be completeley adequate or transferable to every case of optionality, but it does well for the Chamorro case. A thorough analysis of optionality is outside the scope of this dissertation, for a discussion of optionality in OT see Anttila (2006, 2007); Kimper (2011c); Kaplan (2011b); Bayles, Kaplan, & Kaplan (2016) among others. In the grammar that extends umlaut

whereas non-triggers are underspecified and become [–back] by default; the triggers could carry a floating [-back] that needs to be docked; the triggers could have a [+tense] vowel and the difference between tense and lax vowels is later neutralised, with lax vowels occurring in closed and tense vowels in open syllables, cf. Chung (1983). To determine which of these options is preferable is orthogonal to the topic discussed here, so I will leave this question open.

to secondary stress, a second license constraint which is satisfied by associating the feature to any foot, see (342), outranks the faithfulness constraint.

(342) Lic-Ft
Count a violation for any [+front] feature not associated to a root node dominated by a foot.

This constraint is trivially satisfied if the feature spreads into a head foot, but it can induce umlaut to a foot if the head foot cannot be reached due to higher ranked constraints, as is shown by the tableau in (343).

(343) *Optional umlaut with secondary stress*

		i=(gumaʔ)$_{Ft}$(niha)$_{HdFt}$	NoGap	Bin	Lic-HdFt	Lic-Ft	Id-[+bk]
	a.	i=(gumaʔ)$_{Ft}$(niha)$_{HdFt}$			*	*!	
☞	b.	i=(gimaʔ)$_{Ft}$(niha)$_{HdFt}$			*		*

In the other grammar, the identity constraint outranks the general license constraint. Therefore, umlaut is blocked unless the head foot can be reached (344).

(344) *Optional blocking of umlaut with secondary stress*

		i=(gumaʔ)$_{Ft}$(niha)$_{HdFt}$	NoGap	Bin	Lic-HdFt	Id-[bk]	Lic-Ft
☞	a.	i=(gumaʔ)$_{Ft}$(niha)$_{HdFt}$			*		*
	b.	i=(gimaʔ)$_{Ft}$(niha)$_{HdFt}$			*	*!	

Summarised, umlaut is triggered by a license constraint for a frontness feature which is present on some word-level prefixes with front vowels. The spreading of this feature must be strictly local and non-iterative. Umlaut cannot be part of the stem level, because stem-level umlaut, triggered by infixes, has different properties. It cannot be on the phrase level, because it is counterfed by rhythmic secondary stress and counterbled by stress deletion, two phrase-level processes.

4.5.6 Degemination

4.5.6.1 Data and generalisations

Degemination is a fully optional process. Under degemination, a geminate is reduced to a singleton if it is preceded by an unstressed syllable. (345) shows how degemination is optionally fed by stress deletion.

(345) *Degemination after destressed syllable*

a. lássas-ɲa→lassásɲa ~ lasásɲa
'his skin' (SC83:56)

b. tsáŋŋa-ɲa→tsaŋŋáɲɲa ~ tsaŋáɲɲa
'more light-coloured' (SC83:56)

Notice that (345b) shows that degemination counterbleeds gemination. A syllable must be destressed in order to support degemination. Demoting the stress to secondary does not suffice, as can bee seen in (346).

(346) *No degemination after syllable with secondary stress*
hábbun-mámi→hàbbunmámi
'our (excl.) soap' (SC83:56)

Whether degemination affects syllables that never receive morphological stress cannot be determined given the scarcity or coda consonants, and especially geminates, in such contexts.

4.5.6.2 Analysis

Degemination counterbleeds gemination, as seen above, therefore degemination cannot be a stem-level process. As will be seen in Section 4.5.7, degemination bleeds a type of vowel height adjustment that must occur on the word level. Therefore, degemination itself must be a word-level process, too. This makes a simple analysis along the lines 'degeminate if unstressed' impossible – the destressed syllables are not yet unstressed on the word level, they loose the foot only on the phrase level. However, the geminates that are eligible for degemination violate a crisp-edge constraints, given in (347), as they are dominated by two feet.[121]

(347) CRISP-EDGE–C/FT(CE-C/Ft)
Count a violation for a consonant that is directly dominated by two feet.

Since degemination is optional, there are again two grammars. If the Crisp-Edge constraint outranks ID-GEM, the candidate with degemination wins, compare the tableau in (348).

(348) *Derivation of optional degemination*

		$(\text{las})_{\text{FT}}(\text{sasɲa})_{\text{HDFT}}$	CE-C/FT	ID-GEM	*GEM
	a.	$(\text{las})_{\text{FT}}(\text{sasɲa})_{\text{HDFT}}$	*!		*
☞	b.	$(\text{la})_{\text{FT}}(\text{sasɲa})_{\text{HDFT}}$		*	

If the ranking is reversed, the faithful candidate wins instead, as in (349).

[121] This constraint might need to be adapted if data for geminates wholly or partially outside of feet becomes available, or if there were evidence for layered feet (cf. Martínez-Paricio & Kager 2015). Given the data at hand, it works fine.

(349) *Optionally, no degemination applies*

	(las)$_{\text{FT}}$(sasɲa)$_{\text{HDFT}}$	ID-GEM	CE-C/FT	*GEM
☞ a.	(las)$_{\text{FT}}$(sasɲa)$_{\text{HDFT}}$		*	*
b.	(la)$_{\text{FT}}$(sasɲa)$_{\text{HDFT}}$	*!		

The CRISP-EDGE constraint makes no reference to secondary stress, but correctly predicts the absence of degemination in the forms that conserve secondary stress, even if the constraint outranks faithfulness. The geminate in question is never across a foot edge, the constraint is thus not violated, see the derivation in (350).

(350) *No degemination in a binary foot*

	(habbun)$_{\text{FT}}$(mɑmi)$_{\text{HDFT}}$	CE-C/FT	ID-GEM	*GEM
☞ a.	(habbun)$_{\text{FT}}$(mɑmi)$_{\text{HDFT}}$			*
b.	(habun)$_{\text{FT}}$(mɑmi)$_{\text{HDFT}}$		*!	

4.5.7 Vowel height adjustment

4.5.7.1 Data and generalisations

The last relevant process, or rather class of processes, is vowel height adjustment. Chung (1983) and Crosswhite (1998) assume that Chamorro has underlyingly only two vowel heights, low and non-low. And indeed, in native vocabulary it is possible to predict the height of non-low vowels, high or mid, almost entirely from the context they occur in. In non-derived words, a stressed vowel is mid if it is in a closed syllable, see (351). All other non-low vowels are high, (351b,d) and (352b) for closed, unstressed syllables and (352) for open stressed syllables.

(351) *No high vowels in closed stressed syllables*

a. tsódda 'green banana' (SC20:670)
b. pulónnun 'trigger fish' (SC83:45)
c. éttigu 'short' (SC83:47)
d. sénsin 'flesh' (SC83:48)

(352) *High vowels in open stressed syllables*

a. gúmaʔ 'house' (SC83:46)
b. bìlimbínis 'star apple' (SC20:663)
c. halúʔu 'shark' (SC20:665)

A rather large group of otherwise completely nativised Spanish loans, see (353), as well as a few native words, compare (354), allows a stressed syllable to have non-high vowels, even if the syllable is open.

(353) *Mid vowels in open stressed syllables in nativised loans*

a. néni 'baby' (SC83:47)

b. hóbin 'young' (SC20:683)
c. bóti 'boat' (SC83:47)
d. sitbésa 'beer' (SC83:47)

(354) *Mid vowels in open stressed syllables in native vocabulary*

a. téʔi 'scattered' (SC20:665)
b. dóʔak 'white spot on eye' (SC20:665)
c. pwéŋi 'night' (SC20:664)

For this group, Chung (1983) assumes that they are underlyingly high vowels, which have a diacritic so that a lowering rule applies irregularly. I will follow Halle & Vergnaud's (1987) analysis and assume that they have underlyingly mid vowels and that therefore in contemporary Chamorro, the difference between high and mid vowels is phonemic. A rather small group of nativised loans (355d-e) and two native words contain stressed high vowels in a closed syllable (355a-b).

(355) *High vowels in closed stressed syllables*

a. húŋgan 'yes' (SC83:47)
b. múŋŋa 'don't!' (SC83:47)
c. asút 'blue' (SC83:47)
d. lístu 'quick' (SC83:47)

I will follow Chung (1983) and treat them as true exceptions. Less nativised loans show mid vowels in more contexts, namely in unstressed closed syllables. They tend to lose them if they get nativised and show optionality, see (356).

(356) *low vowel in unstressed syllable in non-nativised loans*
kumpjúta ~ kompjúta 'computer' (SC20:666)

I will exclude those two last patterns, which are rather marginal, from the analysis.

Stress (re)assignment in the course of the derivation affects the height of non low vowels, both in closed and in open syllables. A syllable that has its stress demoted to secondary retains its non-high vowels, whether it is closed, see (357a) or open, see (357b).

(357) *Mid vowels in MSS syllables*

a. [kóbbli-nmámi]
/kòbblinmámi/
money-1PL.EXCL
'our money' (SC83:46)

b. [néni-nníha]
/nèninníha/
baby-3PL

'their baby' (SC83:48)

A high vowel that is unstressed in an unaffixed form, but stressed under affixation is mid in a closed syllable. This syllable may be closed by gemination, as in (358), or underlyingly, as in (359).

(358) *Mid vowels in derived stressed and closed syllable*

a. [dàŋkulóɲɲa]
/dáŋkulu-ɲa/
big-CMP
'bigger' (SC83:39)

b. [òttimóɲɲa]
/óttimu-ɲa/
end-3SG
'her end' (SC83:48)

(359) *Mid vowels in derived stressed syllable*

a. malagóʔmu
malágu̥ʔ-mu
wanting-2SG
'your wanting' (SC83:48)

b. lapéssu
lápis-hu
pencil-1SG
'my pencil' (SC83:48)

In some contexts, there is variation between mid and high vowels. If a vowel that is mid in an unaffixed form is destressed under stress shift, the vowel can be mid or high. This is again true both for mid vowels in closed syllables, see (360), and in open syllables (361).

(360) *Optional high vowel in DSS closed syllables*

a. [loklókɲa] ~ [luklókɲa]
/lókluk-ɲa/
boiling-3SG
'its boiling' (SC83:49)

b. [tsoʔgwídzi] ~ [tsuʔgwídzi]
/tsóʔgwi-dzi/
do-APPL
'to do for' (SC83:49)

(361) *Optional high vowel in DSS open syllables*

a. [nobjáɲa] ~ [nubjáɲa]

/nóbjɑ-ɲa/
girlfriend-3SG
'his girfriend' (SC83:49)

b. [neníhu] ~ [niníhu]
/néni-hu/
baby-1SG
'my baby' (SC83:49)

Lastly, if a closed syllable receives rhythmic secondary stress, it can have either a mid or a high vowel, again in free variation, compare (362).

(362) *Optional high vowel in RSS closed syllables*

a. [tìntagoʔta] ~ [tèntagóʔta]
/tintɑ́guʔ-ta/
messenger-1PL.INCL
'our messenger' (SC83:48)

b. [mùnduŋgóɲɲa] ~ [mònduŋgóɲɲa]
/mundóŋgu-ɲa/
cow's.stomach-1SG
'its stomach' (SC83:49)

The table in (363) gives an overview on the patterns. In closed syllables, hypothetical underlying mid and high vowels behave exactly alike: Mid under primary stress and realised morphological secondary stress; optionally mid or high under rhythmic secondary stress and deleted morphological secondary stress; and high if completely unstressed. In open syllables, mid and high vowels do not pattern identically. High vowels are always high, independently from stress. Mid vowels, on the other hand, are high if they are completely unstressed or receive rhythmic secondarily stressed; optionally high or mid if they are in a DSS position; and mid if they are primary stressed or have realised morphological secondary stress.

(363) *Overview of vowel adjustment*

Underlying	PS	MSS	DSS	RSS	ØS
CiC.	e	e	i/e	i/e	i
CeC.	e	e	i/e	i/e	i
Ci.	i	i	i	i	i
Ce.	e	e	i/e	i	i

Vowel height adjustment interacts both with gemination, as seen above in example (358) it is fed by it, and with degemination. Degemination bleeds vowel height adjustment, if the latter is analysed as lowering, as in Chung (1983), it feeds the adjustment if analysed as raising as in Halle & Vergnaud (1987). Both degemination and vowel height adjustment in positions where stress has been deleted are optional.

If there is no degemination, the vowel in the destressed syllable may be either high or mid, see (364a). However, if degemination is chosen, the optionality of vowel height adjustment evaporates: Only a high vowel is licit in front of a former geminate, see (364b).

(364) *Interaction of vowel height adjustment and degemination*

a. [ginippémmu] ~ [gineppémmu]
/<in>góppi-mu/
<INFL>jump.over-2SG
'what you jumped over' (SC20:667)

b. [ginipémmu] *[ginepémmu]
/<in>góppi-mu/
<INFL>jump.over-2SG
'what you jumped over' (SC20:667)

4.5.7.2 Analysis

As has been seen, stressed closed syllables have mid vowels, and unstressed syllables have high vowels. However, both statements are not completely surface true: Stressed closed syllables might have a high vowel, if they carry only rhythmic secondary stress, and unstressed syllables might have a mid vowel, if they were stressed at some point in the derivation. However, the statement is categorically true if we look at the stresses that do not get altered at the phrase level. I propose thus that there is height adjustment both at the word level, where it is obligatory, and at the phrase level, where it is optional. The phrase-level adjustment might of course undo previous rounds of adjustment, in a Duke-of-York fashion.

Word level adjustment is triggered by the markedness constraint in (365); a constraint against stressed high vowels in closed syllables.

(365) íC.
Count a violation for a head syllable that dominates a high vowel and a moraic consonant.

This constraint outranks a basic faithfulness constraint for height, leading to lowering of potential underlying high vowels, see the tableau in (366).

(366) *Obligatory lowering with main stress*

		$(\text{itti})_{\text{HDFT}}\text{gu}$	*íC.	ID[±h]
	a.	$(\text{itti})_{\text{HDFT}}\text{gu}$	*!	
☞	b.	$(\text{etti})_{\text{HDFT}}\text{gu}$		*

The constraint in (365) crucially does not differentiate primary from secondary stress, it treats all stresses alike. Therefore, the mid vowel is derived, too, if the stress falls on another syllable, see (367).

(367) *Obligatory lowering with secondary stress*

		(itti)$_{FT}$(guɲɲa)$_{HDFT}$	*íC.	ID[±h]
	a.	(itti)$_{FT}$(guɲɲa)$_{HDFT}$	*!*	
☞	b.	(etti)$_{FT}$(goɲɲa)$_{HDFT}$		**
	c.	(itti)$_{FT}$(goɲɲa)$_{HDFT}$	*!	*

At the phrase level, íC. is optionally ranked above the faithfulness constraints. If *íC. is ranked above faithfulness again, newly stressed syllables, that is syllables that receive rhythmic secondary stress, are lowered as in (368).

(368) *Optional lowering with secondary stress on the phrase level*

		tin(ta)$_{FT}$(goʔta)$_{HDFT}$	PARSE-FT	*íC.	ID[+HIGH]	DEPFT
	a.	tinta(goʔta)	*!*			
	b.	(tinta)$_{FT}$(goʔta)		*!		*
☞	c.	(tenta)$_{FT}$(goʔta)			*	*

With the reverse ranking, the syllables that receive the stress at the phrase level remain high, compare (369).

(369) *Optional non-lowering with secondary stress on the phrase level*

		tin(ta)$_{FT}$(goʔta)$_{HDFT}$	PARSE-FT	ID[+HIGH]	*íC.	DEPFT
	a.	tinta(goʔta)	*!*			
☞	b.	(tinta)$_{FT}$(goʔta)			*	*
	c.	(tenta)$_{FT}$(goʔta)		*!		*

At the phrase level, there is a second constraint responsible for height adjustment, (370), which mitigates against unstressed mid vowels.

(370) *ĕ
Count a violation for a mid vowel not dominated by a head syllable.

This constraint is again variably ranked with respect to the faithfulness constraint. Syllables that lose their stress at the phrase level due to CLASH-HEAD raise a potential mid vowel, if *ĕ outranks faithfulness. This is true for open and closed syllables, see (371) and (372) respectively.

(371) *Optional raising in closed destressed syllable*

		(lok)$_{FT}$(lokɲa)$_{HDFT}$	CLASH-HEAD	*ĕ	ID[±+h]
	a.	(lok)$_{FT}$(lokɲa)$_{HDFT}$	*!		
	b.	lok(lokɲa)$_{HDFT}$		*!	
☞	c.	luk(lokɲa)$_{HDFT}$			*

(372) *Optional raising in open destressed syllable*

		$(ne)_{Ft}(nihu)_{HdFt}$	Clash-Head	*ĕ	Id[±+h]
	a.	$(ne)_{Ft}(nihu)_{HdFt}$	*!		
	b.	$ne(nihu)_{HdFt}$		*!	
☞	c.	$ni(nihu)_{HdFt}$			*

With the reverse ranking, however, the destressed vowels remain mid, as showed in (373) for loklókɲa.

(373) *Optional non raising in closed destressed syllable*

		$(lok)_{Ft}(lok\text{ɲ}a)_{HdFt}$	Clash-Head	Id[±+h]	*ĕ
	a.	$(lok)_{Ft}(lok\text{ɲ}a)_{HdFt}$	*!		
☞	b.	$lok(lok\text{ɲ}a)_{HdFt}$			*
	c.	$luk(lok\text{ɲ}a)_{HdFt}$		*!	

This bi-level attribution of height adjustment allows for a Duke-of-York derivation: An underlyingly high vowel, e.g. if we assume that [lokluk] is underlyingly /lukluk/, might be lowered at the word level for being in a secondarily stressed syllable, but be raised again to its original shape at the phrase level because the syllable has lost its stress, i.e. /lúkluk-ɲa/→lùklúkɲa→ lòklók-ɲa→[lu klókɲa]. As we will see in the following, such a Duke-of-York derivation is necessary for cases where the destressed vowel is followed by a geminate.

As we have seen, mid vowels in underived open syllables, that is, the few vowels for which it is necessary to assume that they are underlyingly mid, are optionally lowered if destressed. However, this optionality does not exists in syllables where the openness is of the syllable is not underlying, but derived. If degemination opens a syllable – recall that syllables opened by degemenination always end up stressless – these syllables obligatorily show up with a high vowel. To solve this puzzle, I suggest that vowels in front of geminates (or even in all closed syllables) are always high when they reach the word level. This can be derived in at least three ways: It could be an accident of the lexicon – most words with geminates are native, whereas the underlying mid vowels are from the loaned vocabulary. Or it could be principled, either due to a morpheme structure constraint or due to a raising process at the stem level. This would account better for the fact that loans with geminates do not seem to differ from native vocabulary. The last option might have the problem that raising in closed syllables is typologically awkward. For now, I will remain agnostic on this question and just assume that in the word-level input, there are no mid-vowels before a geminate. The tableau in (374) shows the derivation of the obligatory high vowel under degemination.

(374) *Word level: Interaction of lowering and degemination*

	gi(nip)$_{FT}$(pimmu)$_{HDFT}$	*íC.	CE-C/FT	ID-GEM	ID[±h]
a.	gi(nip)$_{FT}$(pimmu)$_{HDFT}$	*!*	*		
b.	gi(nip)$_{FT}$(pemmu)$_{HDFT}$	*!	*		*
c.	gi(nep)$_{FT}$(pemmu)$_{HDFT}$		*!	**	
d.	gi(ni)$_{FT}$(pemmu)$_{HDFT}$			*	*
e.	gi(ne)$_{FT}$(pemmu)$_{HDFT}$			*	**!

In the co-grammar in which degemination applies, candidates a. to c. are out because they do not degeminate. In addition, candidates a. and b. violate the constraint against stressed closed syllables with high vowels. Candidates d. and e. degeminate, creating thus an open, stressed syllable. In principle, both high and mid vowels are acceptable in this position. However, because I assume that before a geminate all non-low vowels enter the word level as high, candidate e. incurs an additional gratuitous violation of faithfulness. Note that the ranking of IDGEM and ID± high is not trivial, as the reverse ranking would predict degemination to apply if the vowel preceding the geminate is high, in order to prevent lowering.

At the phrase level, non of the optional rankings can yield a mid vowel in this situation: The rankings can lower in secondarily stressed syllables, but this syllable loses its stress; or preserve mid vowels in destressed syllables, but here the vowel is high and remains high.

If degemination does not apply at the word level, the destressed vowel may either be mid – lowered at the word level, preserved at the phrase level, or high – lowered at the word level, and raised at the phrase level in a Duke-of-York fashion.

4.5.8 Summary and conclusion

Stress and its interactions with segmental processes in Chamorro constitute a notably early argument against cyclic frameworks and for transderivationality. For a work on countercyclic processes it is thus a worthwhile endeavour to show that Chamorro can be derived in a cyclic framework with comparatively strict assumptions. The analysis and its level are summarised in (375).

(375) *Stratal affiliation of processes*

Stem level
Stress competition
Gemination
Infix-umlaut

Word level
Clitic-umlaut
Optional degemination
Obligatory lowering

Phrase level
Destressing (ω-bound)
Rhythmic secondary stress (ω-bound)
Optional lowering
Optional raising

This analysis is not compatible with Richness of the Base. As has been pointed out, I must assume that roots have an underlying foot, but not a head foot. Prefixes can have a head foot, or be unfooted, but cannot carry a regular foot. Furthermore, I must make assumptions on the underliyng distributions of mid vowels: They must not appear in open syllables that are not an underlying head syllable. Otherwise, we would expect to find high vowels that become mid, if stress is shifted onto them, like *néni~ninéhu, which seems to be unattested. Finally, my analysis makes crucial use of Duke-of-York derivations. Duke-of-York derivations have been criticised as an unjustifiable artefact of serial phonology (McCarthy 2003b), but there have been recent arguments that Duke-of-York patterns must be accounted for since feeding Duke-of-York patterns occur in natural language (Gleim 2019). The Chamorro case is different, technically one can devise a system in which the high vowel is never mid, as its midness leaves no traces in the derivation. However, in order to derive the difference between underlyingly open syllables, and syllables that are opened up by degemination, it would be necessary to adopt morpheme structure constraints and sort of introduce the Duke-of York in that way.

4.6 Kimatuumbi: Two Countercyclic Interactions with Word-Level Gliding

Arguably the most complex cases of countercyclicity come from Kimatuumbi (Bantu, Odden 1993, 1996), where two separate processes interact countercyclically with another process, namely glide formation or gliding. Gliding is a lexical process that applies both at the stem and at the word level. It counterfeeds Shortening, a process that is sensitive to phrasal information, and is bled by Initial Tone Insertion (ITI), a different phrasal process. Odden's solution to this problem is to make cyclicity considerably weaker: A rule R that applies on a cycle φ_i can be sensitive to the entire structure in which it is embedded. This way, the phrasal processes can be reanalysed as belonging to a previous cycle or stratum. Imagine the structure and process in (376). In a classical cyclic framework we have to say that the Rule A→B__C applies at φ_j whereas Odden can postulate that it applies already on φ_i.

(376) $[[A]_i C]_j \rightarrow [[B]_i C]_j$

The aim of this section is to re-analyse the two purported countercyclic interactions in a cyclic way. My analysis of the shortening-gliding interaction is similar to Odden's — I believe that shortening is indeed a stem-level process, but I will liberate it from any reference to phrasal information, making its application compatible with cyclicity. For the other interaction, I go the opposite way and argue that gliding applies even at the phrase level, and that is is exactly those instances of gliding that can be bled by ITI.

The challenges that Kimatuumbi poses for cyclicity are well known. It is, in that sense, one of the famous challenges alongside Chamorro and Hijazi Bedouin Arabic. Kaisse & McMahon (2011) say about Kimatuumbi glide formation: 'But the case is extremely unusual and complex; again, it is not the sort of thing phonologists run into more than once or twice in a career' (Kaisse & McMahon 2011: 2244). In opposition to the other cases, there have been very few attempts, if any, to reanalyse the Kimatuumbi interactions in more mainstream framework, be it cyclic or non-cyclic. An exception for this is Truckenbrodt (1995, 1999), who analyses parts of the data in parallel prosodic OT, such as shortening, but leaves out the crucial countercyclic interaction with gliding.

Since the data is very intricate, I will introduce it piecewise. In section 4.6.1, I will briefly introduce the first countercyclic problem, the interaction of gliding and ITI, and sketch out the solution to it. After discussing the data that shows gliding in more depth in section 4.6.2, I propose a comprehensive analysis of gliding, the crucial process for both countercyclic interactions (section 4.6.3). Afterwards, I zoom in on ITI, and show that an analysis of ITI as a phonological process is problematic (section 4.6.4). Instead, I argue, it should be considered allomorphy. However, it is not straightforward to model this allomorphy (or process, even) without a good grasp of the tonology in Kimatuumbi, which I discuss and analyse in 4.6.5. This gives us the means to finalise the analysis of this countercyclic interaction in section 4.6.7. In section 4.6.8, then, I will discuss the second process that interacts countercyclically with gliding, and suggest that shortening is a stem-level reflex of an Ezafe-morpheme.

4.6.1 Gliding and ITI: analysis in a nutshell

Gliding is a process that transforms the sequence high vowel-vowel into a sequence glide-long vowel, high vowels being į and ų.[122] As can be seen in (377), gliding is a word-bound process that does not apply across word boundaries: In (377a), the vowel of the class prefix *į* surfaces as a glide, because it is followed by a vowel. In (377b), the high vowel of *įtabų́* is also followed by a vowel, but it does not glide, because there is a word boundary between the two vowels.[123]

(377) *Gliding is applies inside words, but is blocked by word boundaries*

a. į-ų́lá → jųų́lá
CL-frog
'frogs' (DO96:113)

b. įtabų́ asį́mįlwá *įtabwáasį́mįlwá
'borrowed books' (DO96:126)

Crucially, gliding can be blocked for purely phonological reasons, namely if the high vowel that would undergo gliding has a high tone and the *following* vowel is long, compare (378). There, the prefix *nį́* carries a high tone on its vowel, and the stem initial vowel is long, and the high vowel surfaces faithfully as a vowel in the output. Both conditions must be met in order for gliding to be blocked, as will be seen in section 4.6.2. Less importantly for our purposes, gliding is also blocked if the high vowel itself is long.

(378) *Gliding is blocked by high tone + long vowel*
pa-tų́-aándįįké → patų́aándįįké
COMP-1PL-write.PFV
'when we wrote' (DO96:295)

The second process is Initial Tone Insertion (ITI). It inserts an initial high tone on the first mora of a closed class of morphemes, including some prefixes, under very peculiar phrasal conditions; For now we can simplify them as 'insert a high tone on the first mora, if a preceding word has no high tone', see (379), in which 'ɡanį has a high tone after a toneless word, *kįbao* 'tool', but no high tone after a word with a tone, *kįtumbį́* 'hill'.

[122]The data is given in IPA, except for the vowels, where I follow Odden's convention: The high vowels are į, ų and the high-mid and low-mid vowels are i,u and e,o respectively.
[123]All examples are from Odden (1996), in the examples given as DO96.

(379) *ITI is sensitive to the phrasal context*

a. kɪ̧bao gánɪ̧
'which stool' (DO96:245)

b. kɪ̧tumbɪ̧́ ganɪ̧
'which hill' (DO96:245)

Now, since ITI refers to phrasal information and gliding does not, the cyclic prediction would be that a high vowel that can become high toned via ITI and appears in a glidable context, glides before it can acquire the high tone that would save it from gliding. The high tone would then associate to the newly formed long vowel. However, this is not the case: high tone insertion bleeds gliding. Compare (380a), where the vowel of the prefix *kʊ̧* glides and there is no high tone insertion because *ʊ̧tɪ̧lɪ̧́* has a high tone, with (380b), where a high tone is inserted onto *kʊ̧* and gliding does not apply.

(380) *ITI bleeds Gliding*

a. ʊ̧tɪ̧lɪ̧́ kʊ̧-aanɟʊ̧́ → ʊ̧tɪ̧lɪ̧ kwaanɟʊ̧́
2SG-run.PFV.SBJV to-firewood
'You should run to the firewood' (DO96:275)

b. ʊ̧tɪ̧lɪ̧ kʊ̧-aanɟʊ̧́ → ʊ̧tɪ̧lɪ̧ k**ʊ̧́aa**nɟʊ̧́
2SG-run.PFV to-firewood
'You ran to the firewood' (DO96:275)

The gist of the cyclic reanalysis is the following: The prefixes that can undergo ITI, as well as gliding, are phrasal functional words, but integrate into the prosodic word that has been built on previous cycles, just as I assume for the masculine articles in Icelandic in section 4.4. Gliding is not only a stem- and word level process, but also a phrasal process. However, phrasally, it cannot apply across prosodic words, which makes it de facto restricted to the aforementioned prefixes. A bleeding interaction between gliding and a phrasal ITI process should in principle now be derivable. However, I argue that ITI is not a phonological process, but allomorph selection. As such, it precedes the phrasal application of gliding, which also derives the transparent interaction. The analysis is schematically illustrated in (381) for the case where gliding is bled, and (382) for the case in which gliding is not bled.

(381) *Schematic derivation of countercyclic bleeding*

Word level phonology	
aanɟų́	Input
[aanɟų́]$_{\omega}$	Prosodic structure is built
Morphosyntax	
[ųtįlį]$_{\omega}$ {kų́,kų} [aanɟų́]$_{\omega}$	Concatenation
[ųtįlį]$_{\omega}$ kų́ [aanɟų́]$_{\omega}$	Allomorph selection
Phrase level phonology	
[ųtįlį]$_{\omega}$ [kų́aanɟų́]$_{\omega}$	Prosodification
[ųtįlį]$_{\omega}$ [kų́aanɟų́]$_{\omega}$	Gliding is blocked

(382) *Schematic derivation of not-bled phrasal gliding*

Word level phonology	
aanɟų́	Input
[aanɟų́]$_{\omega}$	Prosodic structure is built
Morphosyntax	
[ųtįlį́]$_{\omega}$ {kų́,kų} [aanɟų́]$_{\omega}$	Concatenation
[ųtįlį́]$_{\omega}$ kų [aanɟų́]$_{\omega}$	Allomorph selection
Phrase level phonology	
[ųtįlį́]$_{\omega}$ [kųaanɟų́]$_{\omega}$	Prosodification
[ųtįlį́]$_{\omega}$ [kwaanɟų́]$_{\omega}$	Gliding applies inside ω

Until now, the data have been presented in a very much simplified fashion. In order to devise an analysis that works, it is necessary to discuss the data in detail. In the next section, we will look at gliding and develop an analysis for this process first.

4.6.2 Gliding: data

Vowel hiati inside words[124] are – with some notable exceptions – systematically repaired. The vowel sequence that is relevant for us is the high vowels į or ų followed by any other vowel. If such a sequence arises through concatenation, it is repaired by gliding the high vowel into [j] and [w] respectively, hence the name of the process. Concomitantly, the second vowel is lengthened, which can be regarded as an instance of compensatory lengthening. (383) shows gliding of a high back vowel, from the class prefix *lų*, in front of a low vowel, the root *até*.

(383) *Gliding between high and non-high vowel*
lų-até → lwaaté
CL-banana.hand
'banana hand' (DO96:113)

[124] 'word' here is to be understood pre-theoretically and refers to the root with all prefixes and suffixes.

If two high vowels are concatenated, the pattern is the same: The first one glides, the second lengthens (384). If two identical high vowels are adjacent, there is no (visible) glide, because there are no non-initial *ji̧ and *wu̧ sequences.

(384) *Gliding between two high vowels*

a. i̧-ú̧lá → ju̧ú̧lá
CL-frog
'frogs' (DO96:113)

b. ķi-ú̧lá → kju̧ú̧lá
CL-frog
'frog' (DO96:113)

For the roots in questions, we mostly have independent evidence that they are vowel initial and not glide-initial, and also, that the underlying vowel is short, compare (385), in which some of the roots from above are combined with prefixes that do not have a final high vowel.

(385) *Length is not underlying*

a. ka-ú̧lá → kaú̧lá
DIM-frog
'small frog' (DO96:114)

b. Ø-até → até
CL9-banana.hand
'banana hands' (DO96:114)

Gliding inside words is blocked in two instances: First, if the high vowel is long itself, it does not glide, see (386) where the prefix *mu̧u̧* appears with a long vowel for independent reasons.

(386) *Long high vowels do not glide*
mu̧u̧-Ø-até → mu̧u̧até
in-CL9-banana.hand
'in the banana hands' (DO96:278)

The second instance of blocking is somewhat more unusual and theoretically challenging: A high vowel resists gliding if two conditions are met: It bears a high tone, and the following vowel is long, see (387).

(387) *High toned high vowel + long second vowel block gliding*

a. pa-ní̧-aándi̧i̧ké → paní̧aándi̧i̧ké
COMP-1SG-write.PFV
'when I wrote' (DO96:123)

b. ca-tú̧-oóndi̧té → catú̧oóndí̧té
COMP-1PL-peel.PFV
'what we peeled' (DO96:118)

Note that both conditions must be met together. A high tone alone does not suffice to block gliding, compare (388) where the high toned vowels of the prefixes *nį́* and *tų́* glides, nor does a long second vowel on its own, compare (389) where the low toned prefix vowels of *ų* and *tų* glide, even though they are followed by a long vowel. Be aware that in the case of a long vowel in the second syllable, there is no compensatory lengthening, a super long vowel does not arise.

(388) *High tone alone does not suffice for blocking*

a. pa-nį́-ųtį́té → panjų́ųtįté
COMP-1SG-pull.PFV
'when I pulled' (DO96:123)

b. ca-tų́-asį́įmé → catwáasį́įmé
COMP-1PL-borrow.PFV
'what we borrowed' (DO96:123)

(389) *Long second vowel alone does not suffice for blocking*

a. ų-ų́ųmįte → wų́ųmįte
2SG-win.PFV
'you won' (DO96:116)

b. tų-áandįįke → twáandįįke
1PL-write.PFV
'we wrote' (DO96:116)

In addition, there are a three prefixes (*kį́-*, *tį́-*, *angalį́-*), all having a high tone, that idiosyncratically do not glide, even if they precede a short vowel, see (390).

(390) *Idiosyncratic non-undergoers of gliding*

a. kį́-ųkųmų́ → kį́ųkųmų́
'The Ukumu family' (DO96:122)

b. w-angalį́-éka → wangalį́éka
'without having laughed' (DO96:122)

We have seen now that generally applies inside, but not across, words. However, to acces how gliding behaves inside words, it is important to consider word-internal structure. I will base the description of this structure on Odden's 1996 analysis as a descriptive, but not analytical tool. Odden (1996) assumes three lexical strata, the first of which, Level 1, is equivalent to the traditional stem level, the two others, Level 2 and Level 3, are a stratified word level. Gliding applies in all three level under his analysis. The account that I propose will reduce the number of lexical strata to the traditional two, the stem and word levels. Level 1 in Odden (1996) consists of the root and all suffixes. Since nouns and adjectives do not have suffixes, we can find gliding at the stem level of a plurimorphemic input only in verbs. Here, gliding applies both between a root and a suffix vowel, as well as between two suffix vowels, see (391) for an example of the latter.

(391) *Stem-level Gliding*
akjaana
ak-į-an-a
'to net hunt for each other' (DO96:273)

As we will see below, gliding between prefixes applies left-to-right. Given the few opportunities of gliding in the stem due to the shape of most suffixes, we cannot test whether gliding applies from left to right (equivalent to inward out; since we are talking about suffixes), or right to left in this domain. The instances of blocking discussed above all came from Level 2 and Level 3 (later reanalysed as word and phrase level) instantiation of gliding. That is no accident, because blocking is not really observable at the stem level: Verbs do not have underlying tones, and the grammatical tones are arguably only added at the word level. Furthermore, there are no suffixes that contain an underlyingly long vowel.

Level 2 of Odden's analysis consist of the stem formed at Level 1 and most prefixes. Here, we can observe all of the aforementioned blocking phenomena, in fact, most of the examples above contain Level 2 prefixes, such as for example in (388) or (389) as well as all the examples with noun class prefixes seen so far. Since multiple prefixes may attach to one stem, we can also observe an effect of directionality. If we imagine an input sequence like the one in (392a) and apply gliding, two outcomes are possible.

(392) a. iui
b. juui
c. iwii

First, gliding might apply in the *iu* pair first, yielding *juu*. In the second pair, *ui*, gliding would now be blocked, because due to the compensatory lengthening *u* would not be amenable to gliding any more, compare (392b). This is the outcome that we find in Kimatuumbi, as can be seen in (393). The second option would be to glide *ui* first, yielding *wii*. This, too, would block further gliding, as it repairs both hiati at once, compare (392c). In (393), the prefix *mų* glides, causing compensatory lengthening on the prefix *į*. This compensatory lengthening blocks gliding of *į*, because high long vowels do not glide.[125]

(393) *Gliding applies left-to-right*
mų-į-ųté → mwįįųté *mųjųųté
2PL-OBJ-pull
'you should pull it' (DO96:271)

[125]I'd like the reader to note that this interaction by itself is countercyclic for a framework in which every act of prefixation constitutes a cycle, because it is gliding with the *outer* prefix that bleeds gliding with the inner prefix, and not the reverse.

If there are two Level 2 prefixes, and it is the inner prefix that has the potentially gliding high vowel, gliding is actually optional. This optionality will be crucial in distinguishing word level gliding from, in my analysis, phrase level gliding. Consider the underlying forms in (394). They two possible surface forms: One were gliding applies, and one where gliding underapplies. This property will be important to argue for a difference of cyclic affiliation of the Level 2 prefixes, and the ones that undergo ITI.

(394) *Gliding with a non-leftmost prefix is optional*

a. kʉ-tʉ-ákɨa → kʉtʉákja ~ kʉtwaákja
INF-OBJ.1PL-hunt.BEN
'to hunt for us' (DO96:121)

b. kʉ-nɨ-áandɨka → kʉ-nɨáandɨka ~ kʉnjáandɨka
INF-OBJ.1SG-write
'to write me' (DO96:121)

Gliding with the first prefix though is obligatory, see (395). With prefix es belonging to this level, the leftmost prefix always glides if it can.

(395) *The leftmost prefix glides obligatorily*

a. kɨ-óma → kjoóma * kɨóma
OBJ-spear
'to spear it' (DO96:121)

b. kɨ-áandɨka → kjaándɨka * kɨaándɨka
OBJ-swrite
'to write it' (DO96:121)

Now, let us turn to Odden's Level 3, which I will later reanalyse as phrasal. This level consist of the words formed so far, and a relatively small class of prefixes. For nouns, the relevant ones are the class marker for noun class 5, and the three positional prefixes, listed in (396).[126]

(396) *Level 3 prefixes*

a. lɨ- 'CL5'
b. mʉ- 'in'
c. kʉ- 'to'
d. pa- 'at'

With these prefixes, if gliding is possible, it is obligatory, compare the examples in (397).

(397) *Level 3 prefixes glide obligatorily*

a. kʉ=ɨ-sɨwá → kwɨɨsɨwá
to=CL-island

[126] All prefixes of this level for verbs contain a non-high vowel and are thus not relevant for gliding.

'to the islands' (DO96:113)

b. mʊ=ɪ̧-kálaango → mwɪ̧ɪ̧kálaango
in=CL-frying.pan
'in the frying pans' (DO96:113)

c. mʊ=Ø-eéla → mweéla
in=CL-money
'in money' (DO96:114)

Crucially, the presence of a prefix belonging to this small group does not make the gliding of a following prefix optional, either. In (398), gliding between Level 2 prefixes and the stem must apply, even though the vowels that glides does not belong to the leftmost prefix by virtue of the prefixation of the Level 3 prefix. This is an argument for the cyclic organisation: At the time where we decide whether e.g. *lʊ* in (398a) glides obligatorily or optionally, it must glide obligatorily as the outer prefix is not yet added, and leftmost prefixes have to glide.

(398) *L3 prefixes do not make the gliding of L2 prefixes optional*

a. pa=lʊ-áanɟʊ́ → palwáanɟʊ́ *palʊáanɟʊ́
at=CL-firewood
'at the firewood' (DO96:272)

b. mʊ=kɪ-átɪ́ → mʊkjaátɪ́ * mʊkɪátɪ́
in=CL-family.farm
'on the family farm' (DO96:271)

However, gliding is blocked by an iteration of gliding between a Level 3 prefix and a root or another Level 2 prefix, see (399). This is of course motivated in a cyclic approach where the inner prefix is visible first, but it is a challenge for a non cyclic approach, since we have both outward or right to left gliding and inward or left to right gliding among prefixes.

(399) *Gliding between inner prefix and stem blocks gliding of L3 prefix*
mʊ=ɪ-ʊ́lá → mʊjʊʊ́lá *mwɪɪʊ́lá
in=CL-frog
'in the frog' (DO96:271)

Lastly, as mentioned in section 4.6.1, gliding is sensitive to boundaries: It only applies between affixes; or between affixes and roots. It never applies across word boundaries, see (400).

(400) *Gliding is blocked across word boundaries*

a. lɪkaʊ́lɪ alíli *lɪkaʊ́ljaalíli
'that grave' (DO96:126)

b. ɪtabʊ́ asɪ́mɪlwá *ɪtabwáasɪ́mɪlwá
'borrowed books' (DO96:126)

Gliding is therefore a process that is restricted to words and shows some signs of cyclicity, namely the blocking of gliding between outer and inner prefixes if the inner prefixes have glided first. This is not an instance of directionality, since directionality is otherwise left to right. The other sign of cyclicity is the lack of optionality of gliding for prefixes that are on the surface not at the left edge of the word, but became so by concatenation of a Level 3 prefix. Both properties follow if the Level 3 prefixes belong to an outer cycle, so that at the stage where left-to-right gliding applies first, there is no outer affix that could block it, whether obligatorily by gliding first or optionally by simply being present. Gliding is blocked under certain purely phonological conditions, which display a somewhat cumulative effect: Length of the second vowel and a high tone on the first alone do not suffice to block gliding, but do block it if they coöccur. In the next section, I present an analysis of gliding in Stratal OT that assumes only three strata, instead of the four assumed by Odden and that have been employed for exposition and comparability in this section.

4.6.3 Gliding: analysis

I diverge in the stratal affiliation from Odden by conflating his Level 3, with the phrase level. This level contains only a small class of affixes, listed in (396) above. I assume that those affixes are phrasal affixes:[127] functional morphemes that are accessible at the phrase level but integrate into some prosodic category with their host. For Kimatuumbi, I will assume that this prosodic category is the phonological word ω. As in the analysis of Icelandic, I assume that the prefixes enter the phrase level without a prosodic word and must be dominated by one. The other two strata are identical to Odden's first two lexical strata, in regard of the affiliated morphemes. His Level 1 equates to my stem level and his Level 2 to my word level. (401) compares the levels I assume with the levels found in Odden (1996).

(401) *Comparison of levels assumed here with levels in Odden (1996)*

<table>
<tr><th>Odden (1996)</th><th>Present analysis</th></tr>
<tr><td>Level 1</td><td>Stem level</td></tr>
<tr><td>Level 2</td><td>Word level</td></tr>
<tr><td>Level 3</td><td rowspan="2">Phrase level</td></tr>
<tr><td>Postlexical level</td></tr>
</table>

In the remainder of this section, I will go through each stratum and introduce the relevant constraints and their ranking in order to derive gliding. Special focus will be

[127]A phrasal affix can mean two different things: It can either be, as described here, a (functional) morpheme that is syntactically independent, but prosodically integrated with some host (cf. Peperkamp (1996); Bermúdez-Otero & Luís (2009)); or it can be an affix that is inserted into an otherwise already build, post syntactic phonological structure by a special morphological operation (Anderson 2005, 2008). In a framework where all morphology is postsyntactic, the denomination 'phrasal affix' might not be too informative. As discussed in section 4.6.7, the ITI morpheme I propose is problematic for most morphological theories, because its allomorph selection is outward oriented.

put on the conditions that block gliding at the word and phrase level, the triggering conditions will be the same at all strata.

4.6.3.1 Stem level

At the stem level, gliding is only observable via alternating forms for verbs, because only verbs have suffixes. We do not find all instances of blocking in the stem level, because verbs do not have underlying tones, and very rarely underlyingly long suffix vowels.[128]

Therefore, we can observe the effects of some of the basic constraints responsible for gliding on the stem level very neatly. Gliding is triggered by the constraint in (402). A more comprehensive analysis of Kimatuumbi pohonology could probably reduce this constraint to a general *V.V against hiati, but since this work only deals with high vowels and gliding, I will abstain from elaborating this possibility.

(402) *i.V
Count a violation for every hiatus where the first vowel is high.

This constraint is fatally violated by the faithful candidate a. in the tableau in (404).[129] Compensatory lengthening is induced by the constraint in (403), against the deletion of morae.

(403) MAX-μ
Count a violation for every input mora absent in the output.

These constraints prefers candidate b. over candidate c., which fails to lengthen compensatorily, making candidate b. the winner. Candidate b. shifts the mora of the high vowel onto the second vowel, so that it is associated with two morae and thus realised as long. Candidate c. on the other hand deletes the mora instead of shifting it.

(404) *Derivation of stem level gliding*

		akḭana	*i.V	*.μμμ.	MAX-μ	*.μμ.
	a.	akḭana	*!			
☞	b.	akjaana				*
	c.	akjana			*!	

Compensatory lengthening does not create super-long vowels, but they could not arise on the stem level anyway because there are no suffixes with long vowels. The

[128] The only suffix with a long vowel is -aaŋ, the verbal plural (Odden 1996: 49), which is hardly used in the examples in Odden (1996).

[129] Of course there need to be highly ranked faithfulness constraints that rule out other potential repairs of the hiatus, such as MAX-V against vowel deletion and DEP-C against consonant insertion. Since those constraints do not interact meaningfully with any of the processes discussed here, I will omit them and candidates that violate them from the tableaux.

stem level thus exemplifies the effect of the two basic constraint that shape gliding, a constraint against hiati and a constraint against mora deletion.

4.6.3.2 Word level

The same constraints are active on the word level, but *i.V cannot be undominated here: There is blocking of gliding so that some hiati, namely of the type íVV, that is, a high toned high vowel followed by a long vowel, surface faithfully. But, let us start wit the configuration that is the most similar to the stem level: a toneless high vowel followed by a toneless second vowel. Here, gliding works exactly as in the stem level cases discussed above.

As we have seen, a high tone alone is not enough to block gliding, as could be seen in example (388) above. The derivation looks basically identical to the one in (404), just that the high tone crucially stays on the mora it came along with. In this case, we would not expect any tone shifting, but importantly, there is no tone shifting at all in Kimatuumbi at the word and phrase level. So, I assume that this is due to a very high ranked constraint *SHIFT, defined in (405),[130] against tone shifting.

(405) *SHIFT
Count a violation for a tone that is associated in the input to a mora μ_i but in the output associated to a mora μ_j and not associated to μ_i.

(406) *Derivation of gliding of a high toned high vowel*

	ḭ́a	*SHIFT	MAX-T	*.μ́μμ.	*i.V	MAX-μ	*.μμμ.
	a. ḭ́a				*!		
☞	b. jáa						
	c. jaa		*!				
	d. jaá	*!					

The faithful candidate a. in (406) trivially violates the constraint against hiati and is thus suboptimal. Candidate b. is the winner, it leaves the tone on its original mora but shifts the melody to the low vowel. Candidate d. shifts the tone onto the other mora, which in this case serves no purpose. The next instance where gliding is *not* blocked is if the second vowel is long, but the high vowel is toneless, iVV. As mention before, this configuration does not yield an overlong vowel at the surface, so compensatory lengthening does not apply. I assume that this is actually an effect of the phrase level phonology, and that the word level does have super long vowels in its output. This will turn out to be useful for the analysis, but there is an independent empirical reason, too: morphological verb tone which is in some instances mora-counting, discussed in a little more detail in section 4.6.5.5, does consider the extra mora of superlong vowels. Consider the recent past subordinate, where a high tone appears

[130]For the reminder of the analysis of gliding, inputs and outputs in tableaux will consist only of the crucial vowel sequences, chiefly to save space.

on the second mora of the stem (including the object prefix *kį*-). In (407a), the verb root is vowel initial, the second mora is the first root mora, the high tone appears here. In (407b), the root is vowel initial, the prefix glides but no vowel is lost on the surface. The high tone is on the second mora. In (407c) however, the root starts with a long vowel, on the surface, a mora is lost. the high tone appears on the first mora on the surface, against the generalisation that it should appear on the second mora. If the long vowel is however trimoraic at the time morphological tone is assigned this pattern can be easily derived.

(407) *Mora counting verb tone*

a. [patų́kįtél̥įįké]
/pa-tų́-kį-teliįke/
COMP-1PL-CL7.OBJ-cook.PFV
'that we cooked it' (DO96:295)

b. [patų́kjaálįbįįcé]
/pa-tų́-kį-alįbįįce/
COMP-1PL-CL7.OBJ-destroy.PFV
'that we destroyed it' (DO96:295)

c. [patų́kjóondįté]
/pa-tų́-kį-oondįte/
COMP-1PL-CL7.OBJ-peel.PFV
'that we peeled it' (DO96:295)

I propose thus that there is a constraint against super-long vowels in the language (408). It is undominated at the phrase level so that no such vowel reaches the surface, but it is lowly ranked at the word level. The ranking in (409) derives a super-long vowel for this intermediate stage of the derivation.

(408) *.μμμ.
Count a violation for every syllable dominating more then two morae.

(409) *Derivation of gliding before a long vowel*

	iaá	*.μ́μμ.	*i.V	Max-μ	*.μμμ.	*.μμ.
	a. įaá		*!			
☞	b. jaaá				*	
	c. jaá			*!		

Candidate a. violates, again, the constraints against hiati. Candidate c. is suboptimal compared to the winner candidate b., because it deletes a mora. At this level, it is better to created a marked superlong vowel than to lose morae.

As mentioned before, the blocking of gliding can be envisioned as some sort of cumulative effect, that could be derived in OT with means such as local conjunction or harmonic grammar (Smolensky 2006; Pater 2016; Jeney 2016). I will not take any of those routes, though they are in principle compatible with my core assumptions. The blocking can also be derived with more conservative means, namely the aforementioned *Shift constraint and the slightly ad-hoc constraint in (410).[131] This constraint penalises super-long vowels with an initial high tone.

(410) $*.\acute{\mu}\mu\mu.$
Count a violation for every super-long syllable with a high toned first mora.

The tableau in (411) shows how these constraints interact. Candidate a. is the faithful candidate and the winner, it violates of course the constraint *i.V against hiati.

(411) *Derivation of blocking of gliding in a íVV sequence*

		į́aa	*Shift	Max-T	*.µ́µµ.	*i.V	Max-µ	*.µµµ.
☞	a.	į́aa				*		
	b.	jáaa			*!			*
	c.	jaaa		*!			*	
	d.	jaáa	*!				*	
	e.	jáa	*!				*	

Candidate b. glides the high vowel, the tone of the high vowel stays on its original mora. This violates the new constraint (410) against a super long vowel with a high-toned first mora. Candidate c. deletes the tone and creates a licit superlong vowel, but it is ruled out by a high ranked constraint against tone deletion. Candidate d. shifts the tone to another mora and creates a licit superlong vowel in this way, but it violates *Shift, which is generally not a possibility in Kimatuumbi. At last, candidate e. shortens the vowel to a regular long vowel. This candidate does not win, because it also occurs a violation of *Shift in order to save the tone.

4.6.3.3 Phrase level

Gliding at the phrase level is different from gliding at the levels before in two crucial respects. First, it is blocked across word boundaries. Second, it cannot result in overlong vowels, as there are no overlong vowels at the surface.[132] As a consequence, the blocking of gliding in íVV sequences, which is attested on the phrase level as well as on the word level, must be slightly different.

The second difference of the phrase level means for the ranking that *µµµ must outrank Max-µ, precisely because there are no overlong vowels. This leads to the shortening of the overlong vowels created at the previous stage, compare the tableau

[131] Of course, this constraint can be deconstructed as a local conjunction of *.µµµ. and a constraint against high toned first morae. The latter would however be as ad-hoc as the constraint proposed in (410)

[132] An alternative approach could be to postulate that the neutralisation of long and overlong vowels is an effect of phonetic implementation.

in (412). Shortening can lead to the more unmarked falling tone, if the high tone was on the first mora, or to the rising tone if it was a rising tone all along, as in (412). The winner, candidate b. loses a mora, but avoids the marked overlong vowel of the faithful candidate a.

(412) *Detivation of shortening of superlong vowels*

	jaaá	*SHIFT	MAX-T	*.µ́µµ.	*i.V	*.µµµ.	MAX-µ
	a. jaaá					*!	
☞	b. jaá						*

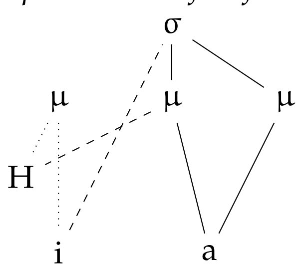
This ranking leads to shortening from an input that yielded overlong vowels at the word level, a high vowel followed by a long vowel, see (413). Here, the mora of the high vowel is lost, which is better than accepting a hiatus (candidate a.) or an overlong vowel (candidate c.).

(413) *Derivation of mora loss in order to glide*

	i̯aá	*SHIFT	MAX-T	*.µ́µµ.	*i.V	*.µµµ.	MAX-µ
	a. i̯aá				*!		
☞	b. jaá						*
	c. jaaá					*!	

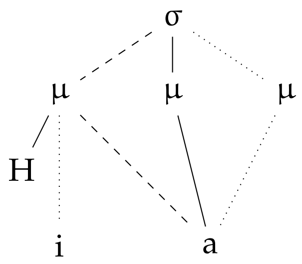
If the input is /íVV/ however, whether inherited from the word level or newly created via concatenation, there is neither shortening nor gliding: The input surfaces faithfully. *.µ́µµ alone in combination with MAX-T and *SHIFT is not enough to derive the blocking at the phrase level. We thus need to consider more shortened candidates, because shortening is in general available at the phrase level and not blocked outright. Such canditates violate *SHIFT, if the deleted mora is the one that originally belonged to the high vowel and the tone is shifted to a new mora, as in the autosegmental mapping in (414). Here, dotted lines indicate deleted associations (that is, the leftmost mora belonging to the high vowel is deleted) and dashed lines indicate new associations, the high vowel becomes an onset, and the high tone shifts.

(414) *Represenation of shifted high tone*



However, an identical surface form can arise, if one of the two morae belonging to the long vowel is deleted, and the tone does not shift mora. Instead, the mora associates to the second vowel instead. This is illustrated by the structure in (415). The line between the high vowel and the syllable node (as it becomes the onset j that linearly precedes all morae) is omitted in order to reduce clutter.

(415) *Representation of shortened long vowel*



Whereas (414) can be excluded by *Shift, a new constraint is needed to prevent a candidate like (415) from winning. Thankfully, such a constraint is well motivated and readily available: long vowels are more resistant to various phonological processes, and this has been accounted for with various constraints (Morén 1997; Urbanczyk 1999), (416) being one possibility.[133]

(416) Max-V:
Count a violation for any mora that is associated with a vowel that is associated to another mora in the input and is not present in the output.

This constraint must outrank *i.V. The subscript numbers in the tableau in (417) are the indices of the morae that the vowels are associated with, not of the vocalic melodies.

(417) *Derivation of blocking of gliding with íVV*

		í̯$_i$a$_j$a$_k$	*Shift	Max-V:	Max-T	*.μ́μμ.	*i.V	*.μμμ.	Max-μ
☞	a.	í̯$_i$a$_j$a$_k$					*		
	b.	já$_i$a$_j$a$_k$				*!		*	
	c.	ja$_j$a$_k$			*!				*
	d.	já$_j$a$_k$	*!						*
	e.	já$_i$a$_k$		*!					*

Candidate a. is the faithful candidate and the winner. Candidates d. and e. are the most interesting contenders: d., equivalent to (414) violates *Shift because moves the high tone onto a mora of the long vowel, which it conserves both. Candidate e., equivalent to (415), violates Max-V: by deleting a mora that belongs to a long vowel. Since there is no candidate that could satisfy both constraints and also *i.V; and since

[133]The exact same constraint cannot be employed to derive the blocking of gliding if the high vowel is long, however, this can be done by a very similar faithfulness constraint that protects the association between a mora and a long vowel. Depending on the interpretation of the Max constraint family, these constraints can potentially be fused.

both constraints outrank *i.V, the faithful candidate is preferred.

The second difference between the word and the phrase level in gliding is that gliding is blocked across certain category boundaries at the phrase level. I will assume that this category is the phonological word. Since all the relevant phonological word boundaries are inherited from the word level, a faithfulness constraint such as the one in (418) can protect certain characteristics of input phonological words.

(418) *EXCORPORATE-ω
Count a violation for a final[134] mora dominated by ω_i in the input that is not dominated by ω_i in the output.

The relevant aspect that needs protecting here is the position at a (right) word edge. Gliding would in any case shift the underlyingly final high vowel away from the right word edge, see the tableau in (419).

(419) *Derivation of blocking of gliding across word boundaries*

		...i̯]$_\omega$[a...]$_\omega$	*SHIFT	MAX-T	EXC-ω	*i.V	*.μμμ.	MAX-μ
☞	a.	...i̯]$_\omega$[a...]$_\omega$				*		
	b.	...]$_\omega$[ja...]$_\omega$			*!			

Here, candidate a. is the winner, even though it creates a hiatus, because the contender candidate b., which moves a mora from its input phonological word into the adjacent phonological word, violates the higher ranked constraint against the excorporation of final morae.

4.6.4 Interaction: data, analysis, problems

The reanalysis of the strata in Kimatuumbi and the assumption that gliding (also) applies at the phrase level are the core ingredients to make a cyclic reanalysis of the gliding-ITI interaction possible: If ITI is phrasal, and some instances of gliding are phrasal, a bleeding relationship between ITI and those instances of gliding is absolutely expected.[135] However, if we look into ITI in detail, it becomes apparent

[134] For our purposes, final and initial morae behave the same. However, there is a process in Kimatuumbi where word-initial morae associated to nasals de-associate from the nasasl which results in compensatory lengthening of the preceding vowel across word boundaries (Odden 1996: 135). This process must be distingushed, either, as done here, by refering to initiality/finality, or by referring to the nasal/vowel difference.

[135] While a countercyclic bleeding interaction is in principle derivable, Kimatuumbi is in fact challenging even if we disregard the evidence that ITI is not a phonological process discussed here. In order to derive the bleeding interaction we would need a constraint prefers the winner to the candidate where the high tone associates to the high vowel over the candidate where the high vowel glides and the tone associates to the following vowel. Given that it cannot be faithfulness, because the tone is the result of a process in this type of account, it is unclear what constraint this could be. Bleeding in OT generally works so that a repair that is normally not available in a marked situation A becomes available if A overlaps with a marked situation B, the repair used for B obviates the need to repair

that it does not look at all like a regular phonological process. First, the target of the process, i.e. the locus of tone insertion, is not phonologically predictable. Second, the trigger of tone insertion, that is the context in which the tone is inserted, is only partially phonological. Due to these two characteristics, especially the first, I contend that ITI is indeed not a process but an instance of allomorph selection. I assume, following i.a. Paster (2006); Pak (2016); Rasin & Trommer (2019); Kalin (2020, 2022a,b) and contra Mascaró (1996), that (phrasal) allomorph selection precedes the application of (phrasal) phonology.[136] In the remainder of this section, I go through the conditions on the ITI triggers and targets and propose a first approximation of a selection frame for the ITI allomorphs. This frame will be significantly simplified and changed after delving into the tonal grammar of the language in section 4.6.5.

First, let us look at the targets. Certain morphemes appear with a high tone on the first mora in some contexts, and without it in other contexts, like the modifier meaning 'which' in (420).

(420) *Basic ITI pattern*

a. ki̧bao g**á**ni̧
'which stool' (DO96:245)

b. ki̧tumbí̧ g**a**ni̧
'which hill' (DO96:245)

These morphemes are independent function words, (421), but also include some prefixes (422), as well as some (arguably) lexical words (423), including class 9 adjectives that have a (stable) high tone on the first mora in other classes.[137]

(421) *ITI mophemes: function words*

a. ntupú 'is not' (DO96:44-46)

b. (all?) wh words: gani̧ 'which', kili 'what', namani̧ 'what', ki̧ti̧wi̧ 'how' bu̧li̧ 'how', ɲai̧ 'who', gaaku 'what kind' (DO96:34)

(422) *ITI mophemes: prefixes*

a. Determiner prefix: a- (DO96:44-46)

b. Prepositions: na- 'with', ku̧-, mu̧-, pa- (DO96:44-46)

c. subordinate verb prefix: ka- (DO96:44-46)

for A. In order to transfer this type of analysis to Kimatuumbi, one would have to say that a í.aa structure does not violate the constraint responsible for glide formation. This is technically possible, but would result in a rather odd constraint that is violated by a hiatus except if the high vowel has a high tone and the second vowel is long. This would replicate convoluted blocking condidtions that have been criticised in rule based phonology in an OT framework. Blocking should follow from constraint interaction, not be hard coded in the constraint.

[136] This is however not a core assumption — this analysis could – with the necessary adjustments – arguably be transferred to a system where phonology and allomorph selection are parallel.

[137] This group is potentially very small: underived adjectives in Bantu are a closed class, including in Kimatuumbi (Odden 1996: 55). Odden (1996) does not give an exact number, in related languages the number is in the low tens. In Odden (1996) 8 such adjectives appear(kúlú, sí̧ní̧, keéle, poú̧, maú̧, laáso, epeési̧, i̧í̧pi̧, mí̧gí̧), of which only three, kúlú 'big' sí̧ní̧ 'small' and mí̧gí̧ 'raw' qualify for ITI in class 9.

d. Numeral prefixes: jʉ-, ba-, gʉ-... (DO96:34)
e. Determiner prefixes: ju-, a-, gu-... (DO96:34)

(423) *ITI mophemes: arguably lexical words*

a. kįndaáį 'today', malaáu 'tomorrow', ncece 'four' (DO96:44-46)
b. Some class 9 underived adjectives, e.g. kúlú 'big' (DO96:44-46)

The prefixes that show ITI are the locative prepositional prefixes, which will be relevant to us, and the determiner and numeral prefixes. These mark agreement for noun class; since they attach to a closed class of roots only (demonstratives, associative word, possessive pronouns, one, two), all of which are consonant or short vowel initial, the insight we can gather from them with respect to the interaction of ITI and gliding is limited. Underived adjectives small, closed class of words, and do not offer any locus for gliding either.

There is also optional ITI on nouns that have a long vowel in their first syllable, see (424). Because the data on ITI on long vowels is incomplete, and since it shows relevant phonological differences with respect to the other instances of ITI (namely optionality, and an OCP effect, compare Odden 1996: 246ff), I will exclude it from the analysis.

(424) *Optional ITI with long vowels*
m-bala ŋgweená → mbala ŋgw**é**ená ~ mbala ŋgw**e**ená
1SG-want crocodile
'I want a crocodile' (DO96:246-47)

The triggering context of ITI is an even bigger challenge than the targets. As mentioned above, ITI is — very roughly – triggered if the target is preceded by word with no high tones. This can be seen in the examples above, some are repeated in (425).

(425) *ITI morphemes following toneless words*

a. m-bala ŋgweená → mbala ŋgw**é**ená
1SG-want crocodile
'I want a crocodile' (DO96:246)

b. kįbao g**á**nį
'which stool'

c. į-jʉnį į-bilį →įjʉnį **į́**bilį
CL8-bird CL4/8.NUM-two
'two birds' (DO96:35)

d. mwaana kįtįwį →mwaana k**į́**tįwį
child how
'how [did he kill] the child?' (DO96:245)

If there is a high tone, ITI generally does not apply, see (426). As (426c) shows,[138] this high tone can be quite a distance removed from the ITI morpheme, there are three intervening toneless morae between the target *kɨ̧tɨ̧́wɨ̧* and the the triggering high toned mora in *tú*.

(426) *ITI morphemes following words with high tone*

a. kɨ̧tumbɨ̧́ g**a**nɨ̧
'which hill' (DO96:245)

b. mɨ̧-kóŋgo ɨ̧-bilɨ̧ →mɨ̧kóŋgo **ɨ̧**bilɨ̧
CL8-tree CL4/8.NUM-two
'two trees' (DO96:35)

c. kɨ̧-túumbili kɨ̧tɨ̧wɨ̧ →kɨ̧túumbili k**ɨ̧**tɨ̧́wɨ̧
CL-monkey how
'how [did he kill] the monkey?' (DO96:245)

Unfortunately, the situation is more complex then this. Prefixes do not contribute and are ignored by ITI. The examples that shows this with nouns, all contain the prefix kɨ̧́, see e.g. (427), which is exceptional for gliding to, since it never glides.[139]

(427) *Prefixes are ignored for ITI*
kɨ̧́-ŋoombe ganɨ̧ →kɨ̧́ŋoombe g**á**nɨ̧
PL-cow which
'What type of cows?' (DO96:247)

The domain that is relevant is thus arguably concomitant with the stem, but this holds only for nouns. In verbs, the first stem mora is ignored and treated like a prefix, see (428). here, the ITI target undergoes ITI even though the verb has a high tone, because the high tone is situated on the first mora.

(428) *First mora in verbs is ignored for ITI*

a. nɨ̧-ka-téleka mʉ̧-kɨ̧-téleéko →nɨ̧katéleka m**ʉ̧́**kɨ̧téleéko
1SG-FUT-cook in-CL7-cooking.pot
'I will go cook it in the cooking pot' (DO96:248)

b. naa-jí-ɨ̧ kʉ̧́-soóko →naajíɨ̧ k**ʉ̧́**soóko
1SG.PST-go-PFV to-market
'I went to the market' (DO96:248)

If the first mora is however also the last mora, though, ITI is blocked and the mora is visible to it. In other words, if a verb has only one mora, this mora has a high tone, ITI is blocked.Compare (429) where ITI does not apply even though the nearest preceding high tone is on the first mora of a verb stem, namely *ljá*.

[138] The high tone on the second syllable of 'how' is there due to a separate phrasal process which inserts a boundary tone on the first or second syllable of phrase final toneless words, discussed in section 4.6.5.

[139] As will be discussed in section 4.6.5, other prefixes of nouns only have a high tone if the noun itself has a high tone, which would be a trigger of ITI independently.

(429) *High tone on only mora of verb blocks ITI*

a. wáŋga-ljá na-mambóondo → wángaljá n**a**mambóondo
without-eat with-Mamboondo
'Without having eaten with Mamboondo' (DO96:248)

b. mbala ljá mʉ̨-kį-líndiilo → mbala ljá m**ʉ̨**kįlíndiilo
1SG.want eat in-CL7-guard.shack
'I want to eat in the guard shack' (DO96:248)

It is not possible to test whether the relevant domain is indeed the stem, or the stem sized phonological word that I am assuming. Every tone that due to an instance of hiatus resolution migrates from a prefix into the inner word will inevitably land on the first mora, which is ignored in verbs. In nouns, such a shift is only possible under very peculiar conditions, one of which is that the noun must bear an underlying tone and thus trigger ITI anyway.

Additionally, there are floating high tones that mark topic, see (430a). This floating tone may land on the last syllable of a topicalised phrase, conditioned by the OCP for at least some speakers.[140] If an ITI morpheme is preceded by such a floating tone, it does not undergo ITI, see (430c).

(430) *Topic high tone blocks ITI*

a. mamboondo H aa-wįįle → mamboond**ó** aawįįle
Mamboondo TOP 3RD.SG-die.PFV
'Mambondo died' (DO96:237)

b. lįbʉ̨lʉ̨́le H aa-kátįte na-mboópo → lįbʉ̨lʉ̨́l**e** aakátįte
Libulule TOP 3SG-cut.PFV with-machete
námboópo

'Libulule cut with a machete' (DO96:236)

c. na mamboondo H na-kjiímbe → mamboond**ó** n**a**kjiímbe
and Mamboondo TOP with-knife
'and Mamboondo [cut] with a knife' (DO96:236)

This floating tone is not (necessarily) realised, when it would be directly adjacent to another high tone to its left, compare (430b). This raises the question: does a floating focus tone block ITI, even if it cannot be realised? This would be important to know for judging whether ITI applies before or after OCP induced tone deletion. The rule ordering in Odden (1996: 268ff) predicts that the tone is visible for ITI. However, there are unfortunately no examples. This is understandable, as the necessary examples are rather marginal: The topicalised element must be a verb, or containing a verb at its right edge, the verb must be bimoraic with a high tone on the first mora,

[140]This phenomenon is called phrasal high tone in Odden (1996: 234) and analysed drastically differently as a high tone inserted in any non-final syntactic phrase of a certain size. This analysis has been transferred to a framework with that respects the Indirect Reference Hypothesis by Truckenbrodt (1999). However, this high tone insertion targets only pre-verbal phrases, which is the canonical topic position (cf. Odden 1996: 74). I contend thus that an analysis as a (phrasally inserted) topic marker is justified and in fact simpler than the procedural alternatives.

and it must precede an ITI-morpheme. For the time being, I will assume that Odden's prediction is indeed met, and that topic tones always block ITI, even if topic tone is not realised.

Having the data in place allows for establishing a first attempt at a subcategorisation frame. (431) exemplifies this preliminary frame with the example of the ITI morpheme *malaáu* 'today'. Allomorph selection is nested between the word level and the phrase level, after concatenation. In order to access phonological information, the phrase level material must already be linearised. This structure makes it possible to formulate a subcategorisation frame with the following clauses. The first clause, (431a), leads to the insertion of the low toned allomorph following a floating tone. Whether this floating tone is realised depends then on the phrase level phonology and thus cannot be taken into account during allomorph selection. (431b) covers the cases when a high tone directly precedes the ITI morpheme. Here, the low toned allomorph is select any time, even if the preceding mora is the first mora of a verb stem. The next clause covers exactly this case: If a high tone is on a first stem mora of a verb, but no other high tone follows, the high-toned allomorph is selected. If the preceding stem has no high tone at all, irrespective of whether it is a verb or not, the high toned variant is selected, (431d). Lastly in all elsewhere cases – this subsumes the beginning of an utterance or other relevant phrases where ITI does not apply as well as if the preceding stem has some high tone somewhere that is not the first mora of a verb – the low toned variant is selected, (431e).

(431) Subcatecorisation frames for TODAY

a. H malaáu ↔ TODAY
After a floating high tone, a phrasal focus marker, the toneless variant is selected.

b. ... μ́] malaáu ↔ TODAY
Directly after a high tone, the alternating morpheme is always toneless.

c. [μ́...]$_{\Sigma:V}$ málaáu Today
Verb stems with only an initial H lead to the selection of the high-toned variant.

d. [...]$_{\Sigma}$ málaáu ↔ TODAY
Stems without any high tone lead to the selection of the high toned variant.

e. malaáu ↔ TODAY
The default case has the toneless syllable.

This subcategorisation frame is unsatisfying and, more importantly, problematic. Conceptually, it is not desirable to have allomorph selection that employs so many clauses especially if there are just two allomorphs. Subcategorisation is by definition limitedly non-modular (compare e.g. Kiparsky 2021), because it *is* part of the interface. Nonetheless, this subcategorisation frame is jarringly powerful: It can see the stem level affiliation of elements. This is not by itself a phonological or morphosyntactic characteristic, but rather a property of its derivational history. The subcategorisation frame thus, in a sense, can read the derivational history of the context of the allomorph selection. The sensitivity to the verb vs. noun dichotomy, especially on the phrase level and manifested by the mysterious invisibility of the first stem mora, do open up conceptual issues about the nature of subcategorisation, but also a field of hypothetical languages that I cannot fully gauge here. Therefore, such a subcategorisation frame is empirically and conceptually only a slim improvement over Odden's anticyclic approach with unrestricted reference to morphosyntactic features and structures. In order to make the subcategorisation neater, it is paramount to understand the tonal system of Kimatuumbi. In the next section, I propose an analysis if the Kimatuumbi tonology that relies on a minimal employment of phonological strength: An element can be absent, present, or weakly present (Kushnir 2019, 2022). This strength is crucially observable on morae and tonal root nodes. With tesesly minimally enriched representations, it is possible to formulate a subcategorisation frame that only consist of two clauses and reduces overgeneration.

4.6.5 Tonology: data

In this section, I present the core data of the tonal system of Kimatuumbi and suggest an analysis that derives th data in Stratal OT with minimally enriched representations that include weak tonal root nodes and weak morae. The tones in verbs are somewhat different from the tones in nouns: Nouns do have underlying tone whereas all verbal tone is predictable, depending on its morphology and phonological context. This is a common characteristic amongst the languages of the world, compare Smith (2002, 2011); Hyman (2017). The analysis will deal with most aspects of the tonal system in Kimatuumbi, however, I ignore the mechanism that informs the position of morphological tone in verbs. Kimatuumbi is, like many Bantu languages, a language that has a syllable counting mechanism, for an overview see Marlo (2013); Odden & Bickmore (2014). Those mechanisms are challenging for a almost all approaches to phonology, compare Paster (2019); Rolle & Lionnet (2019); Trommer (2022), however this challenge is orthogonal to the question of cyclicity. I will first introduce the data, describing first nouns and then verbs, before I will offer an analysis. The gist of the analysis is that some mora will become weak in the course of the derivation, and those morae tend to lose their tones on the phrase level, while some tones become weak themselves and are unable to trigger ITI.

4.6.5.1 Tone patterns in Kimatuumbi nouns

Nouns can be cross-classified into four categories based on their underlying tones and the tonal shape of the prefixes they select. In a phrase medial position, a noun may either be toneless, (432a), or have high tones (432b), normally not more then two.

(432) *Toneless vs. toned nouns*

a. lʉ-bagalo lwaáŋgu
CL-lath my
'my lath' (DO96:168)

b. lʉ-kóŋgobe lwaáŋgu
CL-lwood my
'my wood' (DO96:169)

Noun classes 5 and 9 do not allow tones to surface on the first mora of the stem (Odden 1996: 169,181),[141] whereas tone is free to be there in all other noun classes. (433) shows that a high tone is free to appear on a first mora of noun of class 4 as well as on a non-initial mora, and (434) shows that the tone can appear on a non-initial mora of class 9, but there is no class 9 noun where it would appear on the first.

(433) *Regular nouns can have a high tone on the first root mora*

a. mɨ-pʉ́ko janaancɨ́má
CL4-bag many
'many bags' (DO96:174)

b. mɨ-katé mɨ-lasó mɨ-laáso
CL4-loaf CL4-long CL4-long
'long loaves' (DO96:34)

(434) *Repellent nouns (Class 9,5) cannot have a high tone on the first root mora*

a. kɨ́-m-baká baatúmbwi ljá
PL-CL9-cat began eat
'the cats started to eat' (DO96:306)

b. *m-báka ...
CL9-báka

I will call nouns of class 5 and 9 'repellent', because they 'repel' tone from the first mora, and all other nouns 'regular'. All toneless nouns and some nouns with a high tone have a different tonal shape when they appear utterance finally. The derivation of this alternation is the core challenge of the tonology of nouns in Kimatuumbi.

4.6.5.2 Toneless nouns

As established above, toneless nouns surface medially without any tone. In this context, we cannot observe any difference between repellent nouns of class 5 and 9 and the others. Compare the example in (435a) which belongs to a regular noun class, and (435b), which belongs to a repellent class: There is no difference.

[141] However, there are counterexamples to this generalisation. The following words have a high tone following the class 5 prefix lɨ-: lɨbígiɨ 'beer area' pg. 25, lɨbáago 'axe' pg. 27, ljéeke 'storage structure' pg. 114.

(435) *Toneless nouns phrase medially*

a. lʊ̧-bagalo lwaáŋgu
CL-lath my
'my lath' (DO96:168)

b. juúju n-domoondo lḭ̀lḭ́
that CL9-gallago not
'that isn't a gallago' (DO96:168)

At the end of an utterance, all nouns have a high tone, including the ones that are toneless phrase medially. The position of this high tone depends on the noun class. In regular nouns, the high tone is on the first stem mora, see (436a). With repellent nouns however, it appears on the second mora, see (436b).

(436) *toneless nouns phrase finally*

a. lʊ̧-b**á**galo
CL-lath
'lath' (DO96:168)

b. n-dom**ó**ondo
CL9-gallago
'gallago' (DO96:168)

There is one exception to this: If the repellent noun is bimoraic, the high tone appears on the first mora and not on the second, see (437).[142]

(437) *Bimoraic toneless nouns of class 9 are regular*

a. ɲama jáaŋgú
CL9.meat my
'my meat' (DO96:184)

b. ɲ**á**ma
CL9.meat
'meat' (DO96:184)

Another type of repellent nouns are toneless phrase-medially (438a,c) and have a final tone phrase-finally, see (438b,d). As (438b) shows, /aanɟʊ̧́/ is not bimoraic underlyingly, it loses its first mora due to shortening discussed in section 4.6.8.

(438) *Toneless ~ Final Tone oscillating nouns*

a. anɟʊ̧ jáaŋgú
CL9.firewood my
'my firewood' (DO96:115)

b. aanɟ**ʊ̧́**
CL9.firewood
'firewood' (DO96:25)

[142]This pattern could alternatively be phrased as: 'All bimoraic nouns, independent of class, are regular, only at least trimoraic nouns may be repellent'.

c. lįįwe ljáaŋgú
CL5.stone my
'my stone' (DO96:29)

d. lįįwé
CL5.stone
'stone' (DO96:29)

All of those roots have an additional initial tone when in another noun class, see (439), as long as the root can appear in another class. Compare e.g. *anɟų* in (438a) with *lw-***á***anɟų́* in (439a), which has an initial high tone.

(439) *Toneless ~ Final Tone oscillating nouns in other classes*

a. lw-**á**anɟų́
CL11-firewood
'piece of firewood' (DO96:25)

b. ma-l**į́**įwé
CL6-stone
'stones' (DO96:29)

I will follow Odden (1996) and assume that this initial tone is underlyingly there in classes 9 and 5 so that this group of nouns that shows the final high tone phrase-finally falls out from the category of *underlyingly* toneless nouns. Excluding these nouns, we get a uniform direction of predictability: If a noun is toneless phrase medially, the phrase final tonal shape is predictable, depending only on the mora count and the noun class. Summarised, nouns that are toneless phrase medially have phrase finally a tone on the first mora if they are not class 5 or 9, or if they belong to class 5 or 9 and are bimoraic; if they belong to class 5 or 9 and are longer then bimoraic, they have a high tone on the second mora phrase finally.

4.6.5.3 High toned nouns

For the high toned nouns, I will first describe the phrase-final context before coming to the phrase medial one. For high toned nouns, the direction of predictability is less obvious then for toneless nouns: In most cases, a phrase final form predicts the phrase medial form and vice versa. However, I contend that the phrase final forms are the better predictor, and therefore I will start with discussing them. Also, I later assume that they represent the underlying tones more faithfully, contra Odden (1996) who assumes that the phrase-medial shape is (mostly) equivalent to the underlying representation.

High-toned nouns have either one or two underlying tones. If they have only one, this tone may be anywhere[143] for regular nouns, see (440)[144], and roughly anywhere

[143]I did not find examples of words with a single high tone on the fifth mora from the right. However, roots with more then four morae are rather rare.

[144]The first tone in (440d) and (440e) is not underlying, but inserted by a process that inserts a high tone on the first stem mora after a prefix, if there is another high tone in the stem, discussed in this

except on the first mora for repellent nouns, compare (441).

(440) *Regular high toned nouns*

a. ma-táandala 'bucks' (DO96:32)
b. kɨ-túkutuku 'bird' (DO96:32)
c. kɨ-tʉʉŋgʉ́ 'onion' (DO96:223)
d. ma-kóoŋgonɨ́ 'hartebeests' (DO96:170)
e. ka-cáŋgaláwe 'little gravel' (DO96:170)
f. ma-gobóle 'cannons' (DO96:35)
g. m-paká 'boundary' (DO96:166)
h. dɨɨ́waɨ 'wine' (DO96:166)

(441) *Repellent high toned nouns*

a. kɨ́-naánkwakwa 'lizards' (DO96:32)
b. kɨ́-nalwɨɨ́gʉ 'chameleons' (DO96:32)
c. kooŋgonɨ́ 'hartebeest'
d. caŋgaláwe 'gravel' (DO96:170)
e. m-baká 'cat' (DO96:166)
f. m-boópo 'machete' (DO96:167)
g. lɨ-gobóle 'cannon' (DO96:35)

Some words have more then one tone phrase finally. Those have both tones on one of the last three morae.[145] These types of nouns are discussed below. However, this only holds if at least one mora of the last three belongs to a long vowel. If all last three morae belong to a short vowel, we find only a single tone,[146] there is only one tone and this tone may be on any mora for regular nouns, see (442). For repellent nouns, the high tone cannot be on the first mora, see (443). If the third to last mora is also the initial mora it cannot bear tone in the repellent classes.

(442) *Last two syllables light, regular nouns*

a. lɨ-kʉlʉ́tɨ 'recruit' (DO96:178)
b. ka-cáŋgaláwe 'little gravel' (DO96:170)
c. ka-ngálawá 'little canoe' (DO96:179)
d. ma-tógolo 'water bucks' (DO96:181)

(443) *Last two syllables light, repellent nouns*

a. kɨ́-naánkwakwa 'lizards' (DO96:32)
b. caŋgaláwe 'gravel' (DO96:170)
c. ŋgalibá 'female circumciser' (DO96:179)

section further below.

[145]Exceptions are taásɨbɨɨ́rʉ 'Muslim rosary', ntítiliíti 'circle' and cases of reduplication, such as lʉkúlukúlú pg. 190.

[146]The exception is, again, reduplication, e.g. lɨkatʉ́katʉ́ 'crab' pg. 190.

There are two gaps: There are no trisyllabic class 9 nouns with a high tone on the penult, and there are almost no four-syllabic class 9 nouns with the high tone on the ultima. Nouns of other classes mostly do not have the high tone on the final mora, unless is a related form in class 9, but even then the tone is optionally on the penult, e.g. *ma-ŋálibá~ma-ŋgalíba* 'female circumcisers'. I will treat these gaps as accidental.

If the noun is bimoraic – since we ignore the rare monosyllabic words here, this implies two syllables with two short vowels – there are two possible shapes for regular nouns: They can have a high tone on both morae or only on the final one, see (444).

(444) *Bimoraic regular nouns*

a. mį-pų́kó 'bags' (DO96:174)
b. kį-pukú 'rat' (DO96:172)

Bimoraic repellent nouns with a high tone always have it on the final syllable, see (445).

(445) *Bimoraic repellent nouns*

a. m-baká 'cat' (DO96:171)
b. n-dilá 'road' (DO96:185)

If at least one of the last three morae belongs to a long vowel, yet different patterns arise. Since the last vowel may never be long, a long vowel can be in the penultimate, encompassing the second and third to last morae, or in the antepeultimate. In that case, only the third-to-last mora belongs to a long vowel.

If the antepenultimate is long, there are three shapes for both regular and repellent nouns: They may have a single tone on the ultima (446a,b), a single tone on the second mora of the long vowel (446c,d), or they may have two tones, on the last mora and on the third to last (446e,f).

(446) *Long antepenultimate*

a. ma-kóoŋgonį́ 'hartebeests'
b. kooŋgonį́ 'hartebeest'
c. paátįįlį 'priest' (DO96:178)
d. dįį́waį 'wine' (DO96:166)
e. lį-baándamá 'spleen' (DO96:177)
f. nɟeénɟemá 'mosquito' (DO96:177)

If the penultimate is long, there are two possible tonal shapes for regular nouns. They have either one high town, on the second to last mora (447b), or two tones, on the final and third to last, as in (447a).

(447) *regular nouns, long penultimate*

a. kiį-ndáandá 'bed' (DO96:174)

b. ka-poópo 'tiny machete' (DO96:184)

Repellent high toned nouns with a long penultimate have three options. Two are just like the ones for regular nouns: High tone on the second two last mora, see (448b), or two high tones, on the third to last and final mora, see (448a).

(448) *Repellent nouns, long penultimate*

a. asáabų́ 'punishment' (DO96:174)

b. m-boópo 'machete' (DO96:186)

The last option is only available if the third to last mora is also the initial mora. If this is the case, we can find only a single tone, on the final mora, instead, see (449).

(449) *Repellent nouns with unstable tone phrase finally*

a. swaalá 'gazelle' (DO96:174)

b. liįwé 'stone' (DO96:29)

Phrase medially, all the forms with a single high tone are identical to their phrase final shape, see (450) for some examples, with the notable exception of the pattern in (449) that we will turn to in a minute.

(450) *High toned roots conserve only tone phrase medially*

a. mbaká jwaáŋgu 'my cat' (DO96:185)

b. ma-tógolo ganaancį́má 'many water bucks' (DO96:181)

c. ka-ŋgálawá kaáŋgu 'my little canoe' (DO96:179)

d. mboópo jaatúumwiįke 'the machete fell' (DO96:175)

e. ma-cángaláwe gaáŋgu 'many hunks of gravel' (DO96:171)

As could be observed in the data, if a noun has two tones, one is always on the final mora. This tone is only present phrase-finally, it is absent phrase medially, see (451). recall that 'bags', 'mosquito' and 'punishment' are *mį-pų́kó, ɲɟeéɲɟemá, asáabų́* respectively at the right phrase edge.

(451) *High toned nouns lose second tone phrase medially*

a. mį-púko janaancį́má 'many bags'

b. ɲɟeéɲɟema na-lį-báago 'mosquito with an axe' (DO96:256)

c. asáabų lį́įlį́ 'punishment not' (DO96:256)

This behaviour is irrespective of whether the noun is repellent or not. As a tentative generalisation we can say that *a noun can only have an unstable final tone, if it has another tone*. The only exception, nouns that have an unstable final tone but no tone phrase medially, are repellent nouns with three mora and a long initial vowel, the ones introduced in (439)/(449), repeated in (452).

(452) *Unstable single tone*

a. lįįwe ljáaŋgú
CL5.stone my
'my stone' (DO96:29)

b. lįįwé
CL5.stone
'stone' (DO96:29)

Keep in mind that those are repellent nouns that do not tolerate a high tone on the first mora, so the mechanism that enforces the repellency must be stronger than the mechanism that belies the generalisation 'unstable tones only occur if there is a stable tone'.

As has already been mentioned in footnote 144, all regular high toned nouns, irrespective of whether they have two or only one tone phrase finally, carry an additional tone on the first mora, as long as there is at least one toneless mora separating the initial mora from the leftmost underlying high toned mora, see (453a-c). (453d) does not insert a high tone, because their underlying high tone is too close.

(453) *Post-prefixal high tone*

a. ma-k**ó**oŋgonį́ 'hartebeests'
b. ka-ŋg**á**lawá kaáŋgu 'my little canoe'
c. ka-c**á**ŋgaláwe 'little gravel' (DO96:170)
d. mį-kaáte 'loaves' (DO96:113)

I will follow Odden (1996) in this case and assume that this initial tone is not underlying, but introduced by the nominal prefixes of regular nouns.[147] Summarising, we can generalise three types of tonal shapes for nouns: One with a single tone phrase-medially and phrase-finally (excluding the potential tone introduced by the prefix) — those are normal high toned nouns, one with no tone phrase medially and one tone phrase finally — those are the toneless nouns, and lastly one with two tones phrase-finally and one tone phrase-medially, the two tone nouns.

In the next part, I will argue based on this description of the data for the underlying representations I adopt. The unstable tones will be analysed representationally as tones associated to weak morae.

4.6.5.4 Assumptions on underlying representations

As mentioned, I diverge massively in my assumptions on underlying representations from Odden (1996). As a consequence, the phonological processes that I have to

[147] It is absent on adjectival stems that take the same prefixes.

derive are also rather different. Odden (1996) derives the surface forms from two restrictive morpheme structure constraints — all nouns can have zero or one tones, if they have a tone, it cannot be on the second mora of a long vowel — and a set of rather complicated and specific rules that copy, shift and delete tones. In addition, he needs to assume that at least some forms either do not undergo the rules or violate the morpheme structure constrains to account for rarer forms such as *paáţįlį* 'priest', which do not follow in his framework.[148] The rules that derive the rest of the distribution are violating the Indirect Reference Hypothesis (IRH) — they specifically refer to morphosyntactic features — and some of the rules are also by themselves countercyclic, as they apply at an early cycle but take phrasal information into account. My analysis on the other hand has two assume either much more complex morpheme structure constraints[149] or to postulate that there are lots of accidental gaps. As an upside, my analysis with arguably less elegant underlying representations will be fully compatible with the IRH and cyclic. While the analysis itself follows in section 4.6.6, I want to summarise here the patterns that I need to derive based on my assumptions on underlying shapes. If a noun has two tones, the second invariably on the final mora, it loses the second tone phrase-medially. Phrase finally, on the other hand, all those tones appear, but there are also tones on underlyingly toneless nouns. Those tones are either on the first stem mora, or on the second, depending on the mora-count of the stem and the noun class. Lastly, the first mora of a noun has a high tone in regular classes, if there is at least one toneless mora between the first mora and the leftmost high tone. Repellent nouns on the other hand avoid a tone on that mora in most circumstances.

4.6.5.5 Tonology of verbs

Unlike nouns, verbs and verbal suffixes do not have underlying tone. All verb tone is predictable based on its mora count, mophosyntactic environment and phrasal position. A morphological category may be expressed by either 0, 1, or 2 tones on the verb stem. 0 tone categories are toneless, such as the negative persistive in (454).

(454) *No tone on verb stems*
nį-ná-kalaaŋga lį́
1SG-NEG-fry not
'I haven't yet fried' (DO96:211)

1 and 2 tone categories differ in where the tone surfaces. A single tone may surface on the first stem mora, compare the categories in (455), or on the final mora, see (456)

[148] According to his morpheme structure constraints, if a long vowel ends up with a rising tone, the tone originates to the syllable to the right, that is /paaţį́lį/. A tone on the penult must be copied onto the ultima before it shifts onto the long vowel, deriving thus incorrect paáţįlį́.

[149] I see the question on whether morpheme structure constraints are desirable as fundamentally unsettled, see Abramovitz (2021) for recent arguments in favour and Tebay (2022) for recent arguments against them.

for examples.

(455) *Single tone on first verb stems mora*

a. ba-a-t**é**leka
3PL-REM-cook
'They will cook' (DO96:191)

b. ba-a-ga-t**é**leka
3PL-REM-CL6.OBJ-cook
'They will cook them' (DO96:191)

c. na-a-t**é**lịketelịịke
1SG-REM-CL6.OBJ-cook.FREQ.PFV
'I used to cook frequently' (DO96:191)

(456) *Single tone on final verb stem mora*

a. nị-tị́-balaaŋg**á**
1SG-FOC-count
'I counted' (DO96:193)

b. ba-a-tị́-telekatelek**á**
3PL.S-REM-FOC-cook.FREQ
'They cooked frequently' (DO96:139)

For other categories, it is necessary to count morae. A high tone can appear either on the second mora from the left, or on the third mora. Whereas all prefixes are disregarded for determining the initial mora in (455), this mora counting starts to the left of the subject prefix, so that it can include up to two prefixes. In (457), the tone falls on the third mora, and, as (457b) shows, the object prefix is counted along.[150]

(457) *Verb tone on 3rd stem mora*

a. ụ-gụndụm**ụ́**je
2SG-scare.SBJV
'you should scare' (DO96:196)

b. ụ-a-gụnd**ụ́**mụje → waagụnd**ụ́**mụje
2SG-3SG.OBJ-scare.SBJV
'you should scare them' (DO96:197)

(458) *Verb tone on 2nd stem mora*

a. pa-á-tem**á**
COMP–3SG-chop
'when he chops' (DO96:201)

b. pa-á-kị-t**é**ma
COMP–3SG-CL7.OBJ-chop
'when he chops it'

Lastly, there is a single pattern that assigns two tones to the stem, a first tone two

[150]If the tone lands on the second mora of the stem by a counting mechanism that counts to two, it is, at least in some morphosyntactically definable forms, deleted phrase medially. There is no data on how this tone loss interacts with ITI in Odden (1996), and Odden does not give an ordering of the two processes which would allow us to deduce his predictions.

the second mora and a second tone on the final mora, (459). This pattern occurs with different morphosyntactic categories, e.g. with the past subordinate in (459a) or with the reflexive in (459b).

(459) *Two tone verb stem*

a. pa-á-ka**á**ta**é**
COMP–3SG.S-cut
'when he was cutting'

b. ʉ-ɨ́-tel**é**k**ɨ** → wɨ́ɨtel**é**k**ɨ́**
2SG-REFL-cook.APPL
'you should cook for yourself'

For nouns, we could roughly generalise three groups: One with a single tone phrase-medially and phrase-finally (excluding the potential tone introduced by the prefix), one with no tone phrase medially and one tone phrase finally, and lastly one with two tones phrase finally and one tone phrase medially. We do not find exactly the same groups with verb. The main difference is that the toneless verbs never occur in phrase final position, they always need something to follow them for syntactic reasons.[151] The other two groups however can be found amongst verbs as well: Two tone verb forms lose the final tone phrase medially, see (460), and one tone verb forms are identical phrase medially and phrase finally, with the exceptions mentioned in footnote 150 and 151.

(460) *Two tone verb loses final tone phrase-medially*
pa-ná-a-temɨt**é** mɨ-kóoŋgó → panáatemɨt**é** mɨkóoŋgó
COMP–1SG-REM-chop CL-tree
'when I was chopping trees'

4.6.5.6 Interaction of tone deletion and ITI

Both verbs and nouns have tones that are arguably deleted phrase medially. These tones can in principle interact with ITI. For verbs, the first stem mora is disregarded in the computation of ITI. Now, the question is if in a verb form that assigns high tone to the first and last stem mora, and the latter is subsequentially deleted phrase medially, does it still trigger ITI? In fact it does, see (461). In (461a), we see that this verb form phrase finally has two tones, on the first mora (which is invisible for ITI), and on the final mora, which is not invisible. In (461b) we see that the final high tone

[151] One can argue that the verb forms mentioned in footnote 150 are toneless and have their phrase final tone assigned to the second mora for the same reason as do class 9 nouns. In order to verify this hypothesis, it would be necessary to check their interaction with ITI. There is yet another group of verbs that are phrase-medially toneless: perfective main clause indicatives have a tone on the first mora phrase finally, and no tone phrase medially. Since the tone is on the first mora, we do not expect it to trigger ITI. For these verbs, an analysis as toneless with phrase final tone insertion suggests itself. However, the domain in which the tone is inserted seems to be smaller compared to nouns. For perfective verbs, it is important that the following word is in the same clause, whereas for nouns it must be in the same utterance.

does not appear phrase medially, and, also that ITI does not apply. The only tone that could block ITI is the deleted final tone.

(461) *Tone deletion on verbs counterfeeds ITI*

a. panɨ́-kɨ-kálaŋgaé
   'when I was frying' (DO96:249)

b. panɨ́-kɨ-kálaŋgae pa-mwoótó
   'when I was frying it by the fire' (DO96:249)

This is actually something that the present, until now preliminary, analysis predicts: Deletion is phrasal, whereas ITI is allomorphy that precedes the phrase level. It should not be sensitive to deletion that at that point did not yet happen. For an OT approach that contends that ITI is a phrase level process, however, this data point is problematic and potentially fatal: If both ITI and tone deletion are phrasal, they should not be able to interact opaquely, but ITI in (461) is counterfed by tone deletion.

For nouns, for the most part, if the second tone deletes, there is still another tone in the domain that is relevant for ITI. However there is this subset of class 9 and 5 nouns that have a final tone phrase finally and no tone phrase medially. Unlike verbs, this deleted tone does not block ITI, see (462a).[152]

(462) *Tone deletion on nouns feeds ITI*

a. lɨɨwe ljá̲aŋgú
   CL5.stone my
   'my stone' (DO96:29)

b. lɨɨwé
   CL5.stone
   'stone' (DO96:29)

This is an interaction that would be expected for either a parallel application of ITI and deletion, or deletion preceding ITI: deletion applies first, the noun is now toneless and can trigger ITI on the ITI morpheme. This is incompatible with my analysis: ITI is analysed as allomorphy that precedes the phrase level, and tone deletion is clearly a phrasal process. In the next section, section 4.6.6, I will account for this difference by postulating a different representation for final tones in verbs and nouns.

4.6.6 Tonology: analysis

For my detailed analysis I need to make two assumption on underlying representations. First, as in the analysis of the Akan pattern, I adopt register tier theory. The relevant aspect of this theory for the Kimatuumbi analysis lies not the register tones, but the presence of the tonal root node as a means of organisation, cf. Meyase (2021).

[152] The possessive pronouns are ITI morphemes, however, their allomorphy is somewhat more complex. Consider mɨkóngo jaáŋu 'my trees' where ITI is not triggered and there is also no final high tone, but a tone on the antepenult.

The second assumption is a limited version of strength (Kushnir 2019). For my purposes, it suffices to assume that some elements can either be weak, strong (or regular) or not present at all, so three levels of specification instead of the two one gets from a element which can either be present or absent. The relevant objects that can be weak are morae and the afore mentioned tonal root nodes. (463) gives an overview over the possibilities of combination (without underspecification), and how I will represent the respective structures linearly. The first row represents a regular high toned mora, it has a strong mora and a strong tonal root node. The second row shows a completely weak high toned mora, both mora and tonal root node are weak. The third and fourth row give a strong mora with a weak tonal root node and a weak mora with a strong tonal root node respectively.

(463)

H	H	H	H
|	|	|	|
$\circ$	$\circ_{w}$	$\circ_{w}$	$\circ$
|	|	|	|
μ	μ_{w}	μ	μ_{w}
á	$\acute{a}^{w}_{w}$	$\acute{a}^{w}$	$\acute{a}_{w}$

Now, the gist of the analysis is the following: Tones on weak morae ($\acute{a}^{w}_{w}$,$\acute{a}_{w}$) are deleted phrase medially, whereas other tones survive. Because deletion happens after allomorph selection, this is irrelevant for the ITI. Weak tones, that is tones associated to a weak tonal root node, on the other hand do not delete, but are ignored by the allomorphy mechanism for ITI. If a tone is weak and associated to a weak mora ($\acute{a}^{w}_{w}$), it both deletes and is invisible for ITI. The task of the analysis is now to reliably assign weakness to the correct morae and tones.

4.6.6.1 Stem level

The stem level, which corresponds to the root + suffixes, is crucial for the task of distributing weak morae and root nodes. Here, only nouns may have underlying tone, whereas all verbs are toneless. The stem level is the place of many phonological processes, such as vowel harmony, which will not be further discussed. Relevant to us are the building of a prosodic word and final mora-weakening, (as well as gliding and shortening which will be discussed in greater detail in section 4.6.8). The first, construction of the phonological word, is triggered by a prosody-building constraint such as the match-constraint in (464) (cf. Selkirk 2011; Elfner 2015). Under the Indirect Reference Hypothesis, unlike other constraints, prosody-building constraints may have some access to morphological information. However, as discussed in chapter 3, the exact locus of primary prosody building is not crucial for the analyses discussed here. Thus, the formation of the prosodic word could also precede the stem level proper.

(464) Match (X°ω)
Count a violation for every maximal X° that is not matched with a phonological word.

The second relevant process results in the reduction of final vowels. Final vowels are obligatorily short in Kimatuumbi (except for the rare monosyllabic words, cf. Odden 1996: 223). I propose that short vowels are reduced too: They do not possess a strong mora, but a weak mora. This can be seen as a representational implementation of final extrametricality. This weak mora is enforced by the constraint in (465a). Where reference to strong elements is crucial, they are marked with sub- or superscript s. The constraint in (465b) makes sure that there are no long extrametrical syllables.

(465) a. $*[\mu_s]_\sigma]_\omega$
Count a violation for every phonological word that ends in a syllable that dominates a strong mora.

b. $*[\mu_w\mu_w]_\sigma$
Count a violation for a syllable with two weak morae.

Now, let us consider a phrase like the one in (466a), for which I assume the prosodic representation in (466b). Since the root is phrase final, it has both of its tones on the surface.

(466) *Prosodic structure of nouns in isolation*

a. lų̀lį̀mį́ 'the tounge'
b. $[[$lų$[$lį̀mį́$]_\omega]_\omega]_\varphi$

At the stem level, the input is equal the underlying representation of the root — nouns do not have any stem level affixes, there are no suffixes and the prefix attaches at the word-level. The output will construct the phonological word, due to the Match constraint, and weaken the last mora due to (465a), compare the tableau in (467). candidate a. fails to build a prosodic word, and candidate c. violates the constraint against final strong morae, making candidate b. the winner.

(467) *Derivation of final mora weakening*

	lį̀mį́	Match-X°-ω	$*[\mu_s]_\sigma]_\omega$	$*\mu_w$
	a. lį̀mį́	*!		
☞	b. $[$lį̀mį́$_w]_\omega$			*
	c. $[$lį̀mį́$]_\omega$		*!	

However, not all final syllables are extrametrical. They might maintain a strong mora, if they carry the only high tone. This is due to Culminativity, cf. Hyman (2006) for the general principle, and Gjersøe (2020) for a more direct predecessor, which demands one and only one prominent mora. Prominent here entails two things: The mora must be strong and bear a high tone.

(468) CULM(INTAVITY)
Count a violation if there is no, or more then one strong mora associated with a high tone.

Culminativy must be dominated by a constraint DEP-H against the insertion of high tones, since toneless stems do exist and are not altered at this level. Furthermore, there must be a constraint against tone-shifting — already motivated for the analysis of gliding — so that satisfying CULMINATIVITY and $*[\mu_s]_\sigma]_\omega$ at the same time is impossible for words with underlying final tone. The tableau in (469) shows this for the stem level derivation of *mbaká* 'cat'.

(469) *Weakening fails if final mora carries only tone*

		paká	DEP-H	CULM	*SHIFT	$*[\mu_s]_\sigma]_\omega$
☞	a.	$[\text{paká}]_\omega$				*
	b.	$[\text{paká}_W]_\omega$		*!		
	c.	$[\text{páka}_W]_\omega$			*!	
	d.	$[\text{páká}_W]_\omega$	*!			

Candidate b. weakens the mora and violates thus CULMINATIVITY, candidate c. shifts the tone and candidate d. inserts a tone onto the first vowel, neutralising this type of noun with nouns like lʊ̧lɪ́mɪ̧. If CULMINATIVITY outranks MAX-H, this constraint also derives the fact that the second high tone has to be on the final vowel, the extrametric one. It thus reduces the problem with the cumbersome morpheme structure constraints or sizeable accidental gaps in tone distribution that the present analysis has.

Additionally, the tone on a weakened mora must be weakened, too. This weakening is induced by the constraint in (470), which prohibits strong tonal root nodes associated with weak morae.

(470) *W(EAK)μ–S(TRONG)∘
Count a violation for a weak mora associated to a strong tonal root node.

Verbs do not have underlying tones, and the morphological tones they surface with are added only on the word stratum (cf. Odden 1996: 190). Verbs, as well as toneless nouns, thus always weaken the last mora. Compare the tableau in (471), which selects winner that is toneless and weakens the final mora.

(471) *Derivation of weakening in verbs*

		teleka	Dep-H	Culm	*Shift	*[μ_s]$_\sigma$]$_\omega$
	a.	[teleka]$_\omega$		*		*!
☞	b .	[teleka$_w$]$_\omega$		*		
	a.	[téleka$_w$]$_\omega$	*!			

However, tones on the initial mora of verbs show some peculiarity: They are invisible for ITI. This is a characteristic they share with tones of extrametrical syllable in nouns (but not verbs). I derive this commonality with the weakening of the tonal root node, which happens in both cases at the stem level. The weakening of the tonal root node in nouns is derived by constraints, as shown above, but the weak tonal root node in verbs is a morpheme. It is present in all verbs, and, as far as I can gauge from the data, also all de-verbal derivations.[153] It might therefore very well be the phonological reflex of little v.[154] (472) gives the vocabulary entry for little v.

(472) little v ↔ $\circ_w$

In summary, at the stem level the last mora of a prosodic word is extrametrical, unless it carries the only high tone. Tones on extrametrical morae get weakened. The initial mora of verbs is associated with a weakened tonal root node, but not with a tone. The tonal processes are otherwise quite uneventful, nothing happens to tones.

4.6.6.2 Word level

At the word level, two major morphological operations alter the situation: verbs get their morphological tone, and (most) prefixes are concatenated. We will first look at the nouns and their prefixes, before turning to the verbs.

The nominal prefixes encode the noun class. They consist of a segmental component (ba-, kį-, etc.) except for class 5, where the prefix is added only at the phrase level. Furthermore they have a tonal component: The regular classes have a high tone if the root itself has a high tone, which docks, if the OCP allows it, on the first mora. I assume that classes 5 and 9 also have a tonal component, namely a low tone. This tone will be employed to derive the repellency of these classes. In the Bantuist tradition, it is uncommon to assume phonologically active low tone Stevick (1969);

[153]The data on this is unfortunately not conclusive. If so, it arguably compounds the countercyclicity of Odden's framework. Odden (1990, 1996: 277) states that for countercyclic look ahead rules, the form that they consider from outside their domain is equal to the underlying representation. However, this cannot be the case for ITI: It is sensitive to some verbal tones, which are all derived. We can take another reasonable guess and assume that the form it can access is at the same step of derivation to the form it is currently computing, for ITI that means on the second word-level before the application of ITI. At that stage, the derived noun is already a noun. The process is thus not only able to look ahead, but also back into the derivation of the adjacent form to access its internal stem boundary (necessary independent of nominalisations) and major category labels, which are in the case of nominalisation not equal to the outer category labels.

[154]see among many other Panagiotidis, Spyropoulos, & Revithiadou 2017 for precedence for the assumption that little v on verbs can be overtly morphologically expressed.

Hyman (2001), but there are precedents, e.g. Cammenga (2004); Trommer (2022).

The segmental prefixes, at least if the can form a syllable, are not integrated into the existing prosodic word, instead they form a new, recursive prosodic word with the existing one. The tableau in (473) shows the derivation for lų[lį̃mį̃], 'tongue', FAITH-ω is a cover constraint that penalises any alteration or deletion of the inherited prosodic word. *REC-ω penalises recursive phonological words, compare (Selkirk 1995).

(473) *Derivation of recursive prosodic word building*

	lų[lį̃mį̃]$_\omega$	MATCH-XP-ω	Faith-ω	*REC-ω
	a. lų[lį̃mį̃]$_\omega$	*!		
☞	b. [lų[lį̃mį̃]$_\omega$]$_\omega$			*
	c. [lų lį̃mį̃]$_\omega$		*!	

Candidate a. leaves the prefix unprosodified, which violates the high ranked match constraint, and candidate c. shifts the boundaries of the input prosodic word, violating faithfulness. The winner is b., which constructs a recursive prosodic word.

If a prefix tone is present, it docks to the first mora, unless it would violate the OCP[155] The tableau in (474) shows this for the low tone in a toneless class 9 noun. the class 9 prefix also has some nasal element, according to Odden (1996: 25) the palatal nasal, but its exact nature is not of the essence for our purposes. Candidate b. is optimal compared to its competitors which delete the low tone or let it float.

(474) *Derivation of low tone docking*

	ɲL [tuumbo$_W$]$_\omega$	MAX-L	*FLOAT	*SHIFT	Max-H
	a. L[ntuumbo$_W$]$_\omega$		*!		
☞	b. [ntùumbo$_W$]$_\omega$				
	c. [ntuumbo$_W$]$_\omega$	*!			

The tableau in (475) shows the word level derivation of a class 9 noun which arguably has a high tone on the first mora. This tone cannot be shifted, because of the high ranked *SHIFT constraint. The low tone is preferred to the high tone due to specific MAX constraints for high and low tones respectively.[156].

[155] An alternative would be to postulate that the insertion frame for the H toned variant of the prefixes is restricted to stems which a.) have a tone and b.) have no tone on the first two morae.

[156] But it could also be analysed with reference to the position of tones, as I did for Akan in chapter 4.2

(475) *Derivation of low tone docking onto high toned mora*

		ɲL [ndóoɲá$^{\text{W}}_{\text{W}}$]$_{\omega}$	Max-L	*Float	*Shift	Max-H
	a.	L [ndóoɲá$^{\text{W}}_{\text{W}}$]$_{\omega}$		*!		
☞	b.	[ndòoɲá$^{\text{W}}_{\text{W}}$]$_{\omega}$				*
	c.	[ndóoɲá$^{\text{W}}_{\text{W}}$]$_{\omega}$	*!			
	d.	[ndòóɲá$^{\text{W}}_{\text{W}}$]$_{\omega}$			*!	

In the case of (475), this yields a noun that has only a weak high tone on a weak mora. These are the type of nouns where we can see that tone deletion in verbs has a different effect from tone deletion in nouns.

Verb tone is different from nominal tone as there is no underlying tone for the stems – prefixes, unlike most nominal prefixes, may very well come along with a tone. All tones that appear on the verb stem are assigned at the word level. The tone on the stem appears on a mora which is determined by counting from the left, the starting point includes some prefixes for some categories. Other tones are uniformly assigned to the final mora.

Similar mora-counting tone patterns can be find in a wast array of Bantu-languages (Marlo 2013; Odden & Bickmore 2014), and various approaches have been proposed, e.g. ghost structure (Rolle & Lionnet 2019), different L_0H sequences (Cammenga 2004; Trommer 2022) or simply mora counting rules or constraints (Odden 1996; Paster 2019; Sande et al. 2020). The tone distribution algorithm of morphological verb tone in Bantu is and remains theoretically challenging, but it is largely orthogonal to the topics of this dissertation. I will thus remain rather agnostic in how the mora counting is implemented in detail. I want to point out that a common approach, analysing, let's say a tone on the second mora as a LH sequence, does not work within my analysis. We will se in a moment why this is the case. For now, I will just assume that the morphological verb tones find their appropriate position by fiat.

Some of those positions the verb tone attaches to are already modified, namely the first mora of the stem, which has a weak tone root, and the last mora of the stem, which is weak itself. I assume that the morphological tone, if it lands on a first stem mora, will be weak, whereas it is regular if it lands on any other mora. Consider the verb forms in (476), repeated from (458). In (476b) the high tone, arguably exponing the fact that this is a verb of a subordinate clause, cf. Odden (1996: 201), lands on the first mora, yielding a weak tone. In (476a), it lands on the second mora which gives us a regular tone.

(476) *Verb tone on 2nd stem mora*

a. pa-á-tem**á**
COMP–3SG-chop
'when he chops' (DO96:201)

b. pa-á-kį-t**é**ma
COMP–3SG-CL7.OBJ-chop
'when he chops it' (DO96:201)

This is achieved by having faithfulness constraints protecting the already present weak tonal root node, whereas in other positions general markedness prefers the epenthesis of strong tonal root nodes. Those general markedness constraints are crucially outranking the constraint *W(EAK)μ–S(TRONG)∘, so that we get a strong tone on a weak final mora. Consider the verb form in (477) repeated from (461), which has both an initial and a final stem tone phrase-finally.

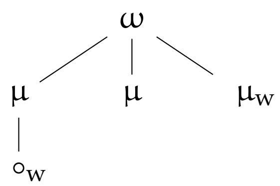
(477) *Tone deletion on verbs counterfeeds ITI*

a. panį́-kį-kálaŋgaé
'when I was frying' (DO96:249)

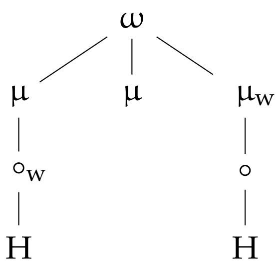
b. panį́-kį-kálaŋgae pa-mwoótó
'when I was frying it by the fire' (DO96:249)

The structure that enters the word level from the stem level for a form like *katae* is the one in (478),[157] whereas (479) gives the representation of the output of the word level.

(478) *Structure of stem level output for phrase medial /kaatae/*



(479) *Structure of word level output for phrase medial /kaatae/*



The tableau in (480) maps the two forms on each other.[158] Candidate a. associates the tones in the appropriate positions and is otherwise faithful, it is the optimal candidate which violates the constraint that demands a strong tone to associate with a strong mora. Candidate c. strengthens the final mora in order to satisfy that constraint, but this fatally violates a faithfulness constraint for that mora. Candidate

[157] We will ignore the loss of the mora for now. It is orthogonal to the tonal processes and its interaction with gliding will be discussed in chapter 4.6.8. syllables are omitted for space considerations.

[158] The morphological tones are given here as pre-and suffix respectively, but this depends of course on the precise analysis of morphological tone that one adopts. Candidates that have the morphological tones in a wrong place or not at all are omitted from the tableau.

d. also satisfies that constraint, albeit by inserting a weak tonal root node, which is less optimal.

(480) *Derivation of two tone verbs*

		H [ka^{w}laŋgae$_{W}$]$_{\omega}$H	ID-∘	ID-μ	DEP-∘$_{W}$	*Wμ–S∘	DEP-∘
☞	a.	[ká^{w}taé$_{W}$]$_{\omega}$				*	*
	b.	[kálaŋgaé$_{W}$]$_{\omega}$	*!			*	*
	c.	[ká^{w}laŋgaé]$_{\omega}$		*!			*
	d.	[ká^{w}laŋgaé$^{W}_{W}$]$_{\omega}$			*!		*

However, if there is only one verb tone which is associated with the final syllable, CULMINATIVITY makes sure that the weak mora is strengthened. CULMINATIVITY is still outranked by DEP-H, since there are completely toneless words. The final high tone in class 5/9 nouns is not affected, because the L-tone on the first mora satisfies CULMINATIVITY at this level.[159]

It is important for ITI that monosyllabic verbs do not weaken their final mora, nor do they associate a weak tone root. Again, there are multiple approaches for this that are compatible with the framework proposed here. Monosyllabic words can be exempt from mora-weakening at the stem level, because a word with only a weak mora is not well formed. The absence of the weak tone root can be achieved similarly, or by postulating that the exponent of little v has an allomorph for monosyllabic stems, see Trommer & Gleim (2017) for a proposal of similar syllable counting allomorphy expressing little v in Bari.

The output that the word level generates are significant, as they will also serve as the input for the context of ITI. But let us first look at how these outputs yield the correct Phrase level forms.

4.6.6.3 Phrase level

At the phrase level, there are two relevant positions: phrase medial and phrase final. Phrase here refers to the biggest prosodic unit in the language, which encompasses entire utterances. There are arguably smaller intermediate domains between it and the words, however, these to not contribute to the processes discussed here and are henceforth ignored. There is also a morphological tone (or rather, syntactic tone) that has to be considered: The topic marker, which inserts a high tone on the last syllable of topicalised syntactic phrases. These topicalised syntactic phrases are necessarily (phonological) phrase medial. I will first discuss the phrase-medial position, before coming to the phrase edge and the topic tone.

Phrase medially, toneless nouns and verbs surface faithfully toneless. The same holds for nouns and verbs with only non-final tones. Embedded prosodic words

[159] This assumption is contra Hyman (2006).

with a tone on the final mora show a more diverse picture: If that tone is the only tone, it survives. If there is another tone in the domain, it is deleted in verbs. In nouns, it is deleted if the other tone was a part of the underlying representation of the root, but not if it was introduced by the prefix. The base for the analysis as already been laid out: Tones on weak morae are deleted, independent of whether they are weak themselves or not. Weak tones on the other hand are not deleted, as long as they associate to a strong mora. It is irrelevant whether they stay weak or get strengthened, for simplicity, I will assume the former. The crucial constraint which is responsible for the deletion of tones is given in (481). This constraint must outrank MAX-H, as it triggers deletion.

(481) *H↔ μ_w
Count a violation for every high tone associated with a weak mora.

The tableau in (482) shows the derivation of a to tone noun, with a weak tone on a weak mora and a regular tone on a strong mora. The strength of the tones, as it is not important, is omitted. Candidate a. is out because it has the tone on the weak mora, and c. is suboptimal because it inserts a mora to strengthen the weak mora. Th winner, b., deletes the tone.

(482) *Derivation of phrase-medial tone deletion on two toned noun*

	$[\text{lʊ̧}[\text{lɪ̧mɪ̧́}_\text{W}]_\omega]_\omega$...	ID-μ	DEP-T	*SHIFT	SPEC-ω	*H↔ μ_w	MAX-T
	a. $[\text{lʊ̧}[\text{lɪ̧́mɪ̧́}_\text{W}]_\omega]_\omega$					*!	
☞	b. $[\text{lʊ̧}[\text{lɪ̧́mɪ̧}_\text{W}]_\omega]_\omega$						*
	c. $[\text{lʊ̧}[\text{lɪ̧́mɪ̧́}_\text{S}]_\omega]_\omega$	*!					

The tableau in (483) shows the same for a repellent noun, a noun belonging to class 9 or 5 which blocks high tones from its first mora, that has a (strong) low tone and a weak high tone on a weak mora. Candidates a. and c. are ruled out for the same reason as in (482), and candidate d. is ruled out by the familiar constraint *SHIFT, which prevents any saving of the final tone by shifting it to another position.

(483) *Derivation of phrase-medial tone deletion on repellent noun*

	$[\text{ndòoɲá}_\text{W}]_\omega$...	ID-μ	DEP-T	*SHIFT	SPEC-ω	*H↔ μ_w	MAX-T
	a. $[\text{ndòoɲá}_\text{W}]_\omega$					*!	
☞	b. $[\text{ndòoɲa}_\text{W}]_\omega$						*
	c. $[\text{ndòoɲá}_\text{S}]_\omega$	*!					
	d. $[\text{ndòóɲa}_\text{W}]_\omega$			*!			

The tableau in (484), at last, shows the derivation of a toneless noun, which surfaces faithfully.

(484) *Derivation of phrase-medial toneless noun*

		[ɲama$_W$]$_\omega$...	ID-μ	DEP-T	*SHIFT	SPEC-ω	*H↔ μ_w	MAX-T
☞	a.	[ɲama$_W$]$_\omega$						
	b.	[ɲáma$_W$]$_\omega$		*!				

A final tonal morpheme of Kimatuumbi has to be accounted for, namely the high tone insertion at the phrase edge that marks topics. I assume that this tone is a reflex of topic morphology, which is clitisised to all topicalised phrases. In order to make this work, I have to assume that every XP that precedes the VP is indeed topicalised, including subjects in default clauses. The topic clitic consist of two elements - a high tone, and a weak mora, as in (485).

(485)
H
|
μ_W ↔ TOPIC

The mora then integrates into the final syllable. I assume that a syllable with two weak morae is automatically turned into a syllable with a regular mora. If the word the clitic attaches to is a host that already ends in a regular mora, which carries a high tone, both mora and tone are deleted (or remain floating, as long as this has no phonetic effect). The clitic is also deleted if its docking would violate the OCP, at least for some speakers Odden1996.

If a word is positioned at the right phrase edge, weak tones are not deleted. Also, toneless nouns appear here *with* a tone. I analyse both as boundary effects: The former is due to the constraint in (486b), which penalises phrases that end in weak morae. It is schematically identical to the constraints seen for C'Lela in section 4.1 and Hijazi in section 4.3. The latter is enforced by the constraint in (486a), compare Worbs (2016); Gleim (2018) for similar constraints that enforce boundary tones.

(486) a. FINALFALL
Count a violation for every ϕ-final minimal prosodic word that does not have a falling contour.

b. $*\mu_W]_\phi$
Count a violation for a phrase whose last vowel dominates a weak mora.

FINAL FALL is in fact never violated: If we have a word that ends in a high tone, this high tone is transformed into a fall by adding a mora, see (487).[160]

[160] This can also be analysed as adding a low tone, the contour tone then is phonetically perceived as

(487) *Final Fall*

a. [naaljáa]
na-a-ljá
1SG-REM-eat
'I will eat' (DO96:256)

b. [mbakáa]
m-paká
'cat' (DO96:256)

The tableau in (488) shows the derivation of a noun with two high tones phrase finally. Candidate a., the faithful candidate, violates the two boundary constraints, as is end neither in a fall nor a strong mora. Candidate c. strengthens the final mora, but still has no fall. Candidate d. has a falling contour and a strong mora and looks superficially identical to the phrase medial winner, candidate e. Just like that, it violates MAX-H. However, the phrase medial winner ends in a weak mora and thus does not violate ID-μ. Phrase medially where $*\mu_w]_\phi$ is not active, it is more optimal then candidate b. Phrase finally though, e. is out because it violates $*\mu_w]_\phi$ and d. because it fares word with low ranked constraints compared to b.

(488) *derivation of Finall Fall for a noun with a final high tone*

		[lų̧[lį̧mį̧w]ω]ω]ϕ	FINAL-FALL	$*\mu_w]_\phi$	ID-μ	$*H\leftrightarrow\mu_w$	MAX-H	DEP-μ
	a.	[lų̧[lį̧mį̧w]ω]ω]ϕ	*!	*!		*		
☞	b.	[lų̧[lį̧mį̧į̧]ω]ω]ϕ			*			*
	c.	[lų̧[lį̧mį̧]ω]ω]ϕ	*!		*			
	d.	[lų̧[lį̧mi̧]ω]ω]ϕ			*		*!	
	e.	[lų̧[lį̧mi̧w]ω]ω]ϕ		*!			*	

Toneless nouns and low toned nouns do not need to lengthen the final syllable in order to fulfil FINALFALL, it suffices that they introduce a high tone. The high tone lands on the first mora, if it is free, or on the second, if the first mora is low toned, e.g. in a class 9 noun. I refrain from illustrating this with a tableau. I will remain agnostic on the mechanism that is responsible for this leftward placement, it can can either be baked into the FINALFALL constraint or some general mechanism that prefers high tones closer to the left edge.

being hosted by a long vowel, cf. Yu (2003, 2023).

4.6.7 Subcategorisation-frame revisited

With this background analysis of the tonal phonology of Kimatuumbi in place, we can turn to the apparent countercyclic process interaction. It is now possible to propose a subcategorisation-frame has both fewer clauses compared to (431) and requires only phonological context information, see (489). Clause a., the more specific clause, inserts the high toned allomorph after a (minimal) prosodic word without a strong high tone. This is a rather simple algorithm: It goes through every mora and checks whether it has a strong high tone. If it reaches the first mora and has not found a high tone, it selects the first allomorph. If it encounters a high tone, or if it does not encounter a mora, it aborts and clause b. selects the elsewhere allomorph.

(489) a. $(\mu_{\geq 1})_\omega$ málaáu
directly adjacent to a minimal ω without a strong H-tone, select the high toned variant
b. Elsewhere, select the low-toned variant.

The first attempt needed an extra clause for floating tones, which in my analysis are associated to a (weak) mora and thus just as visible as any other mora associated to a tone. It needed another extra clause for disregarding the initial verb mora. In the new version, this tone is representationally different and thus ignored. A final extra clause exempted the first mora of a verb from this, if it was also the last mora. This is derived here by postulating that in this case, the verb tone is strong. The new version can also account for the interaction with tone deletion: Some deleted tones are visible, whereas others are invisible for ITI. Under my ordering, this a priori problematic, as ITI precedes phrasal deletion. However, since ITI ignores some tones anyway (tones on verb-root initial morae), it is straightforward to assume that the the property that makes those tones invisible is the same. The feature that determines visibility to ITI, and the feature that determines stability (i.e. is the tone deleted phrase medially or not?) are independent and can be cross-classified, giving us the types in (490). All four combinations are indeed attested.

(490) *Crossclassifcation of weak tonal root nodes and weak morae*

	weak tone	strong tone
Weak mora	deleted medially, no trigger	deleted medially, trigger
Strong mora	no deletion, no trigger	no deletion, trigger

The subcategorisation algorithm proposed here is more powerful then the ones proposed by Paster (2006, 2009). It predicts non-local allomorphy of the type 'if there is a segment x somewhere in the search domain, choose allomorph A.' which weakens the conditions on locality. I am not aware of any such cases of allomorphy outside the orbit of tone, for another tonal example see Rolle & Bickmore (2022). It does not, though, get rid of locality completely: The search algorithm starts at the edge where the allomorph is inserted and moves from there. Something like 'choose suffix-allomorph A if root starts with a [k]' is still impossible do derive.[161]

This allomorph selection frame is unusual for two additional reasons. First, phrasal allomorphy is generally rare, Bermúdez-Otero & Luís (2009) even assume that allomorphy is germane to word and stem level elements.[162] The examples that exists, like allomorphy of the English articles (many, see e.g. Pak 2016 for a recent discussion) or the Spanish feminine article Harris (1989) have in common that they are still inward oriented, whereas the Kimatuumbi allomorphy regards syntactically more distant linear contexts. An example that is somewhat similar to the Kimatuumbi case comes from the allomorphy of the Welsh article, which shows up as [r] after a preceding vowel outside its DP, and as [ɨ] after a consonant, see Hannahs & Tallerman (2006), who argue that this must be allomorph selection and cannot be reduced to phonological rules.[163] Deal & Wolf (2017) and Rolle & Bickmore (2022) argue that outward sensitive allomorphy must be limitedly available, however, the discuss word internal allomorph selection, it is unclear how their proposals would extend to phrasal contexts. A proposal that suggests pervasive phrasal allomorphy not only for functional material but also for lexical roots is found in Tsay & Myers (1996) and McPherson (2019) for Taiwanese and Seenku respectively, however, the allomorphy there is strictly inward looking.

This analysis is also hard to reconcile with the standard assumption in Stratal OT and its predecessor LMP that all material that reaches the phrase level phonology has undergone at least word level phonology (cf. Kiparsky 2018: 12). This assumption does not preclude phrasal affixes in general, a function word can still be forced to integrate into a prosodic domain with a lexical word and undergo phonological process distinctive for that domain, cf. Selkirk (1995). However, it can only have one underlying representation, which precludes allomorphy as observed with ITI. A common solution to account for affixes that show a syntactically freer distribution and have thus been analysed as phrasal affixes/special clitics (Anderson 2005, 2008) with the assumptions of LMP is to assume that they are indeed lexical affixes that express some morphosyntactic feature, their distribution in an utterance is in the domain of syntax (cf Bermúdez-Otero & Payne 2011) . This approach does not work for ITI: It does not show any allomorphy based on the shape or features of its host, but is sensitive to its linear predecessor, which can be syntactically very loosely related to the phrase carrying the ITI morpheme. To extend such an analysis would be to postulate that in a sentence such as (430), repeated in (491) the prefix /na/, which is a preposition and introduces a PP adjunct to the (elided) verb, is indeed a suffix to

[161] The locality could be regained under the assumption that a full high tone 'percolates up' to the prosodic word and is thus directly adjacent to the ITI morpheme. If this path is chosen, it must be determined which features can be transferred to higher prosodic nodes and what that means outside allomorph selection.

[162] They make this argument for stem allomorphy. The Kimatuumbi case is somewhat different, the ITI morphemes do not trigger allomorphy on adjacent words, they are allomorphic themselves.

[163] Zimmermann (2018b) however reanalyses this allomorphy as phonology.

/mamboondo+H/, the subject of the verb and topic of the sentence, separated from the PP by the position of the elided verb. This, frankly, strikes me as improbable.

(491) *ITI is sensitive to ellipsis*

a.	na	mamboondo	H	~~aa-kátįte~~	na-kjiímbe → mamboond**ó** n**a**kjiímbe
	and	Mamboondo	TOP	cut	with-knife

‘and Mamboondo [cut] with a knife’

As I have argued extensively, ITI is also a bad candidate for a phonological process: It is specific to a list of morphemes, the context in which it is triggered is not easily categorised phonologically and it it does not behave like other processes of floating high tone docking, which have some sensitivity to the OCP *inside* the prosodic domain in which they are realised. In addition, tone deletion in verbs counterfeeds ITI, which makes it impossible for Stratal OT to analyse both as phrase level phonological processes, where we would expect a feeding interaction between two process on the same stratum.[164]

I suggest thus that vocabulary insertion for some morphemes, in the case of Kimatuumbi the ITI morphemes, may be delayed until very late, where allomorph selection has access to the linear context, and also, as seen in (491), to elision operations. A similar proposal in the framework of stratal OT can be found in Gjersøe (2020), who argues that the allomorphs of the oblique case in Nuer are only selected before entering the phrase stratum. Unless one adapts precompliation theory (Hayes 1990), which is arguably too powerful, this makes the prediction that ITI elements have not undergone phonology before the phrase level. This is not a problem for the prefixes of major interest here, however, it might be problematic for the longer words that undergo ITI such as malaáu and especially the bimoraic class 9 adjectives, which are arguably not functional morphemes.[165] Because the number of elements is still very low, I contend for the time being that these elements do not necessitate a mechanism like precompilation and can simply be lexicalised as elements that are inserted from the lexicon prior to the phrase level computation.

4.6.8 Shortening

4.6.8.1 Puzzle

Odden (1990, 1993, 1996) presents another piece of data from Kimatuumbi that he

[164] In rule-based LMP, it is possible to have ITI as a phonological process and order it before tone deletion in verbs (even though the other objections against it being a phonological process still stand). However, such an analysis still requires reference to at least some of the featural enrichments I propose, because tone deletion in verbs and nouns must happen at different points in the derivation, as nominal tone deletion feeds ITI. Given that the latter is a utterance level rule, this is potentially a problem for frameworks which have a cyclic phrase level: The more restricted process of ITI should apply before very late nominal tone deletion.

[165] In the last case, the adjectives are sensitive to the noun that they modify. In this contexts, allomorphy is crosslinguistically more expected, cf. Mascaró (1996). The adjectives of class 9 do not undergo any lexical phonological process, but other adjectives that have an overt prefix, do.

analyses with counter-cyclic rules, namely the interaction of shortening and, again, gliding. Gliding, as established, happens on every level of Kimatuumbi phonology, or, in Odden's framework, the three lexical levels. Shortening is a process for which the phrase level structure is crucial: It applies if a root is not at the right edge of some phrasal domain. This phrasal domain is smaller than the one relevant for tone distribution, the latter might very well be the utterance. The domain for shortening includes e.g. the noun and its modifiers or the verb together with the object, but not entire sentences. (492) gives examples of nouns in a shortening context, and (493) of verbs.

(492) *Shortening in nouns*

a. kį-kóloombe caáŋgu → kįkól**o**mbe caáŋgu
CL7-cleaning.shell my
'my cleaning shell' (DO96:219)

b. kį-kóloombe kį-kúlú → kįkól**o**mbe kįkúlú
CL7-cleaning.shell CL7.big
'a big cleaning shell' (DO96:219)

c. kį-kóloombe ca asįkoópų → kįkól**o**mbe ca asįkoópų
CL7-cleaning.shell POSS bishop
'cleaning shell of the bishop' (DO96:219)

(493) *Shortening in verbs*

a. na-a-kį-twéetiį kį-kóloombe → naakįtw**é**tiį kįkóloombe
1SG-REM-CL7.OBJ-take.PFV CL7-cleaning.shell
'I took a cleaning shell' (DO96:225)

b. kálaaŋga kį-ɲɟáambų́ → kál**a**ŋga kįɲɟáambų́
fry CL7-cassava
'to fry cassava' (DO96:226)

c. na-an-kálaaŋgįįle lį́ → naankál**a**ŋg**į**le lį́
1SG-fry.APPL.PFV not
'I did not fry for him' (DO96:226)

We see that the nouns in (492) such as *kį-kóloombe*, which have a long vowel underlyingly, lose this vowel if they are modified, be it by a pronominal possessive, a nominal possessive or an adjective. (493) shows the same for verbs, which shorten if they have an overt object following or some adverbial markers, such as the negation *lį́*.

Crucially, Shortening is fed by stem level applications of gliding, compare (494)– remember that gliding implies compensatory lengthening and so creates a long vowel. In (494b), we see that the gliding of the suffix *į*, the applicative, with the suffix *an*, the reciprocal, creates a sequence *jaa* with a long vowel. However, if the verb appears in a shortening context as in (494a) with the object *įtuúmbili*, the long vowel does not appear. However, word level gliding, that is gliding between the stem and prefixes, does not feed shortening. As (495) shows, the vowels that became long due to a shifting prefix mora stay long even in a shortening context. (495b) shows both feeding and counterfeeding: The long vowel that arises from gliding of the suffix į is shortened, the long vowel that arises from the gliding of the prefix vowel of *tų*.

(494) *Gliding feeds shortening*

a. twaakj**a**na įtuúmbili
tų-ak-į-an-a įtuúmbili
'we net hunt monkeys for each other' (DO96:273)

b. akjaana
ak-į-an-a
'to net hunt for each other' (DO96:273)

(495) *Gliding counterfeeds shortening*

a. kj**ųų́**la caáŋgu
kį-ųla caáŋgu
'my frog' (DO96:272)

b. tw**aa**kjana įtuúmbili
tų-ak-į-an-a įtuúmbili
'we net hunt monkeys for each other' (DO96:273)

If shortening is phrasal, given that it arguably needs phrasal context information as it applies only if there is some phrase and the target is not on the right edge of that phrase, it is countercyclically counterfed by a word level process. In Odden's analysis, Shortening is a stem level process that has countercyclically access to information that belong to the phrase level.

The cyclic reanalysis I propose is similar in its ordering to Odden's analysis: Shortening applies on the stem level, and is thus cyclically counterfed by word-level gliding. However, I reanalyse shortening so that is is *not* sensitive to phrasal information, but to morphological information present on the stem level without violating the IRH or cyclicity. I assume that shortening is the reflex of an Ezafe morpheme, that marks modified heads. Before presenting this solution in detail, we will have a closer look at the data that illustrates Shortening.

4.6.8.2 Shortening: exceptions

Shortening applies to nouns if there is a non-empty modifier to the right of the word. With verbs, it applies if a direct or indirect object follows the verb, as well as the negative particle.[166]

There are exceptions to shortening, both systematic and lexical. The lexical exceptions are mostly found in nouns. (496) shows cases where shortening does not apply at all, whereas (497) shows cases where shortening affects only the rightmost long vowel.

[166] According to Odden's description, other adverbs must also trigger shortening, but there is no convincing data.

(496) *Idiosyncratic blocking of shortening*

a. paáti̧li̧ → paáti̧li̧ jwaáŋgu 'my priest' (DO96:223)

b. ki̧tu̧u̧ŋgu̧ú̧ → ki̧tu̧u̧ŋgu̧ú̧ caáŋgu 'my onion' (DO96:223)

c. li̧i̧wé → li̧i̧we lwáaŋgú 'my stone' (DO96:29)

(497) *Partial blocking of shortening*

a. taási̧bi̧í̧ru̧ → taási̧bi̧rú̧ jaáŋgu 'my muslim rosary' (DO96:223)

b. ntiítiliíti → ntiítilití waáŋgu 'my circle' (DO96:223)

For the cases in (497), it is difficult to say whether they constitute an exception: Stems with more than one long vowel are rare. All noun roots with underlyingly two long vowels are either completely or partially immune to shortening. Verbs can acquire a second long vowel via gliding, and if they do, both vowels are affected by shortening, as has been seen above. There is only one verb with two underlying long vowels (*keenŋgeemba* 'to uproot tubers' Odden 1996: 157), but it is not given in a shortening context. Furthermore one verbal suffix that has a long vowel, -aaŋ, however, it shortens preceding vowels independently from Ezafe and does thus not help us in defining the number of shortened vowels.[167]

Verbs in certain tenses systematically do not undergo shortening. This includes all verb-focal tenses, as well as the negative persistive (Odden 1996: 227). This shows that shortening is very idiosyncratic: There are lexical exceptions, chiefly in nouns, and morphosyntactic exceptions where some verb forms are immune to shortening. Before we come to the actual analysis, I want to show that a prosodic analysis is not possible: On can argue that the stem-level maps to a prosodic domain, and that vowels outside that domain such as prefixes are immune to shortening. However, if the prefix vowel undergoes gliding, it shifts into this prosodic domain. Given that I adopt Proper Bracketing, the syllable cannot be partially outside the domain and partially inside.

4.6.8.3 Analysis of shortening and interaction with gliding

I propose that Shortening, just as ITI, is not a true phonological process, but the reflex of a morpheme. Shortening applies (mostly) if a head has an overt modifier. This is a context where we find segmental, concatenative morphology in other, unrelated languages, most prominently the Ezafe morpheme in Iranian languages, but also construct state morphology in Afro-Asiatic languages or the 'linker' in some Austronesian languages, such as Philippine languages or Chamorro (Chung 2020). I will briefly present a a glance of this typological picture, before arguing that Kimatuumbi shortening should be analysed as an instance of the same phenomenon.

[167] Many stem level suffixes induce shortening, independently from whether they have a long vowel themselves, compare Odden (1996: 156ff). A unified analysis of stem level shortening in Kimatuumbi is outside the scope of this work, but appears very well compatible with the analysis of the apparent countercyclic shortening proposed here.

In Persian (Ghomeshi 1997), the Ezafe morpheme appears on a noun if is modified by a possessor, an adjective, just as in Kimatuumbi. Just as in Kimatuumbi, the Ezafe morpheme can also attach to (some) prepositions. (498c).

(498) *Ezafe in Persian*

a. otâq-e kutʃik
room-EZ small
'small room' (Samiian 1983)

b. otâq-e ali
room-EZ Ali
'Ali's room' (Samiian 1983)

c. poʃt-e manzel
behind-EZ house
'behind the house' (Ghomeshi 1997)

Another Iranian language that has Ezafe is Kurmancî (Strunk 2005). It is found in mostly the same contexts as in Farsi, but there are more Ezafe allomorphs: It agrees with the head noun in gender (499a,b) and definiteness, and can also cause allomorphy (or a lexical phonological process) on roots it attaches too. According to Bermúdez-Otero & Luís (2009), this entails that Ezafe is a (lexical) affix, a categorisation that is shared by Strunk (2005).

(499) *Ezafe in Kurmancî*

a. mal-a sor
house-EZ.F.DEF red
'red house' (Strunk 2005)

b. heval-ê mɨn
fried-EZ.M.DEF I
'my friend' (Strunk 2005)

c. [dija]
/dê-a/
'mother-EZ.F.DEF' (Strunk 2005)

Construct state has a more limited distribution in Semitic languages, such as Hebrew (amongst many others Borer 1999; Faust 2014), where it only marks nouns modified by other nouns, but not adjectives, (500a,b).[168] Like in Kurdish, construct state can coöccur with stem allomorphy or a stem internal process, (500c), in this case without accompanying concatenative morphology.

(500) *Construct state in Hebrew*

a. noca-t xasida

[168] In other Afro-Asiatic languages, such as the Cushitic language Iraqw, construct state is found with a more 'Iranian' distribution and found on a modified noun before another noun, adjective or even relative clause, see Mous (2007)

feather-EZ stork
'stork feather' (Faust 2014)

b. noca xamuda
feather cute
'cute feather' (Faust 2014)

c. [beit more]
/bajit more/
house-EZ teacher
'teacher's house' (Borer 1999)

In Chamorro (Chung 2020), Ezafe is marked on modified nouns (501a,b), but also on verbs, at least when modified by certain adverbs, see (501c).

(501) *Linker-Construction in Chamorro*

a. lamasa-n dikiki?
table-EZ small
'small table' (Chung 2020: 156)

b. estufaw-n sɑli
estufao-EZ bird.sp
'Estufao of Micronesian starling' (Chung 2020: 162)

c. ha catgi-n bɑba
AGR laugh-EZ bad
'She laughed mockingly' (Chung 2020: 399)

There are two differences between Ezafe in Iranian, Hebrew and Chamorro on the one hand, and Kimatuumbi Shortening on the other: Ezafe is for the most part segmental, whereas shortening is suprasegmental. This is not a big difference, morphemes with all sorts of meaning can be segmental in one language and suprasegmental in another (Gleim, McCann, Tebay, Trommer, & Zimmermann in progress). Furthermore, Ezafe in Iraqw is at least partially marked with tone changes in the stem (Mous 2007). The second difference is that Iranian and Afro-Asiatic Ezafe is restricted to nouns, adjectives and prepositions, whereas Shortening applies to verbs as well (As does Ezafe in Chamorro, albeit in less contexts). I contend that this is a minor difference as well: If an Ezafe morpheme is possible for nouns, then it should be possible for verbs, too. We can see this for different morphological features with respect to categories as well: Agreement is common on verbs and adjectives, but can have reflexes on adverbs as well (Chumakina & Corbett 2008). Ezafe might be rarer in general which restricts the available data, but there is nothing in principle that restricts it to nouns. Indeed we, see in the few languages discussed here that the set of targets of Ezafe can be rather diverging: only nouns in Hebrew, nouns and possibly prepositions (cf. Alphonce 2022) in Iraqw, nouns, adjectives and prepositions in Iranian, nouns and verbs in Chamorro, nouns, verbs, adjectives and preposition in

Kimatuumbi. To conclude this excursus, I analyse the Shortening in Kimatuumbi as the reflex of a non-segmental Ezafe morpheme. This Ezafe morpheme belongs to the stem level and is a suffix. Ezafe is generally a type of agreement, and agreement morphemes are often on a level, be it stem or word, where the element they agree with is not yet present. For example, German adjective agreement happens on the a lexical level (Wiese 1986), but it reflects the presence or absence of a definiteness morpheme that is added only later. If Ezafe applies or does not apply in a given construction, is thus a question of morphosyntactic operations and not a reflex of phonology.

Ezafe in Kimatuumbi is a stem level affix. Shortening, its reflex, is computed at the stem level. The fact that shortening is counterfed by word level gliding is thus not a countercyclic process interaction, but a cyclic process interaction and fully expected in any cyclic framework.

This concludes the basics of the reanalysis: Shortening is not a process that is sensitive to phrasal structure, but to the presence of the Ezafe morpheme, which is a stem level morpheme. However, it is not trivial to formulate shortening morphology without introducing some anti-IRH mechanism such as indexed rules or constraints, compare Zimmermann (2017). In order to keep with the IRH, non-linear morphology is analysed as the concatenation of sub- or suprasegmental structures (Akinlabi 1996; Bermúdez-Otero 2012). This is straightforward for binary features and lengthening, where it is a feature or a mora that is concatenated. However, there is traditionally no feature that marks shortness that could be employed to this end. The brute force approach would be to assume, in addition or instead of morae, the feature [-long], or, following Kushnir (2019) the adoption of negatively active morae. An alternative to this can be found in Zimmermann (2013, 2017),[169] or to employ a Duke-of-York derivation.[170] Ultimately, as mentioned in footnote 167, the analysis of Ezafe-shortening should be unified with an analysis of the other shortening processes observed at the Kimatuumbi stem level.

The decision is, however, independent from the point I want to make, so I will present here the most straight-forward option with a negative mora.

Consider the tableau in (502). The input consists of a root with a long vowel and the Ezafe morpheme, the negative mora μ^{-1}. The faithful candidate a. is out because it violates *FLOAT. The negative mora cannot associate to a short vowel, candidate c., as that would delete the complete vowel. It cannot be deleted either, candidate d., as this violates a high ranked constraint against mora deletion. The winner is thus

[169] Her approach however relies crucially on coloured containment, which is equivalent to a less strict bracket erasure than the one I assume for this project, see chapter 2.3.1.

[170] Duke-of-York derivations as a possibility are inherent to Stratal OT (cf. Gleim 2019). Under a Duke-of-York approach, one feature +F is introduced by the Ezafe morpheme and spreads onto vowels and vowels with the feature +F are shortened due to a general constraint that prohibits +F on long vowels. At the word level, +F is highly marked and deleted, so that the reason for shortening becomes opaque.

candidate b., where the negative mora docks to the long vowel.[171]

(502) *Derivation of Shortening*

		koloombe μ^{-1}	*FLOAT	MAX-V	MAX-μ	ID-LONG
	a.	koloombe μ^{-1}	*!			
☞	b.	kolombe				*
	c.	koloomb		*!		
	d.	koloombe			*!	

These constraints, combined with the constraints responsible for gliding and compensatory lengthening, derive the correct output for a form with stem level gliding and Ezafe: Gliding, but no lengthening, see the tableau below in (503). Candidate a.violates the constraint against the hiatus and deletes the mora. Candidate b. undergoes gliding with lengthening, but still fails to harbour the mora. The winner candidate c. integrates the mora which usurps a stem mora (either of the high or the low vowel), but preserves the high vowel as a glide. In candidate d. the mora absorbs the mora of the high vowel, which is deleted, making the candidate suboptimal.

(503) *Shortening blocks lengthening*

		aki̯ana μ^{-1}	*i.V	MAX-V	MAXμ	ID-LONG
	a.	aki̯ana	*!		*	
	b.	akjaana			*!	
☞	c.	akjana				
	d.	akana		*!		

As mentioned above, there are lexical irregularities to shortening. Verbal Ezafe can affect all long vowels in a verb, however, given the contexts in which gliding can apply and the restrictions on long vowels, it is de facto only up to two vowels that are affected. In nouns, shortening either fails, or it is only one vowel that is targeted. Under the approach with the negative mora, this must be due to allomorphs of the Ezafe morpheme. Verbal Ezafe consist of two negative morae, nominal Ezafe, determined by the root, has a zero allomorph or a single negative mora. (504) gives the list of allomorphs.

(504) *Ezafe Allomorphs*

a. EZAFE ↔ $\mu^{-1}\mu^{-1}$ / $]_V$ ___

b. EZAFE ↔ Ø/{paáti̯li̯, li̯i̯wé...}___

c. EZAFE ↔ μ^{-1}

The interaction between shortening and gliding is now completely cyclic. At the time

[171] If this proposal is to be elaborated, it must be defined whether this candidate violates MAX-μ or whether the mora is simply absorbed by the negative mora, and what this means exactly. Since this tableau's purpose is to illustrate rather the general gist, I will leave these questions open.

at which word-level gliding applies, the negative mora has either been associated, or has already been deleted. Consider (505), the stem level derivation for /ki̧-u̧la/ 'frog'. At the stem level, the prefix is not yet available. Shortening fails, because there is no long vowel that can be shortened. Since deletion is preferred to leaving the mora floating, it is deleted.

(505) *Shortening fails for lack of target*

u̧la μ^{-1}	*i.V	MAX-V	MAXμ	ID-LONG
a. u̧la			*	
b. u̧l		*!		

At the word level, when gliding and compensatory lengthening apply, there is no reason left to shorten: The mora is gone, there is no word-level Ezafe affix.

4.6.9 Conclusion

Kimatuumbi contains two process interactions that are problematic for cyclicity: Word internal gliding is bled by phrasal ITI, and word-level gliding counterfeeds phrasal shortening. In addition, ITI is fed by some instances of phrasal vowel deletion, but counterfed by others. The reanalysis relies on three core ingredients: The adoption of prosodic structure makes it possible to transfer some instances of gliding onto the phrase level, a bleeding interaction with ITI become thus available. ITI however is analysed as allomorphy that precedes the phrase level processes. This is argued for for independent reasons, but it also makes an analysis in OT more straightforward. The subcategorisation frame for the allomorphy crucially relies on the representational assumptions that tonal root nodes and morae can be marked as weak. For Shortening, the trigger is redefined and analysed as an Ezafe morpheme that is present at the stem level. The counterfeeding interaction with word-level processes becomes thus cyclically expected.

These complex interactions observed in Kimatuumbi have been a challenge for cyclic theories of phonology for more than three decades, and showing that a cyclic analysis with the rather strict assumptions of PaC can derive the data is thus surely an advancement. The cyclic reanalysis necessitates the following: First, it assumes diacritic weak/strong features on elements that are otherwise assumed to not be featurally distinct, namely tonal root nodes and morae. More drastically, I propose a sort of allomorphy that is sensitive to the phrasal context of syntactically exterior elements. This is a less powerful framework than the one developed in Odden (1990, 1993, 1996) which has almost unrestricted reference to morphosyntactic features and allows for countercyclic look-ahead rules.

Chapter 5

Comparison with Alternative Approaches

So far we have seen that Prosody and Cycles (PaC), as defined in chapter 3.3, can account for the apparent countercyclic data discussed in the case studies in a cyclic fashion, but it also overgenerates some unattested patterns. In this chapter, I compare it to alternative approaches. The first and most obvious alternative is to say that the countercyclic cases are indeed countercyclic and disprove thus the cyclic hypothesis; and that therefore a non-cyclic framework should be preferred. The most prominent non-cyclic approach to phonology within theoretical phonology is Transderivational faithfulness or Output-Output correspondence (OOC, Chung 1983; Benua 1997; Burzio 1998; Kenstowicz 2002; Albright 2002; Hayes 2000; Kager 1999; Steriade 2008; Rolle 2018b among many others) which in turn has many different implementations. In section 5.1, I will focus on a stringent interpretation of OOC based on (Benua 1997; Kager 1999) and (Hayes 2000). In section 5.1.2 I find that OOC without prosody can account for some of the countercyclic case studies, but not all. The addition of prosody widens the set of derivable languages, but Kimatuumbi still poses a problem. Regarding overgeneration, a comparison to PaC is somewhat inconclusive: the prediction space overlaps, there are (arguably pathological) patterns that PaC derives but OOC excludes, and reversely, there are (arguably pathological) patterns that OOC derives but PaC cannot. An important result is that OOC must generate a specific pattern of countercyclicity, namely a process that applies in the phrasal base must (if it can) feed or bleed a lexical process. This is a severe case of undergeneration, as the reverse, cyclic interaction is attested.

A second alternative is to reject prosody, and relax Bracket Erasure instead, so that some internal brackets are accessible at a later stage of the derivation, following Pesetsky (1979). This is similar to having isomorphic inherited prosodic structures, but makes interestingly different predictions, and in section 5.2 I argue that the approach with prosody fits the data better.

Lastly, in section 5.3, I compare my constraint based approach with a version of PaC that employs extrinsically ordered rules, as in LMP. I show that the rule-based version generates a basically unrestrained set of countercyclic interactions. This is in a stark contrast to the OT version, which can derive some countercyclic patterns, but still excludes a relevant proportion of unattested countercyclic interactions. However, this overgeneration can be restrained with a proposal independently made by Rusyanova & Rasin (2023), which suggest a universal condition that, on each cycle, prosodic rules precede segmental rules. If this proposal is adopted, rule based PaC still generates more countercyclic interactions than the OT version, but also excludes some patterns.

5.1 Output-Output Correspondence

In Transderivational faithfulness, an surface form that is in some way related to the form we want do derive can transfer some characteristica that are phonologically motivated in its own derivation onto the other output. The two outputs stand in a correspondence relationship. This allows us to account for cyclic effects without cycles and a multiple step derivations. Recall the example for cyclicity from German in chapter 2.1, partially repeated in (506), where a velar fricative /ç/ is backed after a back vowel inside a word, but not across word boundaries.

(506) *Cyclic counterfeeding in German*

a. dʁaχə '(male) dragon'

b. dʁɛçɪn '(female) dragon'

c. zɑː çiːna → zɑː çiːna 'saw China'

In a cyclic framework, the under-application of backing of the velar fricative is achieved by ordering the decision of whether the fricative is palatal or uvular before the phrasal concatenation of words, which puts the back vowel adjacent to the fricative in (506c). In OOC, we compare the output /zɑː çiːna/ to the output of /çiːna/ in isolation, the so called base, and can transfer features of it to the output of /zɑː çiːna/. In our case, the base is [çiːna], accidentally fully faithful, and the aspect that we transfer is the the place of articulation of the fricative.

For the derivation, we need our regular markedness constraints, here *[+back]ç, which forbids the sequence of a back vowel followed by the ç, a regular faithfulness constraint which compares Input and Output (therefore, FAITH-IO in the OOC literature, compare Benua 1997), the relevant being ID-[±back], the bases, one as established [çiːna] and the other is [zɑː], and a copy of the faithfulness constraint that compares the output not to the input, but to the base, (which is another output, hence FAITH-OO is used for such constraints), for our case ID-OO-[±back]. In order to get the German pattern, the markedness constraint must be ranked between the two faithfulness constraints, with ID-OO-[±back] ranked highest. In (507), we see how faithfulness to the base blocks backing of the fricative. (508) shows that backing applies, if there is no base that could protect the fricative.

(507) *Cyclic Counterfeeding in OOC*

/zaː çiːna/	Id-OO-[±back]	*[+back]ç	Id-IO-[±back]
[zaː], [çiːna]			
☞ zaː çiːna		*	
zaː χiːna	*!		*

(508) *Cyclic Feeding in OOC*

/dʁaçə/	Id-OO-[±back]	*[+back]ç	Id-IO-[±back]
—			
dʁaçə		*!	
☞ draχə			*

This example suffices to show, that the selection of bases is crucial for the predictions that OOC makes. There have been many proposals inside the OOC literature to define what constitutes a possible base. The most conservative approach supposes that there is only one (lexical) base, and that it must be a morphological substring of the input (e.g., if we want to derive the output for /X-Y-Z/, where X is a root and Y and Z are suffixes, the base can be the output of /X-Y/ or the output of /X/) and that the base must be a word that can be uttered in isolation (Benua 1997; Kager 1999). Two of these conditions have been abandoned in parts of the OOC literature. Burzio (1998) and Kager (2000) propose that a derivation can make reference to multiple lexical bases, i.e. the derivation of /X-Y-Z/ can make reference to the outputs of /X/ and /X-Y/; Burzio (1998); Hall & Scott (2007); McCarthy (2005b) propose that a base must not be a substring of the input, e.g. a an input /X-Y/ can take the output of /X-Z/ as a base, and Rolle (2018b) relaxes the conditions on bases even further and allows a base derived from /X-Z/ for an input /X-Y-Z/. The condition that only strings that can be uttered in isolation has led to famous cases of undergeneration, see e.g. Klein (1997); Trommer (2013), but has to my knowledge not been abandoned. The mechanism of lexical base selection, independent of whether one follows a stricter or looser version, is not deterministic: given an input form and its morphosyntactic structure we cannot know what the base must be, under the stricter definitions we can exclude many potential bases, that is no longer the case for the loosest version that adapts all of the modifications mentioned above, here anything can be the base for anything, as long as they share a root and can be an independent utterance.

Most works that use OOC are limited in their discussion of phonology to phonological processes *inside* words and do not consider phrasal phonology. However, there are extensions of the system to phrasal phonology, for example Hayes (2000) and McCarthy (2007b), in which we have up to two bases – a lexical base, and a phrasal base. The base in (507) would indeed be the phrasal base, and the absence of the base in (508) is the absence of a phrasal base. The lexical base is employed for cyclic effects inside word, the phrase base for cyclic effects across words. I contend that the adoption of a phrasal base is necessary in strictly parallel, OOC based works if phrasal phonology is considered, see Gleim & Rasin (to appear) for a discussion. Given that there are less endeavours within the framework to tackle phrasal phonology, there are less proposals for valid phrase bases. For the purpose of the present comparison, I adopt the definition in (509), which is informed by Hayes (2000: 102) and Kager (1999: 282). Unlike the definitions of lexical bases, this definition is equivalent to a deterministic algorithm that selects bases, for every given input we know what the phrase bases must look like. For lexical bases, I take the definition in (510), however, lexical bases are less central for the discussion at hand.

(509) The Phrasal base is of a word W_i is the output of #W_i#, that is, W_i uttered in isolation.

(510) The lexical base of a wordform X in a context is the output of Y so that Y a) contains the same root as X, b) is a substring of X and c) can be uttered in isolation.

As mentioned above, the letter definition is not deterministic. Take for example the English word 'beloved': The potential lexical bases can be the output of /love/ or /loved/, or there could be no base. The output of /belove/ could not be a base, since it does not exist in isolation, and the output of /ed/ cannot be the base, because it does not include the root. The choice of lexical base thus plays a crucial role in any OOC analysis, whereas the phrasal base, at least according to the definition adopted here, is given.

Last but not least, for this endeavour I will assume an implementation of OOC in OT. Transderivational approaches that are not couched in OT are rare, but do exist, see the overview in Benua (1997).

In the next section, I will establish what type of countercyclic interactions an OOC approach that is constrained by the definition of bases in (510) and (509) can derive, and which it cannot derive. This will be about abstract general patterns, not about the concrete and complex case studies. It can show us that an interaction pattern, let us say countercyclic bleeding on context, can be generally derived, but not that all instances of counterbleeding on context in real languages must be derivable. This will be important, because the three languages discussed in this dissertation that are a problem for OOC – C'Lela, Akan, and Kimatuumbi– all exhibit types of interactions that in principle can be derived. I will discuss these patterns in section 5.1.2. If OOC cannot even derive an abstract pattern, then it should also not be able to derive a real pattern with complications.

5.1.1 Abstract predictions of OOC

In this section, I test for several abstract languages, in which two processes P and Q are defined on a string of symbols and interact countercyclically. The processes have the following shape (511), where (511a) is a feature changing process, (511b) is deletion and (511c) is epenthesis.

(511) a. AB → AC
b. AB → A
c. AB → ACB

I will first look at countercyclic opacity, for which it will be important to establish whether a process interaction is *on focus* or *on context* (compare McCarthy 1999). On focus means that the target of both processes is the same, spoken in the logic of correspondence theory, that it has the same index. On context means that the target is not the same, that the target of one process is the context of the other process. OO Faithfulness can account for some of the on focus opaque interactions, but for none of the on context opaque interactions.

After that, I look at transparent countercyclic interactions. In section 5.1.1.3 I content that OOC must derive countercyclic transparency, if the phrasal process applies in the phrase base. This is a refinement of the claim made by Gleim & Rasin (to appear) that OOC can derive transparent countercyclicity. In the following, I show that other countercyclic transparent interactions can be derived as well as their opaque but cyclic counterpart.

5.1.1.1 Opaque interactions

OOC can derive interactions where P is lexical and Q is phrasal, and P counterfeeds or counterbleeds Q only if the interaction belongs to the set of interactions that can be derived parallelly in Standard OT.

One type of those interactions are Chain-Shifts with three stages, one of them is zero (Kirchner 1996). This is counterfeeding on focus — where either P is feature changing and Q is deletion; or P is epenthesis and Q is feature changing. The former pattern is illustrated with the language in (512) – (514). (512) shows that P, a feature changing process, is lexical: It does not apply across word boundaries. (513) shows that Q is phrasal: It deletes C if followed by D, even if they are separated by a word boundary. The interaction in (514) is countercyclic: lexical P counterfeeds phrasal Q.

(512) *P: feature changing, word bound*
a. AB → AC
b. A][B → AB

(513) *Q: deletion, phrasal*
a. CD → D

b. C][D → D

(514) *P countercyclically counterfeeds Q*

a. AB][D → ACD

In the derivations below, the process P is induced by a constraint *AB, process Q is induced by a constraint *CD. *AB is outranked by a phrasal ID-OO-B constraint, so that it does not apply across words. *CD outranks a MAX-OO-C constraint, so that C's can be deleted even if they appear in a phrase base. Crucially, *CD is outranked by both *AB and MAX-IO-B. (515) shows that AB maps to AC, no IO-OO constraint is active, because the word AB has no phrase base, just as a root in lexical OOC has no base.

(515) *P applies inside words*

	AB	ID-OO-B	MAX-IO-B	*AB	*CD	MAX-OO-C
	—					
a.	AB			*!		
☞ b.	AC					
c.	A		*!			

However, if the string AB belongs to two different words, each with its base, respectively [A] or [B], the ID-OO constraints become active in sanction the mapping of B to C, see (516). Candidate a. is faithful and violates *AB. It is nonetheless the winner, because candidate b. violates the high ranked OOC constraint: The B is protected from changes if there is a corresponding B in a base.

(516) *P is blocked across word boundaries*

	A][B	ID-OO-B	MAX-IO-B	*AB	*CD	MAX-OO-C
	[A],[B]					
☞ a.	AB			*		
b.	AC	*!				
c.	A		*!			

Process Q however is not blocked, because the constraints that triggers it outranks the relevant OOC constraint, see (518). Neither correspondence with the input nor with the base are mor important than *CD, and thus the deleting candidate b. wins.

(517) *Q is not blocked by word boundaries*

	C][D	ID-OO-B	MAX-IO-B	*AB	*CD	MAX-OO-C
	[C],[D]					
a.	CD				*!	
☞ b.	D					*

The counterfeeding can be derived by combining these rankings, see (518). Candidate a. fatally violates *AB, this is unacceptable because there is no B in the base. Recall that the base form is the word in isolation, in this case AC. Candidate c. deleted the B, which violates a high ranlked constraint against B-deletion. Candidate b. is the winner, it violates *CD which is crucially lower ranked than *AB.

(518) *Derivation of countercyclic counterfeeding*

		AB][D	Id-OO-B	Max-IO-B	*AB	*CD	Max-OO-C
		[AC],[D]					
	a.	ABD			*!		
☞	b.	ACD				*	
	c.	AD		*!			

This abstract language is equivalent to the interaction from Hijazi Bedouin Arabic, with B standing in for the low vowel and C for the high vowel. The difference is that in HBA, the context for both processes, raising and deletion, is the same, the open syllable, so that A=D. The countercyclic opacity in Hijazi can thus be accounted for with OOC, and this is also mentioned in McCarthy (2007b: ??).

Another type of opacity that can be derived parallelly is counterfeeding on focus where P can feed Q, and Q can feed P. Such an interaction is instantiated by the interaction of shortening and gliding in Kimatuumbi. In section 5.1.2.3 I discuss why OOC generally can derive such patterns, but fails in the case of Kimatuumbi. OOC can also account for counterbleeding on focus. Counterbleeding on focus, just like the chainshifts mentioned above, can be accounted for in parallel OT (McCarthy 2007b). It is important to note that OOC can account for these patterns, but also for the reverse cyclic patterns with a simple re-ranking.

As discussed in chapter 3.4.1, parallel OT can derive certain instances of counterbleeding where a features that is lost due to a process P can be saved by an assimilatory process Q. Because of the crisp-edge constraints that I use in PaC, PaC cannot derive countercyclic counterbleeding even in those cases, but derives countercyclic self destructive feeding instead (at least unless Crisp-Edge is not modified). OOC is different, because it models the relations between the different domains differently. OOC can deerive countercyclic counterbleeding, but not self-destructive feeding. Recall the language from (58), the core pattern repeated in (519). If we have the additional mapping in (520a), this is countercyclic counterbleeding; if it is (520b), it is countercyclic self destructive feeding.

(519) *Lexical lowering, Phrasal palatalisation*

a. ilu-qa → eloqa
b. ilu qa → ilu qa
c. tuk emo → tuk emo
d. tuk ilu-qa → tuk^j eloqa

(520) *Counterbleeding or self destructive feeding?*

a. tuk ilu → tuk^j ilu

b. tuk ilu → tuk^j elu

In order to derive the core pattern AGREE must be sandwiched between the higher ranked ID-OO[±high][172] and the lower ranked ID-IO[±high]. In order to get cross word palatalisation, *ki must outrank *k^j and an Id-OO constraint that protects velar (omitted from the tableaux). Lastly, there needs to be a MAX[+h] constraint for the opacity. If we rank the constraints as in (521), we get the opaque countercyclic effect.

(521) *Derivation of countercyclic counterbleeding I*

T$_1$	I: tuk iluqa	*ki	ID-OO[±high]	AGREE[−high]	ID-IO[±high]	MAX[+high]	*k^j
	[tuk],[eloqa]						
	O^1: tuk iluqa	* !	**	*			
	O^2: tuk eloqa			*	**	*!	
	O^3: tuk^j iluqa		*!*	*			*
☞	O^4: tuk^j eloqa			*	**		*

The same ranking derives from an input /tuk ilu/ the output as in (520a), not (520b), compare the tableau in (522). We have thus countercyclic counterbleeding, and not countercylic self destructive feeding. As can be seen, candidate d., the one that would be needed for countercyclic self destructive feeding, is harmonically bounded by candidate c.

(522) *Derivation of countercyclic counterbleeding II*

T$_1$	I: tuk ilu	*ki	ID-OO[±high]	AGREE[−high]	ID-IO[±high]	MAX[+high]	*k^j
	[tuk],[ilu]						
	O^1: tuk ilu	* !					
	O^2: tuk elu		*!		*	*	
☞	O^3: tuk^j ilu						*
	O^4: tuk^j elu		*!		*		*

[172] I assume that this constraint only scopes over vowels. This is necessary to prevent a winner 'tok eloqa' from emerging, which would fare better for AGREE in tableau (521), and equally bad for an ID-OO that does not differentiate between consonants and vowels.

OOC cannot derive opaque countercyclic interactions where the opacity cannot be derived in parallel OT. This includes all on context interactions (with the exceptions of the assimilatory counterbleeding discussed above), as well as chain shifts with more then 3 stages or where one of the stages is not zero. This will be shown here with counterfeeding on context, illustrated by the abstract language in (523)– (525).

(523) *P: Feature changing, word bound*

a. AB → AC

b. A][B → AB

(524) *Q: Feature changing, phrasal*

a. CD → CE

b. C][D → CE

(525) *P countercyclically counterfeeds Q*

a. AB][D → ACD

b. AC][D → ACE

For the process P to be word-bound, *AB must outrank ID-IO-B and be outranked by ID-OO-B. For Q, *CD must outrank both faithfulness constraints for D, ID-IO-D and ID-OO-D. As (526) shows, this ranking can derive the correct output for /[AC]D/. But it cannot derive the correct output for /[AB]D/, see (527).

(526) *Q is phrasal*

	AC][D	ID-OO-B	*AB	*BD	*CD	ID-IO/OO-D
	[AC],[D]					
	ACD				*!	
☞	ACE					**

(527) *Derivation of countercyclic counterfeeding fails*

	AB][D	ID-OO-B	*AB	*BD	*CD	ID-IO/OO-D
	[AC],[D]					
	ABD		*!	*		
✄	ACD				*!	
☞	ACE					**

Instead of countercyclic counterfeeding, we have derived cyclic feeding. The analysis fails, because in (527) the ID-OO constraint that could protect the D must be ranked low in order to let D undergo the process Q. OOC constraints can give a special status to targets of processes, but not to triggers. It is thus impossible to distinguish a derived C from an underived C. To reiterate, OOC can derive countercyclic opacity, if the type of opacity can be derived in parallel OT. If the type of opacity cannot be derived in parallel OT, OOC can derive the cyclic version of said opacity, by carrying over the opaque features from a base. However, it cannot derive countercyclic opacities of this type, because, at least under conservative assumptions on bases, there is no base that can sponsor the desired feature.

5.1.1.2 Transparent interactions

In a transparent countercyclic interaction, the phrasal process Q feeds or bleeds the lexical process P. Transparent interactions are generally derivable in OT, so a naive assumption might be that OOC can account for all countercyclic transparent interactions, parallel to its behaviour with opaque interactions. However, this is not the case, and whether it can account for a specific interaction depends on multiple factors. Using abstract patterns, I will narrow it down here somewhat, but as we will se in section 5.1.2, this is not fine grained enough: C'Lela and Akan fall in the categories that OOC should be able to derive, but it still fails to account for the actual data. we will discuss several sub-cases of transparent interactions. First, we will look at instances where Q, the phrasal process, applies in the phrasal base. This categorisation has no pendant in cyclic frameworks, because an isolation form is not an object that carries special value in those theories. If Q applies in the phrasal base, OOC as I stipulate it here must derive countercyclic effects and cannot derive cyclic effects. If Q does not apply in the phrasal base, OOC's predictions vary based on the type of transparent interaction: If Q bleeds P (on context or on focus) OOC can derive the cyclic and the countercyclic interactions. For feeding, the situation is more complex. If it is feeding on context, OOC can derive the cyclic interaction. Whether it can account for the countercyclic interaction as well depends on whether OOC constraints are allowed to refer to prominent base positions. If this is the case, then countercyclic interactions can be accounted for. Feeding on focus is still different, and the predictions depend on the nature of Q.[173] If Q is epenthesis, OOC can derive the countercyclic interaction easily, and it can also derive the cyclic interaction. If Q is feature changing, OOC can derive the patterns with abstract languages, too. Here, I am not confident that the result with abstract languages transfers neatly onto more complex featural representations.

5.1.1.3 Phrasal process applies in the phrase base

A process Q that is phrasal must transparently interact with a process P that is restricted to words, if both Q and P apply in the isolation form, which given our stipulation equals the phrasal base. The example here is given for feeding, but it trivially translates to bleeding or shifting. (528) models a feature changing process that does not apply across word boundaries.

(528) *Process P does not apply across word boundaries*

a. AB → CB

[173] As discussed briefly below, Q cannot be deletion because it is undefined what counterfeeding on focus means if the feeding process is deletion.

b. A][B → AB

The blockade is, again, derived by an Id-OO constraints that protects A which outranks the triggering constraints, e.g., *AB. This OOC constraint is violated by an A→C mapping, if there is a phrasal base containing A. Such a base exists for (528b), but not for (528a), which is the isolation form of a word /AB/. (529) models a process that is sensitive to phrasal information.

(529) *Process Q applies phrasally*

a. D## → B

b. D#{x| x is not #} → D

(529) applies only at phrasal edges. Because every isolation-form is the first and the last in a phrase, the base for every word behaves as if phrase-initial and phrase-final. The process is not carried over to phrase-medial /D/, because Id-IO-D outranks Id-OO-B. If the ranking of these two constraints was reversed, the process would apply in all word-sized domains and would be analysed as word-domain, think of final devoicing in Dutch.

If we have an underlying word /AD/, the phrase base is the output of /##AD##/. This fulfils the context for Q, so we get a mapping for D→B. This creates the context AB. Mutation of A→C can be blocked if there is a phrase base that contains [A]. However, we are in the middle of the computation of the phrase base for an input AD, so there is no phrase base that we can refer to. The process P must thus apply – it cannot distinguish whether its trigger is itself derived or not. We derive thus the mapping in (530), as shown by the tableau in (531).

(530) *Process Q applies in the isolation form*

AD## → AB

(531) *Q in base must feed P in base*

##AD##	Id-OO-A	*AB	*D##	Id-Io-A	Id-IO-D
—					
AD			*!		
AB		*!			*
☞ CB				*	*
CD			*!	*	

It is impossible for OOC to derive the cyclic prediction for the two processes, namely cyclic counterfeeding, i.e. and output AB. Because we are in the process of deriving the base, no Id-OO constraint can protect the /A/ from undergoing the process. The only solution would be to allow for phrasal bases that are more permissive, and allow bases that are not equal to isolation forms. Whereas the same abstract language can be derived with PaC, since this is a feeding interaction, PaC can also derive the cyclic pattern with opacity. Such data is attested, consider Gran Canarian Spanish where arguably word-level consonant deletion feeds phrase final vowel apocope, but apocope does not feed consonant deletion, cf. Broś & Nazarov (2023). Another example of such a cyclic interaction comes from Jita (Downing 1996), where phrasal tone shift counterfeeds a lexical process that deletes one of two adjacent high tones.

A less abstract hypothetical language that illustrates this point is the 'Acin' language from Gleim & Rasin (to appear). As shown in Chapter 3.4.3, this language cannot be derived with PaC, because the prosodic structure was not aligned with the cyclic structure. This feature is however fully irrelevant for OOC. We can just as easily construct a language where process Q applies in the base and the prosodic word and the cyclic domain are isomorphic, as in the abstract language above.

5.1.1.4 Bleeding

Now, let us turn to transparent countercyclic interaction where Q does not apply in the phrase base. As said before, here the type of interaction and even the type of process become relevant. Countercyclic bleeding in context is found if a process Q destroys the context or focus for P, and P does not apply, as in (532) to (534).

(532) *P: feature changing, word bound*

a. AB → CB

b. A][B → AB

(533) *Q: Feature changing, phrasal*

a. BE → DE

b. B][E → DE

(534) *Countercyclic interaction of P and Q (Bleeding)*

a. AB][E → ADE

The interaction in (532) is again derived by recurring to the constraint ID-OO-A that protects base As but not Input As. The interaction in (533) is derived by both ID-IO-B and ID-OO-B being outranked by *EB. For the countercyclic, transparent interaction in (534), ID-IO-A must outrank ID-OO-C, compare the tableau in (535).

(535) *Derivation of countercyclic bleeding*

AB][E	ID-OO-A	*AB	*BE	ID-IO/OO-B	ID-IO-A	ID-OO-C
[CB] [E]						
ABE		*!	*		*	
☞ ADE				*		*
CDE				*	*!	

However, since the process Q does not apply in the base, the cyclic, opaque interaction, given in (536), is derivable, too. For this, the constraint transferring C from the base, ID-OO-C, must be ranked higher than the constraint violated by such a transfer, ID-IO-A, compare the tableau in (537).

(536) *Cyclic interaction of P and Q (Counterbleeding)*
AB][E → CDE

(537) *Derivation of cyclic counterbleeding*

AB][E	ID-OO-A	*AB	*BE	ID-IO/OO-B	ID-OO-C	ID-IO-A
[CB] [E]						
ABE		*!	*		*	
ADE				*	*!	
☞ CDE				*		*

Countercyclic Bleeding on Focus can be derived, too. Here, the ordering of two markedness constraints with respect to each other is relevant. Consider the language in (538), which has the same process P as in (532), but phrasal process Q and interaction as in (538) and (539).

(538) *Q: Feature changing, phrasal*

a. EA → ED

b. E][A → ED

(539) *Q bleeds P*
E][AB → EDB

Here, in order for the candidate EDB to win over the cyclic ECB, we need the markedness constraint *EC to outrank the markedness constraint *DB. *EC must be higher ranked than ID-IO-C, so that the process does not apply to underlying Cs.

5.1.1.5 Feeding on context

Unlike with countercyclic bleeding interactions, the type of process matters with feeding. In addition, feeding on context and feeding on focus do not behave identically. We will start with feeding on context, before coming to the on focus interactions. Countercyclic feeding on context cannot be derived in OOC, if we allow only very coarse Faith-OO constraints. Let us start with the same lexical process P as in(532), repeated in (540), that does not cross word boundaries.

(540) *P: Feature changing, word bound*

a. AB → CB

b. A][B → AB

This process can be fed (on context) by a phrasal process that turns something into a B, like the process in (541). In the language we want to derive, this second process is not bound to words.

(541) *Q: Feature changing, phrasal*

a. DE → BE

b. D][E → BE

If we now assume an input /AD/, we can have two potential interactions, cyclic counterfeeding (542) and countercyclic feeding, as in (543).

(542) *Q counterfeeds P*

AD][E → ABE

(543) *Q feeds P*

AD][E → CBE

The cyclic but opaque interaction is derived by having a high rankedID-OO-A constraint, which is needed to block P from applying across word boundaries anyway. For the cyclic interaction, it must also outrank *AB, compare the tableau in (544).

(544) *Derivation of cyclic counterfeeding*

	AD][E	ID-OO-A	*AB	*DE	ID-IO/OO-D
	[AD] [E]				
	ADE			*!	
☞	ABE		*		*
	CBE	*!			*

In order to derive the countercyclic feeding interaction in (545) instead, *AB must be higher ranked than ID-OO-A. However, simple reranking does not result in the desired pattern, but into yet another language, in which A is turned into C in front of every B, inside words and across words, compare (546).

(545) *Derivation of countercyclic feeding fails I*

	AD][E	*AB	ID-OO-A	*DE	ID-IO/OO-D
	[AD] [E]				
	ADE			*!	
	ABE	*!			*
☞	CBE		*		*

(546) *Derivation of countercyclic feeding fails II*

	A][B	*AB	ID-OO-A	*DE	ID-IO/OO-D
	[A] [B]				
✄	AB			*!	
☞	CB	*!			*

This inability to derive countercyclic feeding on context only persist if we constrain ourselves to very coarse faithfulness constraint. If one accepts positional faithfulness constraints (Beckman 1998; Lombardi 1999) as OO constraints as well, the pattern becomes derivable: In addition to the ID-OO-A constraint, we assume a new constraint ID-OO-A_{FIN}, that is violated if a final A in the base does not surface as an A. This constraints protects A against feature change across word boundaries, but not if the A is non-final in the base. The tableau in (547) shows that the countercyclic interaction is now accounted for, and the tableau in (548) shows that P is still blocked across word boundaries.

(547) *Derivation of countercyclic feeding succeeds I*

	AD][E	ID-OO-A_{FIN}	*AB	ID-OO-A	*DE	ID-IO/OO-D
	[AD] [E]					
	ADE				*!	
	ABE		*!			*
☞	CBE			*		*

(548) *Derivation of countercyclic feeding succeeds II*

	A][B	ID-OO-A_{FIN}	*AB	ID-OO-A	*DE	ID-IO/OO-D
	[A] [B]					
☞	AB		*			
	CB	*!		*		

5.1.1.6 Feeding on focus

Feeding on focus behaves differently from feeding on context. In feeding on focus, the nature of Q is important. First, It cannot be deleting, trivially because deletion takes the focus for another process away.[174] If Q is inserting, then it can feed a process P on focus easily, if it is feature changing the picture is complicated. Let us start with insertion. Imagine a slightly different word-bound process than the one seen before, in (549).

(549) *P: Feature changing, word bound*

a. AB → AC
b. A][B → AB

In addition there is an epenthesising, phrasal process that can feed (549) on focus – for epenthesis that means that the epenthesised element could undergo P. Q in (550) inserts a B in between some segment and an E.

(550) *Q: Inserting, phrasal*

a. XE → XBE
b. X][E → XBE

If P and Q interact cyclically, epenthesis counterfeeds P, as in (551). If they interact countercyclically, the epenthetic element shows up as C, see (552).

(551) *Cyclic counterfeeding*
A][E → ABE

(552) *Countercyclic feeding*
A][E → ACE

As seen above, the underlying Bs are protected from undergoing the process phrasally, because they are protected by a high ranked ID-OO-B constraint, since they have a correspondent in the base. The epenthesized B however does not have a correspondent in a Base, it is not protected by either ID-IO-B or ID-OO-B. However, the countercyclic candidate violates a constraint that the cyclic candidate does not violate, namely DEP-IO-C. If this constraint outranks the markedness constraint *AB, we get epenthesis of B, the cyclic pattern. If *AB outranks it, though, we get the countercyclic pattern with epenthesis of C. The cyclic interaction is derived in (553), the countercyclic interaction in (554).

(553) *Derivation of cyclic counterfeeding*

	A][E	*AE	DEP-C	DEP-B	*AB	ID-B
	[A] [E]					
	AE	*!				
☞	ABE			*	*	
	ACE		*!			

[174]Unless the other process P is insertion, and even then it is unclear whether this interaction is on context or on focus. I have not considered this interaction.

(554) *Derivation of countercyclic feeding*

	A][E	*AE	*AB	Dep-C	Dep-B	Id-B
	[A] [E]					
	AE	*!				
	ABE		*!		*	
☞	ACE			*		

The prediction that we can derive both cyclic counterfeeding on focus, where the focus is created by epenthesis, and its countercyclic reverse, holds under the assumption that the process that changes B→C violates different constraints depending on whether the B is underlying (Id-B) or epenthetic (Dep-C). Those assumptions are not universal. If one either assumes that all feature changing operations are epenthetic or feature spreading, compare i.a. Trommer (2011); Zaleska (2020); it might be the case that both mappings (AE→ABE and AE→ACE) violate the same constraints, except for necessarily low ranked *B and *C. Under such assumptions, OOC can only derive the countercyclic interaction, because B is (in the relevant context) more marked than C.

If Q is not an insertion process, but a feature changing operation, the results are unfortunately not as clear. Let us assume the same process for P as above in (549). The focus of P can be created by a phrasal process Q as in (555).

(555) *Q: Feature changing, phrasal*

a. DE → BE

b. D][E → BE

The derived B is not protected by a Id-OO-B constraint, because it is [D] in the base, and in the input; and not B. Therefore countercyclic feeding as in (556) must apply, compare the tableau in (557).

(556) *Interactions of P and Q*

a. ADE → ACE

b. AD][E → ACE

(557) *Derivation of countercyclic feeding*

	AD][E	*DE	Id-OO-B	*AB	Id-OO-D	Id-IO-D	Id-IO-B
	[AD], [E]						
	ADE	*!					
	ABE			*!	*	*	
☞	ACE				*	*	

Given the constraints in (557), the countercyclic candidate ACE bounds the cyclic candidate ABE harmonically. A constraint *AC that would favour the cyclic candidate must be ranked below *AB, because we would otherwise not get the AB → AC mapping inside words. However, standard Ident constraint are more fine-grained than Id-B, and target features. Consider the somewhat more naturalistic toy language below, where P is word bound nasalisation of /o/ (558), Q is phrasal vowel rounding (559) and the two processes interact countercylically (560).

(558) *P: word bound nasalisation*

a. no → nõ

b. n][o → no

(559) *Q: phrasal rounding*

a. aw → ow

b. a][w → ow

(560) *countercyclic feeding*

na][w → nõw

If we assume that the constraint that blocks nasalisation across word-boundaries is Id-OO-[nas], the rounding of the vowel does not violate that constraint, so that it can still block nasalisation of the underlying /a/; compare the tableau in (561).

(561) *Derivation of countercyclic feeding fails*

	na][w	*[-rd][+rd]	Id-OO[nas]	*[+nas][+rd,-nas]	Id-OO[rd]	Id-IO[rd]	Id-IO[nas]
	[na], [w]						
	naw	*!					
☞	now			*	*	*	
	nõw		*!		*	*	

However, it is of course possible to assume that the constraint Id-OO-[nas] is relativised to round vowels, so that the countercyclic interaction is still derivable. In short, the prediction OOC makes for feeding on context are not very clear and depend hugely on the assumed set of constraints and the representation of segments.

5.1.2 Undergeneration

If we apply OOC as defined here to the case studies discussed in this thesis, we expect all of the cases to be derivable, since they are either transparent or opaque in a way that is not a problem for OOC. This is true for Hijazi, Icelandic[175] and the ITI-Gliding interaction in Kimatuumbi. However, two cases, namely Akan and C'lela, cannot be derived with OOC without further assumptions, in both cases because we cannot establish an adequate base. These two cases can be analysed in OOC, if additionally prosodic structure is assumed. If that is done, a parallel analysis that is similar to the phrase level in my analyses can be adopted. There is however a last case of undergeneration, where such a solution is not available. The interaction of Shortening and Gliding in Kimatuumbi is opaque, and while the type of interaction can abstractly be accounted for with OOC, as it can be conceptualised as blocking, the Case of Kimatuumbi still cannot be derived. Because, as established in chapter 4.6.8.2, the domain of shortening cannot be defined prosodically, a prosodic solution is impossible.

5.1.2.1 C'Lela

In C'Lela, phrase-final preservation of final vowels blocks deletion of word-final vowels. As we have seen, in restricted OOC, a phrasal process must bleed or feed a word bound process if it applies in the isolation form. The isolation form is always phrase-final and, in C'Lela, preserves thus the final vowel. OOC can thus lead to the preservation of vowels where we expect deletion, but it cannot do anything else. With the mechanisms at hand, we cannot induce deletion of word final vowels at all, there is just no way to refer to the vowels that are to be deleted, see tableau in (562). In Short, we cannot derive a cyclic effect in OOC, if the cyclic effect is blocked in the isolation form, as we observe in C'Lela.

(562) *Derivation of deletion and blocking fails*

T_1	I: gʷɛ̀lɛ̀ ìrú	*C#	*V#	Max-OO	Max-IO	Dep-OO
	B:[gʷɛ̀lɛ̀], [ìrú]					
☞	O^1: gʷɛ̀lɛ̀ ìrú		*			
	O^2: gʷɛ̀lɛ̀ ìr	*!		*	*	
✄	O^2: gʷɛ̀l ìrú		*	*	*	

No matter how we rank the constraints in (562), C'lela cannot be derived. We can either derive a language where deletion applies phrase finally but is blocked phrase-medially (*V# ≫ *C#, Max-io≫Dep-OO), a language that has no deletion of final vowels at all (as in (562)), or a language that has deletion phrase finally and overapplies it phrase medially (*C# ≫Dep-OO, *V#, ≫Max-io). The problem is that we cannot refer to the locus of deletion with the base, as we would expect for a cyclic effect, because the base does not have deletion. Given the flat representation assumed here, there is no mean to pick out the correct vowels for deletion in the

[175] For Icelandic, we need to assume that the lexical base for masculina is the nominative, whereas it must be some other case for neutra and feminina. This is comparable to my proposal that the masculine article is phrasal, whereas the neuter and feminine articles are word level.

string. Even assuming that some vowels are stressed, as I have done in chapter 4.1, this does not suffice: prefix vowels are arguably not stressed and not deleted, as well as certain medials. In order to refer to the locus of deletion, we need thus an additional mechanism that is not a base.[176] This mechanism can be prosody. If prosody is adopted, the analysis that I propose can be transferred to a model that is fully parallel and employs OOC for cyclic effects.

5.1.2.2 Akan

The problem for Akan is similar, but even more grave: We cannot, given the data at hand, define a phrasal base form for the perfect. The perfect always co-occurs with subjects which in turn determine its tone.[177] However, the subjects are clearly not taken from a closed set or affixes, they belong to the open class of nouns. For the argument's sake, let us assume that the base for the perfect verb is low toned, prefix and root. The input is, following the assumptions adopted in chapter 4.2, toneless, and tone association is motivated by SPECIFY. Without further amendments, referring to the base does not help us to associate the correct tones, because we want to associate two different tones to each toneless syllable. In the tableau in (563), both vowels surface with a high tone, because DEP outranks both the ID-OO constraint and the constraint against association. If either of them outranks DEP, we get a low tone on both syllables, but there is no ways of getting the correct result, with a high tone on the first and a low tone on the second syllable.

(563) *Derivation of countercyclic feeding fails*

	Ésí ato	SPEC	DEP	*ASSOC	ID-OO-T
	[Ésí] [àtò]				
	Ésí ato	*!			
	Ésí àtò		*!*		
☞	Ésí átó			**	**
✄	Ésí átò		*!	*	*

A possible approach to solve this problem is to stipulate that the root initial syllable is prominent. We now can device a system that assigns the correct tones: An epenthetic tone that is faithful to the base in prominent syllables, and a spread tone

[176] Unless one weakens the definition of phrase base and allows a base that contains an affix that is not contained by the input. However, that would only work some times: Some roots, e.g. inanimate, alienable nouns, do not have inflectional suffixes.

[177] The 3rd person singular pronoun ɛ̀ can be omitted, yielding perfect forms without any (overt) subject, e.g. àbá instead of ɛ̀àbá (Joanna Serwaa Ampofo, p.c.). If we assume this as a base, we can derive the Akan pattern in OOC. However, a base should be derived by transparent phonology. The low tone is clearly the default tone inserted because there is no tone to spread. General phonology would predict that the inserted low tone spreads further, to the root, yielding *àbà. In order to block this association, we need some mechanism that distinguishes the two vowels and impedes spreading, such as a prosodic boundary. OOC with prosody, as mentioned below, can derive the pattern without the need to recur to OOC constraints.

in non-prominent syllables, compare the tableau in (564).

(564) *Derivation of countercyclic feeding, 2nd attempt*

	Ésí ato	Spec	Id-OO-T/S	Dep	*Assoc	Id-OO-T
	[Ésí] [à**tò**]					
	Ésí à**tò**			**!		
	Ésí á**tó**		*!		**	**
☞	Ésí á**tò**			*	*	*

However, the tone on the root initial vowel is polar. Our revised OOC approach runs into problems if we look at low toned subjects, such as in (565). Since we cannot have to different bases for /ato/, faithfulness to the base would force us here to have a low tone, even though it is preceded by a low tone as well.

(565) *Derivation of countercyclic feeding still fails*

	Yàw ato	Spec	Id-OO-T/S	Dep	*Assoc	Id-OO-T
	[Yàw] [à**tò**]					
☞	Yàw à**tò**				**	
✄	Yàw à**tó**		*!	*	*	*

As in the C'Lela case, OOC needs an additional mechanism in order to derive the transparent interaction. Again, this mechanism can be prosody and the Crisp-Edge constraints employed in Chapter 4.2.

5.1.2.3 Kimatuumbi shortening

The last case of undergeneration come from the interaction of shortening and gliding in Kimatuumbi, analysed by me as a stem-level reflex of an Ezafe morpheme. Unlike the previous two cases, prosody is not able to rescue an OOC account here. This is unsurprising, as prosody also did not play a (crucial) role in my account in chapter 4.6.8.

Consider the tableaux in (566) and (567). (566) derives shortening for underlying vowels, but the same ranking wrongly derives shortening in derived long vowels as well, as in (567). Reference to the (phrasal) bases does not help, because both words have long vowels in their respective bases. Reference to the input does not help either, because it is the desired vowel length which is always unfaithful to the input length.

(566) *Derivation of Ezafe shortening*

		kį-koloombe μ^{-} caango	Ezafe	Id-OO-V:	Id-IO-V:
		[kįkoloombe] [caango]			
	a.	kįkoloombe caango	*!		
☞	b.	kįkolombe caango		*	*

(567) *Derivation of cyclic counterfeeding fails*

		ki̧-u̧la μ^- caango	EZAFE	ID-OO-V:	ID-IO-V:
		[kju̧u̧la] [caango]			
✄	a.	kju̧u̧la caango	*!		
☞	b.	kju̧la caango		*	

These constraints[178] do not allow to derive Kimatuumbi, only a reverse Kimatuumbi, where the derived vowel is shortened because it is not protected by ID-IO-V:, but the underlying vowel is conserved, yielding *kju̧la and *ki̧koloombe respectively in the context of shortening.

I mentioned above that the type of opacity encountered here is in principle derivable parallelly, and should thus be derivable as countercyclic in OOC. Consider the abstract processes in (568), and the countercyclic interaction in(569), where A is equivalent to a long vowel and B is equivalent to a short vowel in Kimatuumbi, and as in Kimatuumbi , process P counterfeeds Q.

(568) a. P: DB → DA
b. Q: AC → BC

(569) DBC → DAC

This abstract interaction is derivable parallelly, we just need a constraint *DB to outrank *AC, compare the tableau in (570).

(570) *Derivation of countercyclic counterfeeding fails*

DBC	*DB	*AC	ID-B
DBC	*!		
DAC		*!	*

Kimatuumbi is not derivable in this way because we cannot meaningfully formulate a constraint *DB: this would be a constraint against a glide followed by a short vowel, however, there is nothing wrong with the sequence glide-short vowelin the language. A form like *kju̧la is out because of its derivational history, not because it violates a surface markedness constraint. Prosody cannot come to the rescue, because the derived vowel and the underlying vowel are both in the same prosodic domain. Any constraint that would block the association of the negative mora into $[\text{kju̧u̧la}]_\omega$ would also block its association into $[\text{ki̧koloombe}]_\omega$.

The opaque Interaction in Kimatuumbi constitutes thus not only a problem for cyclic analyses, but also a problem for non-cyclic approaches. The cyclic approaches can be rescued by the assumption that shortening is not a phrasal process, but a stem level process triggered by a defective morpheme. The defective morpheme can be

[178] Ezafe is a cover constraint that penalises the non-docking of the negative mora. It looks here like an indexed constraint, but it can be formalised compatible with limited reference. The exact technicalities are not crucially relevant.

introduced into an OOC account, but this does not lead to the correct results. In a cyclic framework, the shortening can apply before lengthening, yielding so the counterfeeding. In OOC, counterfeeding is achieved by faithfulness to a base that does not undergo the process. However, there is no abstract base so that it has the derived long vowel, but not the underlying long vowel.[179]

5.1.3 Comparison of overgeneration

So far, we have discussed OOC with a focus on undergeneration. It cannot derive C'Lela and Akan without prosody or something equivalent, and it cannot derive Kimatuumbi, even with prosody. It cannot derive cyclic opaque interactions where both processes apply in the base, and, depending on assumptions on feature changing operations and epenthesis, it cannot derive (some) cyclic counterfeeding interactions on focus. In the follwing, I will first look at countercyclic languages that PaC generates and OOC does not, and then at languages that PaC cannot generate, but OOC does. With overgeneration I will refer here to countercyclic patterns for which we have not yet found convincing examples. That includes all countercyclic opaque interactions (with the tentative exception of counterfeeding on focus) and misaligned transparent countercyclic interactions (for the definition of misaligned transparent patterns, see Chapter 3).

5.1.3.1 PaC generated unattested language, not generated by OOC

As has been discussed in this chapter, the precise prediction of OO-Correspondence depend on the constraint-Set and base algorithms that are assumed. I will assume that OO-Correspondence can derive all transparent patterns, including feeding on context. This is justified, because even if one adopts a more restrictive constraint set that excludes feeding on context, one is still forced to adopt prosody for cases like Akan and C'lela. Feeding on context is then not derive via OOC constraints, but via reference to the prosodic structure. Still, there is one type of unattested language that PaC generates but OOC does not: namely the case of three level opacity, introduced in chapter 3.4.2. The pseudo language that exemplifies this pattern is repeated in (571).

(571) *Hypothetical 3-Level language*

	#	ki-	hi-	
/map/	ʔimap	kimap	liʔimap	Stem level EPEN
/tilip/	tilip	kidilip	hidilip	Word-level LEN
/tap/	ʔitap	kidap	liʔ**i**dap	EPEN couterfeeds LEN

PaC could account for this pattern by postulating a stem-level sized domain that

[179]If we relax the condition on bases, we could claim the opposite: a base with a non-gliding or no prefix, so that the base vowel of derived long vowels would be short.

survives to the phrase level, where it is relevant for word-minimality. Lenition is counterfed because it applies in-between at the word level. OO-correspondence cannot account for this language, because there is no valid base for /tap/ where lenition is transparently blocked.

5.1.3.2 OOC generated unattested languages, not generated by PaC

PaC makes a strong connection between countercyclic process interactions and the presence of a prosodic domain π which shares a relevant edge with a cyclic domain ϕ_j at a cycle ϕ_{j+x}. OOC does not make any such connection. Therefore, all the patterns that OO-Correspondence can predict, it can predict whether the morpho-syntactic cycle is aligned or not. An example for such a languageis the Acin language from Gleim & Rasin (to appear), another hypothetical language is given in (572).

(572) *Hypothetical Language with misaligned countercyclic bleeding*

	#	gà	# gàmì	àdò	
/má/	má	**màgà**	**má gàmì**	má àdò	LOWER is word-bound
/sàd/	**sàt.**	sàtgá	sàt gàmì	**sàd àdò**	FD is phrasal
/lód/	**lót.**	lòdgà	lòd gàmì	lòd àdò	FD counterbleeds LOWER

In this language, tone lowering (LOWER) before a depressor consonant is word bound, i.e. is triggered only by depressor consonants within the word. As the second row shows, the language has phrasal resyllabification and final devoicing (FD). This devoicing bleeds word-internal tone depression. This pattern is not only easily derived in OO-correspondence, the cyclic mirror language (573) is not even derivable. Final devoicing is triggered by a constraint *D. which is not outranked by ID-OO-voice, so that the we find a d→t mapping only in surface codas. The high tone is preserved because there is no way of enforcing faithfulness to a base that has the low tone, since we see final devoicing in the base. PaC on the other hand can only derive the cyclic mirror language, or a language where resyllabification of the underlying depressor consonant bleeds lowering, mapping thus /lód àdò/ to [ló. dàdò].

(573) *Hypothetical language with cyclic counterbleeding in base*

	#	gà	# gàmì	àdò	
/má/	má	**màgà**	**má gàmì**	má àdò	LOWER is word-bound
/sàd/	**sàt.**	sàtgá	sàt gàmì	**sàd àdò**	FD is phrasal
/lód/	**lòt**	lòdgà	lòd gàmì	lòd àdò	FD counterbleeds LOWER

Table 5.1 gives an overview on the comparison of overgeneration between OOC and PaC. Regarding undergeneration, PaC is preferable to OOC, as it can account for all the patterns discussed in this thesis. OOC struggles with three, and seems to be incapable of deriving Shortening in Kimatuumbi, at least the restrictive version

	OOC	PaC
Transparent interactions		
Q applies in base	**must**	—
aligned	can	can
misaligned	*can*	cannot
Opaque interactions		
Chain Shift	*can*	*can*
Max-F Counterbleeding	*can*	cannot
Max-F Self-Destructive Feeding	cannot	*can (if aligned)*
aligned	cannot	cannot
misaligned	cannot	cannot
3-Level-language	cannot	*can*

Table 5.1: Comaprison of predictions between PaC and OOC

I discuss here. The incapability of OOC to derive cyclic opacity if both processes apply in the base is also a major issue. Regarding overgeneration, the theories are wildly different: PaC can account for some opaque patterns, but excludes transparent misaligned ones. OOC on the other hand can account for all transparent countercyclic interactions.

In Table 5.1 arguably undergenerated patterns are is bold, and overgenrated patterns are in italic. However, this is in the end an empirical question. Whether both approaches overgenerate or none, remains to be investigated. The undergeneration of Kimatuumbi and regular cyclic opacity if the phrasal process applies in the base are the more pressing issue for OOC.

5.2 Pesetskian Bracket Erasure

In the more mainstream version of Bracket erasure, going back to Pesetsky (1979), Brackets are deleted as a last step in every cycle. This entails that the second-to highest brackets are still accessible at any cycle. If we e.g. adopt a non-cyclic phrase level, (maximal) morphosyntactic words are still identifiable via brackets. In a way, it is therefore similar to the framework I propose, but there are two major differences: Smaller morphosyntactic domains, on a cycle φ_j domains $\varphi_{j->1}$, are inaccessible via bracket erasure, but might still map to a prosodic node. Second, brackets are immovable by phonological processes, whereas prosodic domains may adjust due to phonological pressures. A further issue arises with the treatment of clitica, which can be analysed as phrase-level affixes in a framework with prosody. It is not clear how they can be differentiated from independent words in a framework without prosody. All three properties lead to an undergeneration problem for Pesetskian Bracket Erasure, which we will briefly discuss in the following.

5.2.1 Problem 1: farther removed brackets

In C'Lela and Akan, the phrase level morphology refers to the boundary of some domain. The domain blocks spreading in Akan and induces deletion in C'Lela. In Akan, the domain is the root without prefixes, so clearly a domain smaller than φ_{j-1}, which would be at least the cyclic domain encompassing all prefixes, but arguably also the object because those two categories form a domain for vowel harmony, compare Kügler (2015b). In C'Lela, the domain of vowel deletion is entire words, which is fine for an approach with Pesetskian Bracket Erasure. However, it also includes words contained in other words, which I analyse via recursive prosodic words. This cannot be captured by PBE: Here, we would predict only the maximal words to undergo deletion, not the contained words.

5.2.2 Problem 2: re-bracketing

A priori, a morphological bracket cannot be shifted by a phonological rule or process. This is relevant for Hijazi Bedouin Arabic, where the prosodic word misaligns with the morphosyntactic word. This makes it possible to target the vowel in word-final closed syllables as word-final under resyllabification. Since the bracket cannot shift, it is impossible to refer to this vowel as word-final. The analysis from chapter 4.3 can thus not be transferred to this approach. An alternative along the lines of Andersson (2020) that blocks a-raising if the trigger is across a word, and a-raising applies after i-syncope does not work, because it makes the wrong predictions for /ʃarib-ih/ which, at the phrase level, should have only the outermost brackets, i.e. [ʃarib-ih], and ordering of i-syncope before a-raising predicts, wrongly, *[ʃarbih]. If that approach is combined with some cyclicity, so that the correct [ʃirbih] is derived, i-syncope at the phrase level would delete derived high vowels derived from /a/. In order to acount for the range of date, misalignment between cyclic structure und structure accesible at later levels is as important as alignment, and relaxed bracket erasure cannot derive this.

5.2.3 Problem 3: clitica

In the analyses for Icelandic and Kimatuumbi, I employ clitica or phrasal affixes. They are modelled as functional material that is added at the phrase level but integrates into some existing relevant prosodic domain. These clitica must precede the phrase-level in a framework without prosody, and have been accordingly analysed as word level in the LMP literature. In the Icelandic case, the problem might be solvable: We can postulate that there are two word levels, and that the masculine article attaches on the second word level, where epenthesis has already happened. However, this is not a possible approach for Kimatuumbi, because the clitic allomophy is sensitive to the phrasal context. This type of conundrum arguably led to Odden's countercyclic model.

5.3 PaC with Extrinsically Ordered Rules

The analyses can be translated from the constraint-based analyses in chapter 4 to a version of PaC with extrinsically ordered rules (PaC-RB), albeit with some awkward rules. Akan and C'Lela are not very easily transferred, because we deal with blocking, and it is not always trivial to incorporate the negative condition into the rule. If it is possible, however, the patterns follow easily. Chamorro, Icelandic, Kimatuumbi and Hijazi can be translated to a framework with extrinsically ordered rules without complications.

However, the set of additional languages that PaC-RB predicts is much larger. Like the OT based version of PaC (in this section hence, PaC-OT), it derives countercyclic aligned transparent patterns, but, in addition, it also derives all countercyclic aligned opaque patterns. Depending on the assumptions made on rule-odering, it can also derive misaligned patterns, both opaque and transparent.

5.3.1 Predictions

Transparent aligned patterns are derived in PaC-RB similarly to PaC-OT. On cycle φ_i some prosodic constituent π of the size of φ_i is built. On a later cycle $\varphi_{>i}$ this constituent remains unchanged. On the same cycle, some process Q applies generally. Sequentially after that, but on the same cycle, another process P applies restricted to the prosodic domain π. P is potentially fed or bled by Q. The feeding interaction found in Akan and the bleeding interaction of ITI and gliding in Kimatuumbi can be derived this way. C'Lela can also be analysed in this way, if we imagine the preservation of the phrase final vowel as some sort of strengthening that protects it from subsequent deletion.

Unlike the PaC-OT, a rule based approach can easily derive all sorts of opaque countercyclic effects, if there are prosodic domains that align with a cyclic domain: On some cycle φ_i some constituent π of the size of φ_i is built. On a later cycle $\varphi_{>i}$ this constituent remains unchanged and some process Q applies generally. After that, another process P applies restricted to the prosodic domain π. P potentially counterfeeds or counterbleeds Q. A hypothetical language that shows such a behaviour is the language from (17) repeated in (574). Here, word-bound vowel harmony counterfeeds phrasal vowel harmony.

(574) *Hypothetical language with countercyclic counterfeeding*

a. tʊ-ku → tuku
b. pʊtʊ-ku → putuku
c. tʊ mutʊ → tu mutʊ

d. lʊtʊ mutʊ → lʊtu mutʊ
e. lʊtʊ pʊtʊ-ku → lʊtʊ putuku

Table (575) shows the rule based derivation that accounts for this pattern. Given that vowel harmony feeds and counterfeeds palatalisation, there are two palatalisation rules, one that is restricted to word an applies late, so that it is fed, and a general rule that applies early, so that it is counterfed by harmony. A language that had only the first rule would also be an instance of countercyclic opacity.

(575) *Derivation of counteryclic counterfeeding*

Cycle φ_1	
pʊtʊku	Input
[pʊtʊku]$_\pi$	PROSODIFICATION
Cycle φ_2	
[lʊtʊ]$_\pi$ [pʊtʊku]$_\pi$	Input
[[lʊtʊ]$_\pi$ [pʊtʊku]$_\pi$]$_\phi$	PROSODIFICATION
—	VOWEL-HARMONY-ϕ
[[lʊtʊ]$_\pi$ [putuku]$_\pi$]$_\phi$	VOWEL-HARMONY-π
[[lʊtʊ]$_\pi$ [putuku]$_\pi$]$_\phi$	Output

The rule based version can also derive the transparent misaligned pattern that can be derived by OO-correspondence. For this, it is necessary that some prosodification rules apply after some other rules. Recall the Acin language from Gleim & Rasin (to appear) repeated in (576). (577) shows the derivation of the phrase level, where reprosodification applies to late to feed cross word palatalisation.

(576) *Hypothetical language with misaligned countercyclic feeding*

	#	/-i/	/#ima/	
a. /at/	at	a.ci	a.t i.ma	PAL is word-bound
b. /apn/	a.pin	ap.ni	ap.n i.ma	EPEN is phrasal
c. /atn/	a.cin	at.ni	at.n i.ma	EPEN feeds PAL

(577) *Derivation of misaligned countercyclic feeding*

Phrase level		
[at]$_\pi$ [ima]$_\pi$	[atn]$_\pi$	Input
—	[atin]$_\pi$	EPEN
—	[acin]$_\pi$	PAL (π-bound)
[a]$_\pi$ [tima]$_\pi$	—	REPROSODIFICATION
[a]$_\pi$ [tima]$_\pi$	[acin]$_\pi$	Output

Similarly, an opaque misaligned pattern can be derived. Consider the language in (578): Vowel harmony counterbleeds progressive palatalisation.[180] However, the domain of vowel harmony is smaller than the domain of palatalisation, as it does not include clitics. We have thus countercyclic opacity. In addition, this pattern is misaligned, because a process of reprosodification visible by stress shift to the penult destroys the prosodic domain that excludes the clitic. Keep in mind that I assume proper bracketing, so that a prosodic domain cannot be partially dominated by a another domain, ruling out a structure *(oro(kú)$_{\omega}$li)$_{\text{Ft}}$.

(578) *Hypothetical language with misaligned countercyclic counterbleeding*

		#	/-ki/	/=li/	/-ki=li/	
a.	/oro/	óro	óróku	oró**li**	orokúλi	VH ignores clitics
b.	/eri/	éri	eríki	eríλi	erikíλi	PAL affects clitics
c.	/eri/	éri	eríki	er**í**λi	eri**kí**λi	STRESS considers clitics
d.	/oro/	óro	oróku	oróli	orok**ú**λi	VH counterbleeds PAL

This language can be easily derived with rules as well: first, the general rule must apply, like in the opaque aligned language, then the rule that is restricted to some domain, which is thus counterbled. At last, another rule (or set of rules) destroy the prosodic domain that was necessary to restrict the second rule. This is illustrated in the derivation in (579).

(579) *Derivation of misaligned countercyclic counterbleeding*

Clitic Cycle	
[óroki]$_{\pi}$li	Input
[óroki]$_{\pi}$λi	PALATALISATION
[óroku]$_{\pi}$λi	VOWEL HARMONY (π-bound)
[orokúλi]$_{\pi}$	REPROSODIFICATION/STRESS
[orokúλi]$_{\pi}$	Output

A straightforward transferral of PaC-OT to extrinsically ordered rules is thus very much unrestrained. Cyclicity, in such a framework, does not pose hardly any restriction on process interactions. It generates much more unattested languages compared to PaC-OT for two reasons: First, OT's difficulties with opacity means that PaC-OT can only derive a restricted set of opaque patterns. This is not true for a rule based analysis, where opacity is as easily accounted for as transparency. Second, the prosodic structures I adopt can function somewhat like diacritics for past cycles, but must be phonological objects that at least at the phrase level are present in the output. This is not so with ordered rules, here the prosodic structure can serve as a pure diacritic that exists only temporarily at an undesignated intermediate level.

[180] All of the process in this pseudo language are attested: In Basque, progressive palatalisation targets laterals (Iverson & Oñederra 1985). In Hungarian, front/back harmony is root dominated and ignores enclitics (Rebrus, Szigetvári, & Törkenczy 2012), and stress systems occasionally include suffixes, that for other reasons are considered clitics, compare Peperkamp (1996).

	PaC-OT	PaC-RB1	PaC-RB2
Transparent interactions			
aligned	can	can	can
misaligned	cannot	*can*	cannot
Opaque interactions			
derivable in OT	*can (if aligned)*	*can*	*can (if aligned)*
aligned	cannot	*can*	*can*
misaligned	cannot	*can*	cannot
3-Level-language	*can*	*can*	*can*

Table 5.2: Comparison of predictions between PaC-OT and PaC-RB

This feature enables us to derive misaligned patterns, whether transparent or opaque. There is a proposal by Rusyanova & Rasin (2023), that restricts a rule based system in such a way, that by stipulation all stress rules precede all other rules on every stratum. If this stipulation is adopted and extended from stress rules to prosody building rules in general, the overgeneration of the PaC-RB is less severe: It still can generate opaque countercyclic interactions, but no longer misaligned ones. Table 5.2 gives an overview over the predictions of the different implementations of PaC, PaC-RB1 is a rule based implementation with no restrictions on rule ordering, and PaC-RB2 a rule-based implementation that adopts Rusyanova and Rasin's stipulation. As above, italic indicates that the cell represents a pattern that the model overgenerates.

The patterns that distinguish between PaC-OT and PaC-RB are thus opaque countercyclic patterns, and the patterns that distinguish between PaC-RB1 and PaC-RB2 are aligned vs. misaligned patterns. If future research should demonstrate convincingly that opaque, misaligned patterns are attested this could be either interpreted as an argument for PaC-RB1, or as an argument for the rejection of cyclicity, such a discovery would justify to examine in detail whether there are specific countercyclic interaction patterns that PaC-RB1 still cannot derive.

5.4 Summary

In this section, I have compared PaC-OT with alternative approaches that can derive (some of) the countercyclic patterns as well. First, OOC is an approach that rejects cyclicity wholesale and derives cyclic effects with correspondences to different output forms. This approach is generally succesfull in accounting for cyclic effects, and this extends to a degree to the countercyclic effects discussed here. However, it fails to derive Akan, C'Lela and the Shortening interaction of Kimatuumbi, because it cannot define adequate bases. This is a known problem for OOC, compare e.g. Klein (1997) or Trommer (2013). A more general undergeneration problem for OOC is that it cannot derive cyclic opacity if the phrasal process applies in the phrase base. OOC has not only an undergeneration problem, but also an overgeneration

	PaC-OT	PaC-RB1	PaC-RB2	OOC	Attested†
Cyclic opaque interaction					
Q applies in isolation form	✓	✓	✓	✗	✓
Transparent interactions					
aligned	✓	✓	✓	✓	✓
misaligned	✗	✓	✗	✓	✗
Opaque interactions derivable in OT‡					
chain shift	✓	✓	✓	✓	?✣
counterbleeding	✗	✓	✓	✓	✗
self-destructive feeding	✓	✓	✓	✗	✗
Opaque interactions not derivable in OT					
aligned	✗	✓	✓	✗	✗
misaligned	✗	✓	✗	✗	✗
3-Level-language	✓	✓	✓	✗	✓✢

Table 5.3: Comparison of approaches

PaC-RB1: rule based PaC without restrictions; **PaC-RB2**: rule based PaC with universal ordering of prosody rules before melodic rules on every cycle. † Attested here assumes that the countercyclic opaque interactions of Kimatuumbi is reanalysed as suggest in section 4.6.8. ‡ This includes only the instances of chain shift, counterbleeding and self-destructive feeding that *are* derivable in standard parallel OT, not these interactions in general. ✣The potential case is Hijazi Bedouin Arabic, however it is analysed differently in chapter 4.3. ✢The case is Chamorro. Chamorro is analysed along these lines in chapter 4.5, but whether it is truly an example for needs further research, see footnote 35.

problem: It can derive transparent, misaligned countercyclic effects. However, it is not possible to argue that it is fares worse than PaC regarding overgeneration, it avoids some pathologies that PaC-OT predicts, namely the 3-lvel opaque language. For a rule based implementation of PaC, the problem is the opposite: It can derive all the attested patterns just as well as PaC-OT, but generates an almost unrestricted set of countercyclic interactions. These predictions can be ameliorated if Rusyanova & Rasin (2023)'s proposal is (amended and) adopted, but even then it overgenerates more than the OT version. Table 5.3, repeated from Table 1.2, gives an one glance overview of the theories compare here.

Chapter 6

Conclusion

6.1 Summary

In this dissertation, I have examined the NO-COUNTERCYCLICTY-Hypothesis, a corollary of cyclic frameworks. Whereas cyclic process interactions, as predicted by cyclic frameworks, abound among the languages of the world, countercyclic process interactions are exceedingly rare. Nonetheless, they exist. This work has established a list of 11 languages that show countercyclic effects, six of these languages have been examined in detail. I have argued that a framework that integrates prosodic structure and cycles (Prosody and Cycles, PaC) a) predicts a limited degree of countercyclic interactions, and b) this capacity suffices to account for the bulk of attested countercyclic patterns. The rest was amended to an analysis with PAC with justified morphological reconfigurations: The article in Icelandic was analysed as word- and phrase level affix, the article in Chamorro as a word level affix and shortening in Kimatuumbi as the reflex of a stem level Ezafe morpheme.

I have also examined the overgeneration of PaC, and found that it derives relatively few languages with countercyclic interactions that are not attested at all, chiefly countercyclic self-destructive feeding, and countercyclic chain shifts. This space of predictions was compared to two alternative theories, a restrictive version of Output-Output-Correspondence (OOC) and a rule based version of PaC. OOC is not able to generate all the attested patterns: It fails to derive Akan and C'Lela without an additional mechanism such as prosody, and cannot derive the interaction of shortening and gliding in Kimatuumbi at all. It also cannot generate some cyclic interactions, namely cyclic opacity between a word-level and a phrase-level process if the latter applies in the isolation form.

The rule-based version of PaC does not undergenerate, but overgenerates: It can derive almost any countercyclic interaction and is thus virtually indistinguishable from a non-cyclic theory that allows unencumbered reference to brackets. A restriction to rule-based PAC was discussed so that prosodic process are always ordered before melodic processes, with this restriction, overgeneration can be reduced but is still superior to OT-based PaC.

6.2 Look-Ahead

At the first glance, the five languages that show a countercyclic interaction that have not been discussed here do not seem to pose a major problem for PaC, because they are all aligned and transparent, the type of interaction that PaC can generally derive, and some have been reanalysed cyclically (Hausa, Kashaya, Seenku). However, each warrants a closer look under the perspective of PaC, in order to verify if this superficial conjecture holds true. Especially interesting is the case of Seenku, which has been analysed by McPherson (2019) as cyclic with very non-standard cycles and a novel conception of the lexicon.

The comparison of predictions should also be extended to more theories. An obvious candidate here would be OOC with less restrictive phrasal bases, so that it can account for the type of cyclic opacity mentioned above: would this entail deriving more types of countercyclicity? In Chapter 5, I briefly discuss relaxed bracket erasure and argue that it does not fit the data as well as PaC. I do not discuss another approach to brackets, morphological colour. As morphological colour alone is less powerful than weak bracket erasure, it arguably cannot account for the attested cases, but this needs to be verified. PaC, as laid out here, does not offer any account of derived environment effects (DEE), which are firmly attested and any theory of phonology needs to contend with them. Two common mechanisms to do this are underspecification (e.g. Rasin 2016) and the aforementioned morphological colour (van Oostendorp 2008b). These mechanisms make it also easier to account for opacity, so the question that should be investigated is if and how enriching PaC with any of these means widens the space of predicted, unattested patterns of countercyclic process interactions.

References

Abramovitz, Rafael Meghani. 2021. Topics in the grammar of Koryak. Doctoral dissertation, Massachusetts Institute of Technology.

Ahn, Sang-Cheol. 1997. The interplay of phonology and morphology in Korean. Doctoral dissertation, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL.

Akinlabi, Akinbiyi. 1996. Featural affixation1. *Journal of Linguistics* 32:239–289.

Al-Mozainy, Hamza Qublan. 1981. Vowel alternations in a Bedouin Hijazi Arabic dialect: Abstractness and stress. Doctoral dissertation, The University of Texas at Austin, Austin, Texas.

Albright, Adam C. 2002. The identification of bases in morphological paradigms. Doctoral dissertation, University of California, Los Angeles.

Aliero, Muhammad Ango. 2013. Aspects of the morphology of C'lela. Doctoral dissertation, University of Ghana, Legon.

Aliero, Muhammad Ango. 2015. Morphophonological processes of the C'lela noun. *Ghana Journal of Linguistics* 4:1–14.

Alphonce, Chrispina. 2022. The structure of the Iraqw noun phrase. *Journal of the Language Association of Eastern Africa* 1:6.

Anderson, Stephen R. 1969. An outline of the phonology of Modern Icelandic vowels. *Foundations of Language* 53–72.

Anderson, Stephen R. 2005. *Aspects of the theory of clitics*. Oxford: Oxford University Press.

Anderson, Stephen R. 2008. The English "group genitive" is a special clitic. *English Linguistics* 25:1–20.

Andersson, Samuel. 2020. I'm sorry but time travel isn't real: Against counterfeeding from the past. In *Proceedings of the 43rd Annual Penn Linguistics Colloquium*, 15.1.

Anttila, Arto. 2006. Variation and opacity. *Natural Language & Linguistic Theory* 24:893–944.

Anttila, Arto. 2007. Derivations and lelevels of representation. In *The Cambridge handbook of phonology*, ed. Paul de Lacy, 519–536. New York: Cambridge University Press.

Archangeli, Diana, & Douglas Pulleyblank. 2002. Kinande vowel harmony: domains, grounded conditions and one-sided alignment. *Phonology* 19:139–188.

Árnason, Kristján. 2011. *The phonology of Icelandic and Faroese*. Oxford University

Press.

Baković, Eric. 2007. A revised typology of opaque generalisations. *Phonology* 24:217–259.

Baković, Eric. 2011. Opacity and ordering. In *The handbook of phonological theory*, ed. John Goldsmith, Jason Riggle, & Alan C. L. Yu, 40–67. Malden, Oxford, Chichester: Wiley Blackwell.

Baković, Eric, & Lev Blumenfeld. 2024. A formal typology of process interactions. *Phonological Data and Analysis* 6:1–43.

Bateman, Nicoleta. 2007. A crosslinguistic investigation of palatalization. Doctoral dissertation, University of California, San Diego.

Bayles, Andrew, Aaron Kaplan, & Abby Kaplan. 2016. Inter-and intra-speaker variation in French schwa. *Glossa: a journal of general linguistics* 1.

Beckman, Jill Noelle. 1998. Positional faithfulness. Doctoral dissertation, University of Massachusetts Amherst.

Beeler, Madison S. 1970. Sibilant harmony in Chumash. *International Journal of American Linguistics* 36:14–17.

Bellik, Jennifer, Junko Itô, Nick Kalivoda, & Armin Mester. 2022. Matching and alignment. In *Prosody and prosodic interfaces*, ed. Haruo Kubozono, Junko Itô, & Armin Mester. Oxford: Oxford University Press.

Bennett, Ryan. 2018. Recursive prosodic words in Kaqchikel (Mayan). *Glossa a journal of general linguistics* 3.

Benua, Laura. 1997. Phonological relations between words. Doctoral dissertation, University of Massachusetts Amherst.

Benz, Johanna. 2018. Metrical incoherence: different metrical structure at different strata. Paper presented at the 26th Manchester Phonology Meeting.

Bermúdez-Otero, Ricardo. 1999. Constraint interaction in language change: quantity in English and Germanic. Doctoral dissertation, The University of Manchester (United Kingdom).

Bermudez-Otero, Ricardo. 2003. The acquisition of phonological opacity. In *Variation within Optimality Theory: Proceedings of the Stockholm workshop on 'Variation within Optimality Theory ´*, ed. Jennifer Spenader, Anders Eriksson, & Östen Dahl, 25–36. Stockholm: Department of Linguistics, Stockholm University.

Bermúdez-Otero, Ricardo. 2006. Phonological domains and opacity effects: A new look at voicing and continuancy in Catalan. *Handout, Workshop on Approaches to Phonological Opacity, GLOW XXIX, Barcelona, 5 April 2006* .

Bermúdez-Otero, Ricardo. 2011. Cyclicity. In *The Blackwell Companion to Phonology*, ed. Marc van Oostendorp, Colin J Ewen, Elizabeth V Hume, & Keren Rice. Wiley Blackwell.

Bermúdez-Otero, Ricardo. 2012. The architecture of grammar and the division of labour in exponence. In *The morphology and phonology of exponence (Oxford Studies in Theoretical Linguistics 41)*, ed. Jochen Trommer, 8–83. Oxford: Oxford University

Press.

Bermúdez-Otero, Ricardo. 2018. Stratal phonology. In *The Routledge handbook of phonological theory*, ed. S.J. Hannahs & Anna R. K. Bosch, 100–134. Abingdon: Routledge.

Bermúdez-Otero, Ricardo. In Preparation. The life cycle of constraint rankings: studies in early English morphophonology.

Bermúdez-Otero, Ricardo, & Ana R Luís. 2009. Cyclic domains and prosodic spans in the phonology of European Portuguese functional morphs. Paper given at the Workshop on the Division of Labour between Morphology and Phonology & Fourth Meeting of the Network 'Core Mechanisms of Exponence', Meertens Instituut, Amsterdam 16 January 2009. Available at www.bermudez-otero.com/bermudez-otero&luis.pdf.

Bermúdez-Otero, Ricardo, & April McMahon. 2006. English phonology and morphology. In *The handbook of English linguistics*, ed. bas Aarts & April McMahon, 382–410. Oxford: Blackwell.

Bermúdez-Otero, Ricardo, & John Payne. 2011. There are no special clitics. In *Morphology and its interfaces*, ed. Alexandra Galani, Glyn Hicks, & George Tsoulas. Amsterdam, Philadelphia: John Benjamins.

Bliß, Anna. 2020. Do strata allow bringing back intrinsic rule ordering? - a preliminary investigation. *Universität Leipzig Manuscript* .

Blöndal, Sigfús. 1920-24. *Íslensk-dönsk orðabók /islansk-dansk ordbog. [Icelandic-Danish dictionary]*. Reykjavík. URL https://blondal.arnastofnun.is.

Ásgeir Blöndal Magnússon. 1989. *Íslensk orðifjabók. [Icelandic etymological dictionary]*. Reykjavík. URL https://ordsifjabok.arnastofnun.is/.

Bonet, Eulàlia, Lisa Lai-Shen Cheng, Laura J Downing, & Joan Mascaró. 2019. (in) direct reference in the phonology-syntax interface under phase theory: A response to "modular pic"(d'alessandro and scheer 2015). *Linguistic Inquiry* 50:751–777.

Booij, Geert. 1985. Lexical phonology, final devoicing and subject pronouns in Dutch. *Linguistics in the Netherlands* 21–26.

Booij, Geert. 1995. *The phonology of Dutch*. Oxford: Oxford University Press.

Booij, geert, & Rochelle Lieber. 1993. On the simultaneity of morphological and prosodic structure. In *Studies in lexical phonology*, ed. Sharon Hargus & Ellen M. Kaisse, 23–44. San Diego, CA: Academic Press.

Booij, Geert, & Jerzy Rubach. 1984. Morphological and prosodic domains in Lexical Phonology. *Phonology Yearbook* 1:1–27.

Booij, Geert, & Jerzy Rubach. 1987. Postcyclic versus postlexical rules in Lexical Phonology. *Linguistic inquiry* 18:1–44.

Borchert, Mina, Ritva Århammar, & Nils Århammar. 1987. *Wi lear Halunder: Helgoländisches Lehrbuch*. Helgoland: Museum Helgoland.

Borer, Hagit. 1999. Deconstructing the construct. In *Beyond principles and parameters: Essays in memory of Osvaldo Jaeggli*, 43–89. Dordrecht: Kluwer Academic Publishers.

Borowsky, Toni. 1986. Topics in the lexical phonology of English. Doctoral dissertation, University of Massachusetts Amherst.

Borowsky, Toni. 1993. On the word level. In *Studies in lexical phonology*, ed. Sharon Hargus & Ellen M. Kaisse, 199–243. San Diego, CA: Academic Press.

Brame, Michael K. 1974. The cycle in phonology: stress in Palestinian, Maltese, and Spanish. *Linguistic Inquiry* 5:39–60.

Broś, Karolina, & Aleksei Ioulevitch Nazarov. 2023. Modelling opacity and variation in Gran Canarian Spanish apocope. *Glossa: a journal of general linguistics* 8.

Buckley, Eugene. 1996. Levels vs. domains: the case of kashaya vowel length. In *Proceedings of the 22nd annual meeting of the Berkeley Linguistics Society*, ed. Jan Johnson, Matthew L. Juge, & Jeri L. Moxley, 36–45. Berkely: Berkely Linguistic Society.

Buckley, Eugene. 1999. Uniformity in extended paradigms. In *The derivational residue in Optimality Theory*, ed. Ben Hermans & Marc van Oostendorp, 81–104. Amsterdam: John Benjamins.

Buckley, Eugene. 2017. Global effects in Kashaya prosodic structure. In *The morphosyntax-phonology connection: Locality and directionality at the interface*, ed. Vera Gribanova & Stephanie Shih. New York: Oxford University Press.

Burzio, Luigi. 1998. Multiple correspondence. *Lingua* 104:79–109.

Bye, Patrik, & Peter Svenonius. 2012. Non-concatenative morphology as epiphenomenon. In *The morphology and phonology of exponence (Oxford Studies in Theoretical Linguistics 41)*, ed. Jochen Trommer, 427–495. Oxford: Oxford University Press.

Cahill, Michael. 2007a. *Aspects of the morphology and phonology of Kɔnni*. Dallas, TX: SIL International and the University of Texas at Arlington.

Cahill, Michael. 2007b. More universals of tone. *SIL Electronic Working Papers* 7.

Cammenga, Jelle. 2004. *Igikuria phonology and morphology: a Bantu language of South-West Kenya and North-West Tanzania*. Köln: Rüdiger Köppe Verlag.

Cardinaletti, Anna, & Lori Repetti. 2009. Phrase-level and word-level syllables. In *Phonological domains: Universals and deviations*, ed. Janet Grijzenhout & Barış Kabak, volume 16, 79–104. New York: Mouton de Gruyter.

Casali, Roderic F. 1997. Vowel elision in hiatus contexts: Which vowel goes? *Language* 73:493–533.

Casali, Roderic F. 2002. Nawuri ATR harmony in typological perspective. *Journal of West African Languages* 29:3–43.

Charette, Monik. 1991. *Conditions on phonological government*. Cambridge: Cambridge University Press.

Chen, Matthew. 1973. On the formal expression of natural rules in phonology. *Journal of Linguistics* 9:223–249.

Cheng, Lisa Lai-Shen, & Laura J Downing. 2012. Prosodic domains do not match spell-out domains. *McGill Working Papers in Linguistics* 22.

Cheng, Lisa Lai-Shen, & Laura J Downing. 2016. Phasal syntax= cyclic phonology?

Syntax 19:156–191.

Chomsky, Noam. 2001. Derivation by phase. In *Ken Hale: A life in language*, ed. Michael Kenstowicz. Cambridge, MA: MIT Press.

Chomsky, Noam, & Morris Halle. 1968. *The sound pattern of English*. New York, Evanston and London: Harper & row.

Chomsky, Noam, Morris Halle, & Fred Lukoff. 1956. On accent and juncture in English. In *For Roman Jakobson*. The Hague: Mouton.

Chumakina, Marina, & Greville G Corbett. 2008. Archi: The challenge of an extreme agreement system. *Fonetika i nefonetika: K* 184–194.

Chung, Sandra. 1983. Tansderivational constraints in Chamorro phonology. *Lingua* 59:35–66.

Chung, Sandra. 2020. *Chamorro grammar*. Santa Cruz: University of California at Santa Cruz.

Cook, Eung-Do. 1993. Chilcotin flattening and autosegmental phonology. *Lingua* 91:149–174.

Cook, Eung-Do. 2013. *A Tsilhqút'ín grammar*. Vancouver, BC: UBC Press.

Cowell, Andrew, & Alonzo Moss. 2008. *The Arapaho language*. Denver, CO: University Press of Colorado.

Crosswhite, Katherine. 1998. Segmental vs. prosodic correspondence in Chamorro. *Phonology* 15:281–316.

Crysmann, Berthold. 2004. An inflectional approach to Hausa final vowel shortening. In *Yearbook of morphology 2004*, 73–112. Springer.

Cysow, Michael. 2003. Morphology in the wrong place: A survey of preposed enclitics. In *Morphology and its demarcations*, ed. Wolfgang U Dressler, 59–70. Amsterdam: John Benjamins.

d'Alessandro, Roberta, & Tobias Scheer. 2015. Modular PIC. *Linguistic Inguiry* 46:593–624.

Davis, Stuart. 1995. Emphasis spread in Arabic and grounded phonology. *Linguistic Inquiry* 465–498.

Davis, Stuart. 1998. Syllable contact in Optimality Theory. *eoneo* 23:181–211.

Deal, Amy Rose, & Matthew Wolf. 2017. Outwards-sensitive phonologically-conditioned allomorphy in Nez Perce. In *The morphosyntax-phonology connection: Locality and directionality at the interface*, ed. Vera Gribanova & Stephanie Shih, 29–60. New York: Oxford University Press.

Dettweiler, Stephen. 2000. Vowel harmony and neutral vowels in C'Lela. *The Journal of West African Languages* 28:3.

Dettweiler, Stephen. 2015. *C'Lela grammar portrait*. Jos: SIL Nigeria.

Dobashi, Yoshihito. 2010. Computational efficiency in the syntax–phonology interface. *The Linguistic Review* .

Dolatian, Hossep, Aniello De Santo, & Thomas Graf. 2020. Recursive prosody is not finite state. In *Proceedings of the 17th SIGMORPHON workshop on computational* *research in phonetics, phonology, and morphology*, ed. Nicolai Garrett, Kyle Gorman, & Ryan Cotterell, 11–22. Association for Computational Linguistics.

Dolphyne, Florence Abena. 1988. *The Akan (Twi-Fante) language: Its sound systems and tonal structure*. Accra: Ghana Universities Press.

Dolphyne, Florence Abena. 1994. A phonetic and phonological study of downdrift and downstep in Akan. Paper presented at the 25th Annual Conference on African Linguistics, Rutgers University.

Downing, Laura J. 1996. *The tonal phonology of Jita*. München, Newcastle: Lincom Europe.

Eisner, Jason. 1997. What constraints should OT allow? Paper presented at the Annual Meeting of the Linguistic Society of America, Chicago.

Elfner, Emily. 2015. Recursion in prosodic phrasing: Evidence from Connemara Irish. *Natural Language & Linguistic Theory* 33:1169–1208.

Faircloth, Laura Rose. 2020. Emphasis and pharyngeals in Palestinian Arabic: an experimental analysis of their acoustic, perceptual, and long-distance effects. Doctoral dissertation, University of Texas at Austin.

Faust, Noam. 2014. Where it's [at]: A phonological effect of phasal boundaries in the construct state of Modern Hebrew. *Lingua* 150:315–331. URL https://www.sciencedirect.com/science/article/pii/S0024384114001764.

Faust, Noam, & Shanti Ulfsbjorninn. 2018. Arabic stress in strict CV, with no moras, no syllables, no feet and no extrametricality. *The Linguistic Review* 35:561–600.

Felice, Lydia. 2022. Cyclicity and linearity in morphology: The view from Icelandic, Gã, and Kabyle. Doctoral dissertation, Georgetown University.

Féry, Caroline. 2013. Focus as prosodic alignment. *Natural Language & Linguistic Theory* 31:683–734.

Finley, Sara. 2009. Formal and cognitive restrictions on vowel harmony. Doctoral dissertation, Johns Hopkins University.

Beygingarlýsing íslensks nútímamáls. [The Database of Modern Icelandic Inflection]. (n.d.). Kristín Bjarnadóttir (ed.). The Árni Magnússon Institute for Icelandic Studies. Accessed 07.08.2024 from bin.arnastofnun.is.

Íslensk nútímamáls orðabók. [The Dictionary of Modern Icelandic]. 2018. Halldóra Jónsdóttir and Þórdís Úlfarsdóttir ed.). The Árni Magnússon Institute for Icelandic Studies. Accessed 07.08.2024 from https://islenskordabok.is/.

Frajzyngier, Zygmunt. 2012. *A grammar of Wandala*. Walter de Gruyter.

Garrett, Edward. 1999. Minimal words aren't minimal feet. In *Papers in phonology 2: UCLA working papers in linguistics*, ed. M. Gordon, 68–105. Los Angeles, CA: UCLA.

Genzel, Susanne. 2013. Lexical and post-lexical tones in Akan. Doctoral dissertation, Universität Potsdam.

Genzel, Susanne, & Frank Kügler. 2011. Phonetic realization of automatic (downdrift) and non-automatic downstep in Akan. In *Proceedings of ICPhS XVII*, 735–738.

Ghomeshi, Jila. 1997. Non-projecting nouns and the Ezafe: construction in persian.

Natural Language & Linguistic Theory 15:729–788.

Gibson, Courtenay St John, & Catherine O Ringen. 2000. Icelandic umlaut in Optimality Theory. *Nordic Journal of Linguistics* 23:49–64.

Gjersøe, Siri Moen. 2020. Tonal interactions in Nuer nominal inflection. Doctoral dissertation, Universität Leipzig.

Gleim, Daniel. 2018. Two types of tonelessness: The case of Buli. Paper presented at Tone and Intonation in Europe 2018, Göteborg.

Gleim, Daniel. 2019. A feeding Duke-of-York interaction of tone and epenthesis in Arapaho. *Glossa: a Journal of General Lnguistics* 4.

Gleim, Daniel. 2020. Processes at the boundary: Vowel deletion, insertion and retention in C'Lela. Paper presented at the 17th Old World Conference in Phonology, Warsaw.

Gleim, Daniel. 2023. The empirical scope of the strict cycle condition in phonology. In *Cyclicity*, ed. Felicitas Andermann, Gereon Müller, & Mariia Privizentseva, volume 95 of *Linguistische Arbeits Berichte*. Universität Leipzig: Institut für Linguistik.

Gleim, Daniel, Katie McCann, Sören E. Tebay, Jochen Trommer, & Eva Zimmermann. in progress. Database on morphological affixation with mutation / phonological features (mampf). Database, Universität Leipzig.

Gleim, Daniel, & Ezer Rasin. to appear. Transderivational faithfulness but not cyclic architectures can generate transparent countercyclic effects. *Proceedings of WCCFL 2021* .

Goldrick, Matthew. 2000. Turbid output representations and the unity of opacity. *NELS 30* 231–245.

Golston, Chris. 1996. Prosodic constraints on roots, stems and words. In *Interfaces in phonology*, ed. Ursula Kleinherz, 172–193. Berlin: Akademie Verlag.

Golston, Chris. 2021. No stress system requires recursive feet. *Catalan Journal of Linguistics* 20:9–35.

Gouskova, Maria. 2004. Relational hierarchies in Optimality Theory: The case of syllable contact. *Phonology* 21:201–250.

Grijzenhout, Janet, & Martin Krämer. 2000. Final devoicing and voicing assimilation in Dutch derivation and cliticization. In *Lexicon in focus*, ed. Barbara Stiebels & Dieter Wunderlich, 55–82. Berlin, Boston: Akademie Verlag. URL https://doi.org/10.1515/9783050073712-004.

Hall, Tracy Alan. 1989. Lexical Phonology and the distribution of german [ç] and [x]. *Phonology* 6:1–17.

Hall, Tracy Alan. 2022. *Velar fronting in German dialects*. Number 3 in Open Germanic Linguistics. Berlin: Language Science Press.

Hall, Tracy Alan, & John HG Scott. 2007. Inflectional paradigms have a base: Evidence from s-dissimilation in Southern German dialects. *Morphology* 17:151–178.

Halle, Morris, & Michael Kenstowicz. 1991. The free element condition and cyclic versus noncyclic stress. *Linguistic Inquiry* 22:457–501.

Halle, Morris, & Alec Marantz. 1993. Distributed morphology and the pieces of inflectiony. In *The view from building 20*, ed. Kenneth Hale & S.Jay Keyser, 111–176. Cambridge MA: MIT Press.

Halle, Morris, & K. P. Mohanan. 1985. Segmental phonology of Modern English. *Linguistic Inguiry* 16:57–116.

Halle, Morris, & Jean-Roger Vergnaud. 1987. Stress and the cycle. *Linguistic Inquiry* 18:45–84.

Hamann, Silke. 2003. German glide formation functionally viewed. *ZAS Papers in Linguistics* 32:137–154.

Hannahs, S. J, & Maggie Tallerman. 2006. At the interface: Selection of the Welsh definite article. *Linguistics* 44:781–816. URL https://doi.org/10.1515/LING.2006.025.

Hansson, Gunnar Ólafur. 2019. The limits of opaque phonology: Icelandic glide deletion reconsidered. Abstract presented at the Congrès de l'Association canadienne de linguistique 2019.

Hargus, Sharon. 1993. Modelling the phonology-morphology interface. In *Studies in lexical phonology*, ed. Sharon Hargus & Ellen Kaisse, 45–74. San Diego CA: Academic Press.

Harris, James W. 1989. The stress erasure convention and cliticization in Spanish. *Linguistic Inquiry* 20:339–363.

Hayes, Bruce. 1989. The prosodic hierarchy in meter. In *Phonetics and phonology 1: Rhythm and meter*, ed. Paul Kiparsky & G Youmans. Orlando, FL: Academic Press.

Hayes, Bruce. 1990. Precompiled phrasal phonology. In *The phonology-syntax connection*, ed. Sharon Inkelas & Draga Zec, 85–108. Chicago: University of Chicago Press.

Hayes, Bruce. 1995. *Metrical stress theory: Principles and case studies*. Chicago, IL: University of Chicago Press.

Hayes, Bruce. 2000. Gradient well-formedness in Optimality Theory. In *Optimality theory: Phonology, syntax, and acquisition*, ed. Joost Dekkers, Frank van der Leeuw, & Jeroen van de Weijer, 88–120. Oxford: Oxford University Press.

Henderson, Robert. 2012. Morphological alternations at the intonational phrase edge: The case of k'ichee'. *Natural Language & Linguistic Theory* 30:741–787.

Himmelmann, Nikolaus P. 2014. Asymmetries in the prosodic phrasing of function words: Another look at the suffixing preference. *Language* 927–960.

Hyde, Brett. 2002. A restrictive theory of metrical stress. *Phonology* 19:313–359.

Hyman, Larry M. 1987. Prosodic domains in Kukuya. *Natural Language & Linguistic Theory* 5:311–333.

Hyman, Larry M. 2001. Privative tone in Bantu. In *Cross-linguistic studies of tonal phenomena, tonogenesis, Japanese accentology and other topics*, ed. Shigeki Kaji, 237–257. Tokyo: Institute for the Study of Languages and Cultures of Asia and Africa

(ILCAA), Tōkyō Gaikokugo Daigaku.

Hyman, Larry M. 2006. Word-prosodic typology. *Phonology* 23:225–257.

Hyman, Larry M. 2017. Bantu tone overview. *UC Berkeley PhonLab Annual Report* 13:162–177.

Ingason, Anton Karl. 2013. Icelandic umlaut as morpheme-specific phonology. Paper presented at Phonology 2013, Amherst M.A.

Ingason, Anton Karl. 2016. Realizing morphemes in the Icelandic noun phrase. Doctoral dissertation, University of Pennsylvania.

Ingason, Anton Karl, & Einar Freyr Sigurðsson. 2015. Phase locality in Distributed Morphology and two types of Icelandic agent nominals. In *Proceedings of NELS*, volume 45(2), 45–58.

Inkelas, Sharon. 1996. The interaction of phrase and word rules in Turkish: An apparent paradox in the prosodic hierarchy. *The Linguistic Review* 13:193–217.

Inkelas, Sharon. 2014. *The interplay of morphology and phonology*. Oxford: Oxford University Press.

Inkelas, Sharon, & Cemil Orhan Orgun. 1995. Level ordering and economy in the lexial phonology of Turkish. *Language* 763–793.

Inkelas, Sharon, Cemil Orhan Orgun, & Cheryl Zoll. 2004. The implications of lexical exceptions for the nature of grammar. In *Optimality theory in phonology: A reader*, ed. John J McCarthy, 542–551. Oxford: Blackwell.

Iosad, Pavel. 2018. Optimality theory: Motivations and perspectives. In *The Routledge handbook of phonological theory*, ed. S.J. Hannahs & Anna R. K Bosch, 13–36. London, New York: Routledge.

Ishihara, Shinichiro, & Nick Kalivoda. 2022. Match theory: An overview. *Language and Linguistics Compass* 16.

Itô, Junko, & Armin Mester. 1992/2003. Weak layering and word binarity. In *Fa new century of phonology and phonological theory: A festschrift for professor Shosuke Haraguchi on the occasion of his sixtieth birthday*, ed. Takeru Honma, Masao Okazaki, Toshiyuki Tabata, & Shin-ichi Tanaka, 926–65. Tokyo: Kaitakushu.

Itô, Junko, & Armin Mester. 1995. The core-periphery structure of the lexicon and constraints on reranking. In *University of Massachusetts Occasional Papers in Linguistics [UMOP]*, ed. Jill Beckman, Suzanne Urbanczyk, & Laura Walsh, volume 18: Papers in Optimality Theory, 181–209. Amherst MA: GLSA.

Itô, Junko, & Armin Mester. 1999. Realignment. 39–60. Cambridge: Cambridge University Press.

Itô, Junko, & Armin Mester. 2001. Structure preservation and stratal opacity in German. In *Segmental phonology in optimality theory: Constraints and representations*, ed. Linda Lombardi. Cambridge University Press.

Itô, Junko, & Armin Mester. 2003. Lexical and postlexical phonology in Optimality Theory: Evidence form Japanese. In *Linguistische berichte. sonderheft 11: Resolving conflicts in grammars*, ed. Gisbert Fanselow & Caroline Féry, 183–207. Hamburg:

Buske.

Itô, Junko, & Armin Mester. 2007. Prosodic adjunction in Japanese compounds. In *Formal approaches to japanse linguistics (fajl) 4*, ed. Yoichi Miyamoto & Masao Ochi, volume 55, 97–111. Cambridge, MA: MITWPL.

Itô, Junko, & Armin Mester. 2009. The extended prosodic word. In *Phonological domains: Universals and deviations*, ed. Janet Grijzenhout & Barış Kabak, volume 16, 105–133. New York: Mouton de Gruyter.

Itô, Junko, & Armin Mester. 2010. The onset of the prosodic word. *Phonological argumentation: Essays on evidence and motivation* 227:260.

Itô, Junko, & Armin Mester. 2012. Recursive prosodic phrasing in Japanese. In *Prosody matters. essays in honor of Elisabeth Selkirk*, ed. Toni Borowsky, Shigeto Kawahara, Mariko Sugahara, & Takahito Shinya, 280–303. Stanford, CA: CSLI.

Itô, Junko, & Armin Mester. 2013. Prosodic subcategories in Japanese. *Lingua* 124:20–40.

Iverson, Gregory K., & Miren L. Oñederra. 1985. On Basque palatalization. *Folia Linguistica* 19:51–62.

Jeney, Karen. 2016. Positional constraints in Optimality Theory and Harmonic grammar. In *Harmonic Grammar and Harmonic Serialism*, ed. John J McCarthy & Joe Pater. London: Equinox.

Jesney, Karen. 2011. Positional faithfulness, non-locality, and the Harmonic Serialism solution. In *Proceedings of the 39th Meeting of the North East Linguistic Society (NELS 39)*, ed. Suzi Lima, Kevin Mullin, & Brian Smith, 429–440. Amherst, MA: GLSA.

Kabak, Barış, & Anthi Revithiadou. 2009. An interface approach to prosodic word recursion. In *Phonological domains: Universals and deviations*, ed. Janet Grijzenhout & Barış Kabak, volume 16, 105–133. New York: Mouton de Gruyter.

Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Kager, René. 2000. Stem stress and peak correspondence in Dutch. In *Optimality theory: Phonology, syntax, and acquisition*, ed. Joost Dekkers, Frank van der Leeuw, & Jeroen van de Weijer, 121–150. Oxford: Oxford University Press.

Kaisse, Ellen. 1985. *Connected speach: the interaction of syntax and phonology*. New York: Academic Press.

Kaisse, Ellen M., & April McMahon. 2011. Lexical phonology and the lexical syndrome. In *The Blackwell Companion to Phonology*, ed. Marc van Oostendorp, Colin J Ewen, Elizabeth V Hume, & Keren Rice, 2236–2257. Wiley Blackwell.

Kaisse, Ellen M, & Patricia A Shaw. 1985. On the theory of Lexical Phonology. *Phonology* 2:1–30.

Kalin, Laura. 2020. Morphology before phonology: A case study of Turoyo (Neo-Aramaic). *Morphology* 30:135–184.

Kalin, Laura. 2022a. Infixes really are (underlyingly) prefixes/suffixes: Evidence from allomorphy on the fine timing of infixation. *Language* 98:641–682.

Kalin, Laura. 2022b. Verbal plural allomorphy in hunzib and its implications for the cyclicity of the morphosyntax-phonology interface. *Glossa: a journal of general linguistics* 7.

Kaplan, Aaron. 2008. Stress is the trigger of Chamorro umlaut. In *Proceedings of the 2007 Mid-America Linguistics Conference*, ed. Emily Tummons & Stephanie Lux, 135–149. Kansas Working Papers in Linguistics 30.

Kaplan, Aaron. 2011a. Harmonic improvement without candidate chains in Chamorro. *Linguistic Inquiry* 42:631–650.

Kaplan, Aaron. 2011b. Variation through markedness suppression. *Phonology* 28:331–370.

Kaplan, Max J. 2022. Stratal overgeneration is necessary: metrically incoherent syncope in Southern Pomo. *Phonology* 39:597–639.

Karvonen, Daniel, & Adam Sherman. 1997. Sympathy, opacity, and u-umlaut in Icelandic. In *Phonology at Santa Cruz*, volume 5, 37–48. Santa Cruz, CA: University of California.

Kavitskaya, Darya, & Peter Staroverov. 2010. When an interaction is both opaque and transparent: the paradox of fed counterfeeding. *Phonology* 27:255–288.

Kean, Mary-Louise. 1974. The strict cycle in phonology. *Linguistic Inquiry* 5:179–203.

Kenstowicz, Michael. 2002. Paradigmatic uniformity and contrast. In *MIT Working Papers in Linguistics #42: Phonological answers (and their corresponding questions)*, ed. A. Csirmaz, Z. Li, A. Nevins, O. Vaysman, & M. Wagner. Cambridge, MA: MIT Press.

Kim, Yuni. 2010. Phonological and morphological conditions on affix order in Huave. *Morphology* 20:133–163.

Kim, Yuni. 2015. Mobile affixation within a modular approach to the morphology-phonology interface. In *Affix ordering across languages and frameworks*, ed. Alexander Letuchiy & Stela Manova, 111–123. Oxford: Oxford University Press.

Kimper, Wendell. 2011a. Domain specificity and Vata ATR spreading. *Proceedings of the 34th annual Penn linguistics colloquium* 17:155–164.

Kimper, Wendell A. 2011b. Competing triggers: Transparency and opacity in vowel harmony. Doctoral dissertation, University of Massachusetts Amherst.

Kimper, Wendell A. 2011c. Locality and globality in phonological variation. *Natural Language & Linguistic Theory* 29:423–465.

Kiparsky, Paul. 1982. Lexical morphology and phonology. In *Linguistics in the Morning Calm*, ed. In-Seok Yang, 3–91. Seoul: Hanshin Publishing Company.

Kiparsky, Paul. 1983. Word-formation and the lexicon. In *Proceedings of the Mid-America Linguistics Conference*, ed. F. Ingerman. University of Kansas.

Kiparsky, Paul. 1984. On the lexical phonology of Icelandic. In *Nordic prosody III*, ed. Claes-Christian Elert, Irene Johansson, & Eva Strangert, 135–164. Stockholm: Almqvist & Wiksell International.

Kiparsky, Paul. 1985. Some consequences of lexical phonology. *Phonology* 2:85–138.

Kiparsky, Paul. 1993. Blocking in nonderived environments. In *Studies in lexical* *phonology*, ed. Sharon Hargus & Ellen Kaisse, 277–313. Academic Press.

Kiparsky, Paul. 2000. Opacity and cyclicity. *The Linguistic Review* 17:351–267.

Kiparsky, Paul. 2003. Syllables and moras in Arabic. In *The syllable in Optimality Theory*, ed. Caroline Féry & Ruben van der Vijver, 147–182. Cambridge: Cambridge University Press Cambridge.

Kiparsky, Paul. 2011. Compensatory lengthening. In *Handbook of the syllable*, ed. Charles E. Cairns & Eric Raimy, 33–70. Leiden, Boston: Brill.

Kiparsky, Paul. 2015. Stratal OT: A synopsis and FAQs. In *Capturing phonological shades within and across languages*, ed. Yuchau E. Hsiao & Lian-Hee Wee, 2–44. Newcastle upon Tyne: Cambridge Scholars Publishing.

Kiparsky, Paul. 2018. Formal and empirical issues in phonological typology. *Phonological Typology* 23:1–45.

Kiparsky, Paul. 2021. Phonology to the rescue: Nez Perce morphology revisited. *The Linguistic Review* 38:391–442.

Kiparsky, Paul. 2023. Domains of vowel harmony. In *Oxford handbook of vowel harmony*, ed. Nancy Ritter & Harry van der Hulst. Oxford: Oxford University Press.

Kiparsky, Paull. 1973. Abstractness, opacity, and global rules. In *Three dimensions in linguistic theory*, ed. Osamu Fujimura, 57–86. Tokyo: TEC.

Kirchner, Robert. 1996. Synchronic chain shifts in Optimality Theory. *Linguistic Inquiry* 27:341–350.

Kisseberth, Charles, & David Odden. 2003. Tone. In *The Bantu languages*, ed. Derek Nurse & Gérard Philippson, 59–70. London: Routledge.

Klein, Thomas B. 1997. Output constraints and prosodic correspondence in Chamorro reduplication. *Linguistic inquiry* 28:707–715.

Klein, Thomas B. 2000. *'Umlaut' in Optimality Theory: A comparative analysis of German and Chamorro*. Tübingen: Niemeyer.

Kochetov, Alexei. 2011. Palatalization. In *The Blackwell Companion to Phonology*, ed. Marc van Oostendorp, Colin J Ewen, Elizabeth V Hume, & Keren Rice. Wiley Blackwell.

Krämer, Martin, & Draga Zec. 2020. Nasal consonants, sonority and syllable phonotactics: the dual nasal hypothesis. *Phonology* 37:27–63.

Kratzer, Angelika, & Elisabeth Selkirk. 2020. Deconstructing information structure. *Glossa: a journal of general linguistics* 5.

Kügler, Frank. 2015a. Phonological phrasing and ATR vowel harmony in Akan. *Phonology* 32:177–204.

Kügler, Frank. 2015b. Phonological phrasing and ATR vowel harmony in Akan. *Phonology* 32:177–204.

Kügler, Frank. 2017. Tone and intonation in Akan. In *Intonation in African tone languages*, ed. Laura J. Downing & Annie Rialland, volume 24, 89–129. Berlin: Mouton de Gruyter.

Kügler, Frank. 2022. Phrase-level ATR vowel harmony in Anum—a case of recursive prosodic phrasing. *Languages* 7:308.

Kushnir, Yuriy. 2019. Prosodic patterns in Lithuanian morphology. Doctoral dissertation, Universität Leipzig.

Kushnir, Yuriy. 2022. Accent strength in Lithuanian: evidence from the Saussurean accent shift. *Glossa: a journal of general linguistics* 7.

de Lacy, Paul. 2007. Themes in phonology. In *The Cambridge handbook of phonology*, ed. Paul de Lacy, 5–30. New York: Cambridge University Press.

Ladd, D Robert. 1986. Intonational phrasing: the case for recursive prosodic structure. *Phonology* 3:311–340.

Lamont, Andrew. 2021a. Optimality theory implements complex functions with simple constraints. *Phonology* 38:729–740.

Lamont, Andrew. 2021b. Optimizing over subsequences generates context-sensitive languages. *Transactions of the Association for Computational Linguistics* 9:528–537.

Lamont, Andrew. 2024. Optimality theory. University College of London manuscript.

Lee, Seunghun J., & Elisabeth Selkirk. 2022. Xitsonga tone: The syntax-phonology interface. In *Prosody and prosodic interfaces*, ed. haruo Kubozono, Junko Itô, & Armin Mester. Oxford: Oxford University Press.

Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language & Linguistic Theory* 17:267–302.

Lombardi, Linda. 2001. Why place and voice are different: Constraint-specific alternations in Optimality Theory. In *Segmental phonology in Optimality Theory: Constraints and representations*, ed. Linda Lombardi, 13–145. Cambridge: Cambridge University Press.

Łubowicz, Anna. 2002. Derived environment effects in Optimality Theory. *Lingua* 112:243–280.

Mahanta, Shakuntala. 2008. Directionality and locality in vowel harmonyt. Doctoral dissertation, Utrecht University, Utrecht.

Mahanta, Shakuntala. 2012. Locality in exceptions and derived environments in vowel harmony. *Natural language & Linguistic Theory* 30:1109–1146.

Marfo, Charles Ofosu. 2005. Aspects of Akan grammar and the phonology-syntax interface. Doctoral dissertation, The University of Hong Kong.

Marlo, Michael R. 2013. Verb tone in Bantu languages: Micro-typological patterns and research methods. *Africana Linguistica* 19:127–234.

Martínez-Paricio, Violeta, & René Kager. 2015. The binary-to-ternary rhythmic continuum in stress typology: Layered feet and non-intervention constraints. *Phonology* 32:459–504.

Martínez-Paricio, Violeta, & René Kager. 2021. In favour of layered feet. a response to Golston. *Catalan Journal of Linguistics* 20:37–55.

Marvin, Tatjana. 2002. Topics in the stress and syntax of words. Doctoral dissertation, Massachusetts Institute of Technology.

Mascaró, Joan. 1976. Catalan phonology and the phonological cycle. Doctoral dissertation, Massachusetts Institute of Technology.

Mascaró, Joan. 1996. External allomorphy and contractions in Romance. *Probus* 8:181–205.

McCarthy, John J. 1993a. A case of surface constraint violation. *Canadian Journal of Linguistics/Revue canadienne de linguistique* 38:169–195.

McCarthy, John J. 1993b. The parallel advantage: Containment, consis- tency, and alignment. Paper presented at Rutgers Optimality Workshop-I, Rutgers University, October 1993.

McCarthy, John J. 1995. Remarks on phonological opacity in Optimality Theory. In *Studies in Afroasiatic grammar: Papers collected from the second conference on Afroasiatic languages*, ed. Jacqueline Lecarme, Jean Lowenstamm, & Ur Shlonsky, 1–26. The Hague: Holland Academic Graphics.

McCarthy, John J. 1999. Sympathy and phonological opacity. *Phonology* 16:331–399.

McCarthy, John J. 2003a. Ot constraints are categorical. *Phonology* 20:75–138.

McCarthy, John J. 2003b. Sympathy, cumulativity and the Duke-of-York gambit. In *The syllable in Optimality Theory*, ed. Caroline Féry & Ruben van der Vijver, 23–76. Cambridge: Cambridge University Press Cambridge.

McCarthy, John J. 2004. Headed spans and autosegmental spreading. University of Massachusetts Amherst manuscript.

McCarthy, John J. 2005a. The length of stem-final vowels in Colloquial Arabic. In *Perspectives on Arabic linguistics xvii–xviii*, ed. Mohammad T. Alhawary & Elabbas Benmamoun, 1–26. Amsterdam & Philadelphia: John Benjamins.

McCarthy, John J. 2005b. Optimal paradigms. In *Paradigms in phonological theory*, ed. Laura Downing, Tracy Alan Hall, & Renate Raffelsiefen, 170–210. Oxford: Oxford University Press.

McCarthy, John J. 2007a. Derivations and lelevels of representation. In *The Cambridge handbook of phonology*, ed. Paul de Lacy, 99–118. New York: Cambridge University Press.

McCarthy, John J. 2007b. *Hidden generalizations: Phonological opacity in optimality theory*. London, Oakville: Equinox.

McCarthy, John J. 2008. Restraint of analysis. In *Freedom of analysis*, ed. Sylvia Blaho, Patrik Bye, & Martin Krämer, 203–231. Berlin, New York: Mouton de Gruyter.

McCarthy, John J. 2011. Autosegmental spreading in Optimality Theory. In *Tones and features: Phonetic and phonological perspectives*, ed. John A. Goldsmith, Elizabeth Hume, & W. Leo Wetzels, 195–222. Berlin: Mouton de Gruyter.

McCarthy, John J. 2016. The theory and practice of Harmonic Serialism. In *Harmonic Grammar and Harmonic Serialism*, ed. Joe Pater & John J McCarthy, 47–87. London: Equinox.

McCarthy, John J, & Alan Prince. 1994. The emergence of the unmarked. *Proceedings of NELS 24* 333–379.

McCarthy, John J, & Alan Prince. 1995. Faithfulness and reduplicative identity. In

Papers in optimality theory, ed. Jill N. Beckman, Laura Walsh Dickey, & Suzanne Urbanczyk, 249–384. Amherst, MA: GLSA.

McCarthy, John J, & Allan Prince. 1993. Generalized alignment. *Yearbook of Morphology* 79–153.

McPherson, Laura. 2010. Tone features revisited: Evidence from Seenku. In *Diversity in African languages*, ed. Doris L. Payne, Sara Pacchiarotti, & Mokaya Bosire, 5–22. Berlin: Language Science Press.

McPherson, Laura. 2019. Seenku argument-head tone sandhi: Allomorph selection in a cyclic grammar. *Glossa: a journal of general linguistics* 4.

Melick, Christina M. 2012. *Tone in the Mbelime verb system*. Dallas TX: SIL International.

Meyase, Savio M. 2021. Polarity in a four-level tone language: tone features in Tenyidie. *Phonology* 38:123–146.

Michel, Dan. 2009. Positional transparency in c'Lela. In *Proceedings from the Annual Meeting of the Chicago Linguistic Society*, volume 45(1), 455–469. Chicago Linguistic Society.

Michelson, Karin. 1989. Invisibility: Vowels without a timing slot in Mohawk. *Theoretical perspectives on Native American languages* 38–69.

Miller, Taylor Lampton. 2018. The phonology-syntax interface and polysynthesis: A study of Kiowa and Saulteaux Ojibwe. Doctoral dissertation, University of Delaware.

Mohanan, Karuvannur Puthanveettil. 1986. *The theory of lexical phonology*. Dordrecht: Reidel.

Mohanan, Karuvannur Puthanveettil, & Tara Mohanan. 1984. Lexical phonology of the consonant system in Malayalam. *Linguistic inquiry* 575–602.

Mohanan, Tara. 1989. Syllable structure in Malayalam. *Linguistic Inquiry* 589–625.

Morén, Bruce Timothy. 1997. Markedness and faithfulness constraints on the association of moras: The dependency between vowel length and consonant weight. Doctoral dissertation, University of Maryland at College Park manuscript.

Mous, Maarten. 2007. A sketch of Iraqw grammar. Leiden University manuscript.

Myers, Scott. 1991. Structure preservation and the strong domain hypothesis. *Linguistic Inquiry* 22:379–6385.

Nazarov, Aleksei. 2019. Bedouin Arabic multiple opacity with indexed constraints in parallel ot. In *Proceedings of the 2019 Annual Meeting on Phonology*, ed. Hyunah Baek, Chikako Takahashi, & Alex Hong-Lun Yeung. Washington, D.C.: Linguistic Society of America.

Nespor, Marina, & Irene Vogel. 1986. *Prosodic phonology*. Dordrecht: Foris.

Newell, Heather. 2008. Aspects of the morphology and phonology of phases. Doctoral dissertation, McGill University.

Newell, Heather. 2017. Nested phase interpretation and the PIC. In *The structure of words at the interfaces*, ed. Heather Newell, Máire Noonan, Glyne Piggott, & Lisa deMena Travis, volume 68. Oxford: Oxford University Press.

Newell, Heather. 2021. Deriving level 1/level 2 affix classes in English: Floating vowels, cyclic syntax. *Acta Linguistica Academica* 68:31–76.

Newell, Heather, & Glyne Piggott. 2014. Interactions at the syntax–phonology interface: Evidence from Ojibwe. *Lingua* 150:332–362.

Newell, Heather, & Craig Sailor. to appear. Minimalism and the syntax-phonology interface. To appear in In Kleanthes Grohmann and Evelina Leivada (eds.) *The Cambridge handbook of Minimalism and its applications.* Cambridge: Cambride University Press.

Nilsson, Morgan, & Laura J Downing. 2019. Somali vowel qualities and vowel harmony domains. Paper presented at North Atlantic Conference on Afroasiatic Linguistics (NACAL) 47.

Obiri-Yeboah, Michael, & Sharon Rose. 2022. Vowel harmony and phonological phrasing in Gua. *Natural Language & Linguistic Theory* 40:159–193.

Odden, David. 1990. Syntax, lexical rules and postlexical rules in Kimatuumbi. In *The phonology-syntax connection*, ed. Sharon Inkelas & Draga Zec, 259–277. Chicago, IL: University of Chicago Press.

Odden, David. 1993. Interaction between modules in Lexical Phonology. In *Studies in lexical phonology*, ed. Sharon Hargus & Ellen M. Kaisse, 111–144. San Diego, CA: Academic Press.

Odden, David. 1996. *The phonology and morphoilogy of Kimatuumbi*. Oxford: Oxford University Press.

Odden, David, & Lee Bickmore. 2014. Melodic tone in Bantu. *Africana Linguistica* 20:3–13.

van Oostendorp, Marc. 2006. A theory of morphosyntactic colours. Meertens Institute, Amsterdam manuscript.

van Oostendorp, Marc. 2008a. Derived Environment Effects and Consistency of Exponence. In *Freedom of analysis?*, ed. Sylvia Blaho, Patrick Bye, & Martin Krämer, 123–149. Berlin, Boston: de Gruyter Mouton.

van Oostendorp, Marc. 2008b. Derived environment effects and consistency of exponence. In *Freedom of analysis*, ed. Sylvia Blaho, Patrik Bye, & Martin Krämer. Berlin, New York: Mouton de Gruyter.

van Oostendorp, Marc. 2008c. Incomplete devoicing in formal phonology. *Lingua* 118:1362–1374.

Orešnik, Janez. 1972. On the epenthesis rule in Modern Icelandic. *Arkiv för nordisk filologi* 87:1–32.

Orešnik, Janez. 1976. Inflection of modern Icelandic nouns, adjectives and adverbs. *Linguistica* 16:97–118.

Orešnik, Janez. 1977a. On the modern Icelandic palatalization rule. In *Dialectology and sociolinguistics: Essays in honor of Karl-Hampus Dahlstedt*, ed. Claes-Christian Elert, Stig Eliasson, Sigurd Fries, & Sture Ureland, 137–145. Umeå: Acta Univesitatis Umensis.

Orešnik, Janez. 1977b. Modern Icelandic u-umlaut from the descriptive point of view. *Gripla* 2:151–182.

Orešnik, Janez. 1978. The Modern Icelandic epenthesis rule revisited. *Arkiv för nordisk filologi* 93:166–173.

Orešnik, Janez. 1980. On the lack of palatalization before -end- in the plural of Icelandic nominalized present participles such as leikandi. *Linguistica* 20:245–259.

Orgun, Cemil Orhan. 1997. Cyclic and noncyclic phonological effects in a declarative grammar. In *Yearbook of morphology 1997*, ed. Geert Booij & Jaap van Marle. Dordrecht: Springer.

Orgun, Cemil Orhan, & Sharon Inkelas. 2001. Reconsidering bracket erasure. In *Yearbook of morphology 2001*, 115–146. Springer.

Pak, Marjorie. 2008. The postsyntactic derivation and its phonological reflexes. Doctoral dissertation, University of Pennsylvania, Philadelphia, PA.

Pak, Marjorie. 2016. How allomorphic is English article allomorphy? *Glossa: a journal of general linguistics* 1.

Panagiotidis, Phoevos, Vassilios Spyropoulos, & Anthi Revithiadou. 2017. Little v as a categorizing verbal head: Evidence from Greek. In *The verbal domain*, ed. Roberta d'Alessandro, Irene Franco, & Ángel J Gallego, 29–48. Oxford University Press Oxford.

Paschen, Ludger. 2018. The interaction of reduplication and segmental mutation: A phonological account. Doctoral dissertation, Universität Leipzig.

Paster, Mary. 2005. Subcategorization vs. output optimization in syllable-counting allomorphy. In *Proceedings of the 24th West Coast conference on Formal Linguistics*. Somerville: Cascadilla.

Paster, Mary. 2006. Phonological conditions on affixation. Doctoral dissertation, University of California, Berkeley.

Paster, Mary. 2009. Explaining phonological conditions on affixation: Evidence from suppletive allomorphy and affix ordering. *Word structure* 2:18–37.

Paster, Mary. 2010. The verbal morphology and phonology of Asante Twi. *Studies in African Linguistics* 39:78–99.

Paster, Mary. 2019. Phonology counts. *Radical: A Journal of Phonology* 1:1–61.

Pater, Joe. 2016. Universal grammar with weighted constraints. In *Harmonic Grammar and Harmonic Serialism*, ed. Joe Pater & John J McCarthy, 1–41. London: Equinox.

Peperkamp, Sharon. 1996. On the prosodic representation of clitics. In *Interfaces in phonology*, ed. Ursula Kleinhenz, 102–127. Berlin: Akademie Verlag.

Pesetsky, David. 1979. Russian morphology and lexical theory. *MIT Manuscript* .

Pétursson, Magnús. 1986. Janez Orešniks Beitrag zur Erforschung der Isländischen Sprache. *Linguistica* 26:159–170.

Popp, Marie-Luise. 2019. Why mid vowels are not always mid vowels. In *Nels 49: Proceedings of the forty-ninth annual meeting of the North East Linguistic Society*, ed. Maggie Baird & Jonathan Pesetsky, volume 3, 39–48. Amherst, MA: GLSA.

Popp, Marie-Luise. 2022. Phonological correlates of alienability. Universität Leipzig manuscript.

Prieto, Pilar. 2006. Phonological phrasing in Spanish. In *Optimality-theoretic advances in Spanish phonology*, 39–60. Amsterdam: John Benjamins.

Prince, Alan, & Paul Smolensky. 1993. Optimality theory: Constraint interaction in generative grammar. Technical Report, Rutgers Center for Cognitive Science, Rutgers University, New Brunswick, N.J., and Computer Science Department, University of Colorado, Boulder.

Pulleyblank, Douglas. 2002. Harmony drivers: No disagreement allowed. In *Proceedings of the Annual Meeting of the Berkeley Linguistics Society*, 249–267. Washington, DC: Linguistic Society of America.

Raffelsiefen, Renate. 2000. Constraints on schwa apocope in Middle High German. In *Analogy, levelling, markedness: Principles of change in phonology and morphology*, ed. Aditi Lahiri, 125–170. Berlin, New York: de Gruyter.

Þráinsson, Höskuldur. 2017. U-umlaut in Icelandic and Faroese: Survival and death. In *On looking into words (and beyond): Structure, relations, analyses*, ed. Claire Bowern, Laurence Horn, & Raffaella Zanuttini, 99–113. Berlin: Language Science Press.

Rasin, Ezer. 2016. Morpheme structure constraints and blocking in nonderived environments. *MIT Manuscript* .

Rasin, Ezer. 2022. Shifting interactions and countershifting opacity: A note on opacity in Harmonic Serialism. *Linguistic Inquiry* 53:836–851.

Rasin, Ezer. 2024. On the absence of crucially-simultaneous phonological interactions in natural language. Talk presentet at the ZYKLOP Colloquium May 2024 Universitẗ Leipzig.

Rasin, Ezer, & Jochen Trommer. 2019. Allomorph selection and phonology are ordered: evidence from a new universal. Paper presented at the twenty-seventh Manchester Phonology Meeting.

Rebrus, Péter, Péter Szigetvári, & Miklós Törkenczy. 2012. Dark secrets of Hungarian vowel harmony. *Sound, structure and sense: Studies in memory of Edmund Gussmann* 491–508.

Reiss, Charles. 2021. Solving Optimality Theory's chain shift problem. Concordia University manuscript.

Revithiadou, Anthi. 2008. Colored turbid accents and containment: A case study from lexical stress. In *Freedom of analysis*, ed. Sylvia Blaho, Patrik Bye, & Martin Krämer, 149–174. Berlin, New York: Mouton de Gruyter.

Revithiadou, Anthi. 2011. The phonological word. In *The Blackwell Companion to Phonology*, ed. Marc van Oostendorp, Colin J Ewen, Elizabeth V Hume, & Keren Rice. Wiley Blackwell.

Rolle, Nicholas Revett. 2018a. Grammatical tone: Typology and theory. Doctoral dissertation, University of California Berkely.

Rolle, Nicholas Revett. 2018b. Transparadigmatic output-output correspondence:

A case study from Ese Ejja. In *Proceedings of the Annual Meetings on Phonology*, volume 5.

Rolle, Nicholas Revett, & Lee Bickmore. 2022. Outward-sensitive phonologically-conditioned suppletive allomorphy vs. first-last tone harmony in cilungu. *Morphology* 32:197–247.

Rolle, Nicholas Revett, & Larry M Hyman. 2018. Phrase-level prosodic smothering in Makonde. In *Proceedings of the 2018 Annual Meetings on Phonology*, ed. Katherine Hout, Anna Mai, Adam McCollum, Sharon Rose, & Matt Zaslansky. Washington, D.C.: Linguistic Society of America.

Rolle, Nicholas Revett, & Florian Lionnet. 2019. Phantom structure: A representational account of floating tone association. In *Proceedings of the 2019 Annual Meeting on Phonology*, ed. Hyunah Baek, Chikako Takahashi, & Alex Hong-Lun Yeung. Washington, D.C.: Linguistic Society of America.

Rose, Sharon. 1996. Variable laryngeals and vowel lowering. *Phonology* 13:73–117.

Rusyanova, Vera, & Ezer Rasin. 2023. Stress precedence: A new universal constraint on rule ordering. Poster presented at the Morris Halle's Centenary conference at MIT, Cambridge MA.

Samiian, Vida. 1983. Origins of phrasal categories in Persian, an X-bar analysis. Doctoral dissertation, University of California Los Angeles.

Samuels, Bridget. 2012. Consequences of phases for morpho-phonology. In *Phases: Developing the framework*, ed. Ángel J. Gallego, 251–281. Berlin, Boston: De Gruyter Mouton.

Sande, Hannah. 2019. A unified account of conditioned phonological alternations: Evidence from Guébie. *Language* 95:456–497.

Sande, Hannah. 2020. Morphologically conditioned phonology with two triggers. *Phonology* 37:453–493.

Sande, Hannah, Peter Jenks, & Sharon Inkelas. 2020. Cophonologies by ph(r)ase. *Natural Language & Linguistic Theory* 38:1211–1261.

Scheer, Tobias. 2010. *A guide to morphosyntax-phonology interface theories*. Berlin / New York: De Gruyter Mouton.

Scheer, Tobias. 2012. Chunk definition in phonology: prosodic constituency vs. phase structure. In *Modules and interfaces*, 221–253. Catholic Univesity of Lublin (Katolicki Uniwersytet Lubelski) Lublin, Poland.

Scheer, Tobias. 2016. Melody-free syntax and phonologically conditioned allomorphy. *Morphology* 26:341–378.

Schiering, René, Balthasar Bickel, & Kristine A Hildebrandt. 2010. The prosodic word is not universal, but emergent. *Journal of linguistics* 46:657–709.

Schlindwein, Deborah. 1987. P-bearing units: A study in Kinande vowel harmony. *NELS 17* 551–567.

Seidl, Amanda. 2001. *Minimal Indirect Reference: a theory of the syntax-phonology interface*. London: Routledge.

Selkirk, Elisabeth. 1980. The role of prosodic categories in English word stress. *Linguistic inquiry* 11:563–605.

Selkirk, Elisabeth. 1984. *Phonology and syntax: The relation between sound and structure*. Cambridge, MA, London: MIT Press.

Selkirk, Elisabeth. 1986. On derived domains in sentence phonology. *Phonology* 3:371–405.

Selkirk, Elisabeth. 1995. The prosodic structure of function words. In *University of Massachusetts occasional papers in linguistics 18*, ed. Jill Beckman, Laura Walsh Dickey, & Susanne Urbanczyk, 439–470. Amherst, MA: GSLA.

Selkirk, Elisabeth. 2011. The syntax-phonology interface. In *The handbook of phonological theory*, ed. John Goldsmith, Jason Riggle, & Alan C. L. Yu, 435–484. Malden, Oxford, Chichester: Wiley Blackwell.

Selkirk, Elisabeth, & Seunghun J Lee. 2015. Constituency in sentence phonology: An introduction. *Phonology* 32:1–18.

Selkirk, Elisabeth, & Koichi Tateishi. 1988. Constraints on minor phrase formation in Japanese. In *Papers from the 24th annual regional meeting of the chicago linguistic society*, 24-1, 316–336. Chicago, IL: Chicago Linguistic Soyiety.

Shih, Shu-hao. 2016. Binarity and focus in prosodic phrasing: New evidence from Taiwan Mandarin. In *Proceedings of the annual meetings on phonology*, ed. Karen Jesney, Charlie O'Hara, Caitlin Smith, & Rachel Walker. Washington, DC: Linguistic Society of America.

Shwayder, Kobey. 2015. Words and subwords: Phonology in a piece-based syntactic morphology. Doctoral dissertation, University of Pennsylvania.

Smith, Jennifer. 2002. Phonological augmentation in prominent positions. Doctoral dissertation, University of Amherst, Massachusetts.

Smith, Jennifer L. 2011. Category-specific effects. In *The Blackwell Companion to Phonology*, ed. Marc van Oostendorp, Colin J Ewen, Elizabeth V Hume, & Keren Rice. Wiley Blackwell.

Smolensky, Paul. 2006. Optimality in phonology II: Harmonic completeness, local constraint conjunction, and feature domain markedness. In *The harmonic mind: From neural computation to optimality-theoretic grammar*, ed. Paul Smolensky & Géraldine Legendre, volume 2, 27–160. Cambridge, MA: MIT Press.

Snider, Keith L. 1988. Towards the representation of tone: a three-dimensional approach. In *Features, segmental structure and harmony processes*, ed. Harry van der Hulst & Norval Smith, volume 1, 237–65. Dordrecht: Foris.

Snider, Keith L. 1998. Phonetic realisation of downstep in Bimoba. *Phonology* 15:77–101.

Snider, Keith L. 1999. *The geometry and features of tone*. Dallas TX: The Summer Institute of Linguistics and The University of Texas at Arlington.

Snider, Keith L, & Harry van der Hulst. 1993. Issues in the representation of tonal register. In *The representation of tonal register*, ed. Harry van der Hulst & Keith L.

Snider, volume 1, 237–65. Berlin: Mouton de Gruyter.

Steriade, Donca. 2008. A pseudo-cyclic effect in Romanian morphophonology. In *Inflectional identity*, ed. Asaf Bachrach & Andrew Nevins, 313–358. Oxford University Press.

Stevick, Earl W. 1969. Tone in Bantu. *International journal of American linguistics* 35:330–341.

Stewart, John Massie. 1965. The typology of the Twi tone system. *African notes: bulletin of the Institute of African Studies, University of Ibadan* 1:1–27.

Stewart, John Massie. 1993. Dschang and Ebrié as Akan-type total downstep languages. In *The phonology of tone–the representation of tonal register*, ed. Harry van der Hulst, 185–244. Berlin, New York: Mouton de Gruyter.

Stolz, Thomas. 2012. Survival in a niche: On gender-copy in Chamorro (and sundry languages). In *Morphologies in contact*, ed. Martine Vanhove, Thomas Stolz, Aina Urdze, & Hitomi Otsuka, 93–140. Berlin: Akademie Verlag.

Strunk, Jan. 2005. Postnominal modification in Kurdish. University of Bochum manuscript.

Šurkalović, Dragana. 2013. Modularity, phase-phase faithfulness and prosodification of function words in English. *Nordlyd* 40:301–322.

Šurkalović, Dragana. 2015. The no-reference hypothesis. Doctoral dissertation, Universitetet i Tromsø.

Svenonius, Peter. 2012. Look both ways: Outward-looking allomorphy in Icelandic participles. University in Tromømanuscript. Available online at http://ling. auf. net/lingbuzz/001519.

Sverrir Hólmarsson, Christopher Sanders, & John Tucker. 1989. *Íslensk-ensk orðabók/Concise Icelandic-English dictionary*. Reykjavík: Iðunn. URL http://digital.library.wisc.edu/1711.dl/IcelOnline.IEOrd.

Tebay, Sören Eggert. 2022. Interacting (with) morpheme structure constraints: Representational solutions to Richness of the Base Problems in Optimality Theory. Doctoral dissertation, Universität Leipzig.

Topping, Donald M., & Bernadita C. Dungca. 1973. *Chamorro reference grammar*. Honolulu: University of Hawaii Press.

Trommer, Jochen. 2011. Phonological aspects of western Nilotic mutation morphology. Universität Leipzig Habilitation thesis.

Trommer, Jochen. 2013. Stress uniformity in Albanian: morphological arguments for cyclicity. *Linguistic inquiry* 44:109–143.

Trommer, Jochen. 2015. Anticyclic tone polarity in Asante Twi. Universität Leipzig manuscript.

Trommer, Jochen. 2021. The subsegmental structure of German plural allomorphy. *Natural Language & Linguistic Theory* 39:601–656.

Trommer, Jochen. 2022. The stratal structure of Kuria morphological tone. *Phonology* 39:679–723.

Trommer, Jochen. 2023. The strict cycle condition in stratal OT. In *Cyclicity*, ed. Felicitas Andermann, Gereon Müller, & Mariia Privizentseva, volume 95 of *Linguistische Arbeits Berichte*. Universität Leipzig: Institut für Linguistik.

Trommer, Jochen, & Daniel Gleim. 2017. Syllable-counting tone allomorphy in Bari. Paper presented at the 2017 manchester Phonology Meeting.

Truckenbrodt, Hubert. 1995. Phonological phrases–their relation to syntax, focus, and prominance. Doctoral dissertation, Massachusetts Institute of Technology.

Truckenbrodt, Hubert. 1999. On the relation between syntactic phrases and phonological phrases. *Linguistic inquiry* 30:219–255.

Tsay, Jane, & James Myers. 1996. Taiwanese tone sandhi as allomorph selection. In *Annual Meeting of the Berkeley Linguistics Society*, ed. Jan Johnson, Matthew L. Juge, & Jeri L. Moxley, 395–405. Berkely: Berkely Linguistic Society.

Urbanczyk, Suzanne. 1999. Double reduplications in parallel. In *The prosody morphology interface*, ed. René Kager, Harry van der Hulst, & Wim Zonnevel, 499–531. Cambridge: Cambridge University Press.

Uriagereka, Juan. 1999. Multiple spell-out. In *Working minimalism*, ed. S. Epstein & N. Hornstein. Cambridge MA: MIT Press.

Van de Velde, Mark L. O. 2008. *A grammar of Eton*. Berlin, New York: Mouton de Gruyter.

Vennemann, Theo. 1988. *Preference laws for syllable structure*. Berlin: Mouton de Gruyter.

Vigário, Marina. 2010. Prosodic structure between the prosodic word and the phonological phrase: Recursive nodes or an independent domain? *The Linguistic Review* 27:485–530.

Vogel, Irene. 2009. The status of the clitic group. In *Phonological domains: Universals and deviations*, ed. Janet Grijzenhout & Barış Kabak, volume 16, 15–46. New York: Mouton de Gruyter.

Vogel, Irene. 2019. Life after the strict layer hypothesis: Prosodic structure geometry. In *Prosodic studies: Challenges and prospects*, ed. Zhang Hongming & Qian Youyoung, 9–60. Oxford: Routledge.

Walker, Rachel. 2004. Vowel feature licensing at a distance: Evidence from Northern Spanish language varieties. In *WCCFL 23Proceedings*, ed. B. Schmeiser, V. Chand, A. Kelleher, & A. Rodriguez, 787–800. Somerville, MA: Cascadilla Press.

Weber, Natalie. 2020. Syntax, prosody, and metrical structure in Blackfoot. Doctoral dissertation, University of British Columbia Vancouver.

Wheeler, Max W. 2007. Syncope and apocope in the history of Catalan: an Optimality Theory approach. English translation of *La síncope i l'apòcope en la història del català: una aproximació des de l'Optimitat*. In: Max W. Wheeler. Morfologia i fonologia catalana i romàànica: estudis diacrònics. Valencia: Universitat de València.

Wiese, Richard. 1986. Schwa and the structure of words in German. *Linguistics* 24:679–724.

Wiese, Richard. 1996. *The phonology of German*. Oxford: Oxford University Press.

Wilson, Colin. 2003. Analyzing unbounded spreading with constraints: marks, targets, and derivations. University of California Los Angeles manuscript.

Worbs, Sören. 2016. Boundary tones. Unversität Leipzig manuscript.

Yip, Moira Jean. 1980. The tonal phonology of Chinese. Doctoral dissertation, Massachusetts Institute of Technology.

Yip, Moira Jean. 2002. *Tone*. Cambridge: Cambridge University Press.

Yu, Alan. 2007. *A natural history of infixation*. Oxford: Oxford University Press.

Yu, Alan CL. 2003. Contour tone induced lengthening in Cantonese. In *Proceedings of the 15th international congress of phonetic sciences*, ed. M.J. Solé, D. Recasens & J. Romero, 2381–2384. Barcelona: Casual Productions.

Yu, Alan CL. 2023. Tonal context influences tone-duration interaction: Evidence from Cantonese. *JASA Express Letters* 3.

Yun, Jiwon. 2009. A Stratal OT approach to a noun-verb asymmetry with respect to opacity in Korean. In *Proceedings of the 32nd Annual Penn Linguistics Colloquium*, volume 15(1).

Zaleska, Joanna. 2020. Coalescence as autosegmental spreading and delinking. *Phonology* 37:697–735.

Zimmermann, Eva. 2009. Metathesis without reordering. Unversität Leipzig manuscript.

Zimmermann, Eva. 2013. Vowel deletion as mora usurpation: the case of Yine. *Phonology* 30:125–163.

Zimmermann, Eva. 2017. *Morphological length and prosodically defective morphemes*, volume 1. Oxford University Press.

Zimmermann, Eva. 2018a. Being exceptional is being weak: Tonal exceptions in San Miguel el Grande Mixtec. In *Proceedings of the 2017 Annual Meeting on Phonology*, ed. Gillian Gallagher, Maria Gouskova, & Sora Yin. Washington, DC: Linguistic Society of America.

Zimmermann, Eva. 2018b. Gradient symbolic representations and the typology of ghost segments. In *Proceedings of the 2018 Annual Meetings on Phonology*, ed. Katherine Hout, Anna Mai, Adam McCollum, Sharon Rose, & Matt Zaslansky. Washington, D.C.: Linguistic Society of America.

Zimmermann, Eva. to appear. Cooperation at the morpho-phonology interface: An argument for phonological locality. In *WCCFL 2023Proceedings*. Somerville, MA: Cascadilla Press.

Zimmermann, Eva, & Jochen Trommer. 2021. Getting stronger or weaker at every stratum: A new approach to tonal morphophonology. *Poster at the Manchester Phonology Meeting on May 26th, 2021* .

Zimmermann, Eva, & Jochen Trommer. 2022. Getting weaker across layers: The tonal phonology of Shona without stratal re-ranking. *Talk at the University of Warsaw, linguistics colloquium, June 17th 2022* .

Selbstständigkeitserklärung und Erklärung über frühere Promotionsversuche

Hiermit versichere ich, dass ich die vorliegende Arbeit ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe; die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht. Ich habe nicht die Hilfe eines Promotionsberaters/einer Promotionsberaterin in Anspruch genommen. Die Arbeit wurde zuvor weder im Inland noch im Ausland in gleicher oder ähnlicher Form einer anderen Institution vorgelegt. Sie ist weder Bestandteil eines ruhenden Verfahrens noch wurde sie in einem gleichartigen Promotionsverfahren als endgültig nicht bestanden erklärt. Die Arbeit ist vorher auch noch nicht veröffentlicht worden. Ich erkläre, dass ich bisher noch keine Promotionsversuche unternommen habe

Leipzig, 27.09.2024

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Daniel Christoph Gleim