The interaction of reduplication and segmental mutation: A phonological account

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Abstract

This dissertation explores the interaction of reduplication and segmental mutation. Previous studies have shown that both mutation and reduplication can be understood as purely phonological operations in response to defective segmental and prosodic material. Cases of over- and underapplication in reduplicated structures, however, pose a serious challenge to phonological accounts and are apparently better handled by non-modular approaches that invoke morpheme-specific constraints or construction-specific cophonologies. The main goal of this dissertation is to show that a phonological account of over- and underapplication of segmental mutation is not only feasible but that seemingly opaque interactions are in fact predicted by mixed representational-serial approaches. Following the broad research program of Generalized Non-Linear Affixation, and assuming a modular feed-forward architecture of grammar, I demonstrate how apparent cases of overapplication (including "backcopying") follow from the interplay of markedness conspiracies, copying of non-minimal prosodic domains, and phonological stratification. Underapplication, on the other hand, emerges from a shortage of mutation triggers, either due to excessive underspecification or as a direct consequence of minimal copying. In addition, I offer reanalyses of purported cases of suppletive allomorphy in reduplication in terms of complex, yet fully transparent segmental phonological alternations. The dissertation thus strengthens the general argument for item-based approaches to non-concatenative morphology and advocates a strictly modular architecture as an alternative to lexical indexation.

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Acknowledgments

This dissertation grew out of a term paper on verb root alternations in Sye which I wrote in my first year of the graduate program IGRA at Leipzig University. A minor detail that nearly slipped my attention at the time of writing was the fact that in reduplicated forms, mutation always applies to one of the two constituents but never to both copies simultaneously in Sye. I did not pay too much attention to this particular piece of data – after all, this is exactly the behavior that one would expect under an autosegmental theory of mutation. However, I was fortunate enough to be surrounded by a wonderful group of phonologists who not only made me aware of the far-reaching implications of the Sye data but who also suggested me to further pursue the interaction of reduplication and segmental mutation cross-linguistically, which finally became the topic of this dissertation.

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List of symbols and abbreviations

Abbreviations

ATB	Across The Board
BRCT	Base-Reduplicant Correspondence Theory
DOT	Derivational Optimality Theory
ESC	Extended Stratal Containment
FR	Full Rebirthing
FSR	Fixed Segmentism Reduplication
IC	Initial Change
MDT	Morphological Doubling Theory
MLM	Morphological Length Manipulation
MR	Minimal Reduplication
OT	Optimality Theory
PDM	Prosodically Defective Morphemes
ROTB	Richness Of The Base
SOT	Stratal Optimality Theory
TETU	The Emergence Of The Unmarked
VRA	Verb Root Alternations
WSP	Weight-to-Stress Principle

Glosses

A	Agent
ACT	Active
ADJZ	Adjectivizer
ADD	Additive
ADV	Adverb
AN	Animate
APASS	Antipassive
AOR	Aorist
APPL	Applicative
ATTEN	Attenuative
AUX	Auxiliary
BAS	Basic
BEN	Benefactive
CAUS	Causative
CL	Noun class
CNTF	Counterfactive
CONT	Continuous
COS	Change of state

DAT	Dative
DEF	Definite
DESID	Desiderative
DO	Direct object
DUR	Durative
ERG	Ergative
EXCL	Exclusive
FUT	Future
FV	Final vowel
IFUT	Immediate future
IMM	Immediate past
IMP	Imperative
INC	Inclusive
INDEF	Indefinite
INF	Infinitive
INTENS	Intensive
IPFV	Imperfective
ITER	Iterative
LOC	Locative
MOD	Modified
NAR	Narrative
NEG	Negative
NSG	Non-singular
O	Object
PFV	Perfective
PFX	Prefix
PL	Plural
PRET	Pretendative
PRIOR	Prior past
PROG	Progressive
PROX	Proximal
PURP	Purposive
PTCP	Participle
PRS	Present
QUAL	Qualitative
QUOT	Quotative
REC	Reciprocal
RECPST	Recent past
RED	Reduplication
REL	Relativizer
SFX	Suffix
SIM	Similitive
SG	Singular
SP	Spatial

SUBJ	Subjunctive
TC	Temporal-causal
TERM	Terminative
TOP	Topic

Symbols

SL	Stem level
WL	Word level
PL	Phrase level
S	Segment
•	Root node
μ	Mora
σ	Syllable
Φ	Foot
ω	Phonological word
φ	Phonological phrase
ρ	Prosodic node
░	Epenthetic
■	Marked phonetically invisible
COR	Coronal
DOR	Dorsal
LAB	Labial
LAR	Laryngeal
MR	Manner
PL	Place
PHAR	Pharyngeal
[±b]	back
[cg]	constricted glottis
[±c]	continuant
[lax]	lax
[±l]	low
[n]	nasal
[±s]	sonorant
[str]	strident
[v]	voiced

Chapter 1

Introduction

Two of the most well-studied and hotly discussed non-concatenative morphological processes are reduplication and mutation. A central debate concerns the division of labor between phonology and morphology, in particular the questions whether copying is phonological or morphological in nature, and whether or not the phonology may compel identity relations between a base and reduplicant. Cases in which one and the same (string of) segment(s) is targeted by reduplication and mutation provide an ideal empirical testing ground for these issues: if it can be shown that the interaction of reduplication and mutation follows from the same basic phonological principles as other processes, the argument for phonological approaches to non-concatenative morphology will be considerably strengthened.

When reduplication copies (a part of) a stem that is also targeted by a mutation process, three types of interactions are conceivable (1). Mutation may apply *locally* to the reduplicated stem and treat it the same as a simple stem, ignoring its internal morphological structure. Alternatively, mutation may *overapply* and affect both the base and the reduplicant even when one of them is in a position that would normally not qualify as a locus of mutation. As a third option, it may be the case that reduplication blocks the application of mutation, resulting in *underapplication*. All three interaction types are empirically attested.

(1) *Interaction space for reduplication × mutation*

a.	LOCAL APPLICATION	Mutation applies locally to base or reduplicant.
b.	OVERAPPLICATION	Mutation applies to both base and reduplicant.
c.	UNDERAPPLICATION	Mutation fails to apply in reduplicated word forms.

In Sye, certain prefixes induce segmental changes in the initial segment(s) of verb roots. When a triggering prefix is combined with a reduplicated verb root, the segmental alternations occur on the adjacent but not the distant root (2). Seereer-Siin marks noun classes by a combination of prefixes and initial consonant mutation. In reduplicated agent nouns, mutation is (optionally) realized on both base and reduplicant despite the fact that only a single noun class prefix is present (3). In Lakota, a final low vowel is sometimes raised to /e/ before certain mutation-triggering suffixes. When a trigger suffix is attached to a reduplicated stem, however, vowel mutation fails to apply and neither the base nor the reduplicant undergo reduplication (4).

(2) *Local application of mutation in Sye* (Crowley 1998)

omol 'fall'	SIMPLE	PRECEDED BY TRIGGER *ɣw-* '3PL:FUT'
SIMPLE	omol	ɣw-amol
REDUP.	omol-omol	ɣw-**amol-omol**

(3) *Overapplication of consonant mutation in Seereer-Siin* (Mc Laughlin 2000)

fec 'dance'	SIMPLE	PRECEDED BY TRIGGER *o-* 'CL.1'
SIMPLE	fec	[1]
REDUP.		o-**peː-pec**

(4) *Underapplication of vowel mutation in Lakota* (Shaw 1980)

apʰa 'strike'	SIMPLE	FOLLOWED BY TRIGGER *-ʃni* 'NEG'
SIMPLE	apʰa	apʰe-ʃni
REDUP.	apʰa-pʰa	**apʰa-pʰa**-ʃni

The standard approach to reduplication within the framework of Optimality Theory (Prince and Smolensky 2004) is Base-Reduplicant Correspondence Theory (BRCT) (McCarthy and Prince 1995), at the heart of which lies the assumption that reduplication is triggered by a RED morpheme which comes with its own family of base-reduplicant faithfulness constraints. A fundamentally different view is taken in the theory of Minimal Reduplication (MR), which analyzes morphemes whose exponent is reduplication as containing defective prosodic nodes that are repaired by copying of phonological material (Saba Kirchner 2010). The choice whether or not copying or some other repair is optimal, as well as the shape of the copied string, are governed by general phonological constraints. MR does not stipulate a constraint that could compel identity between base and reduplicant.

As argued by Saba Kirchner (2010, 2013) and Zimmermann (2017b), a phonological theory of reduplication is superior to hybrid approaches that rely on a RED morpheme in accounting for a range of empirical facts, including reduplicative allomorphy and avoidance of multiple reduplication. However, cases of over- and underapplication in reduplicated forms as in (3) and (4) pose a serious challenge to purley phonological approaches: why should an independent mutation process be blocked in reduplicated forms if there are no special constraints (or cophonologies) overseeing identity relations between base and copied material? And why should a mutation operation that normally applies only once do so multiple times if the phonology is blind to whether a given process simultaneously affects a base and a reduplicant? The goal of this thesis is to seek answers to these questions. I will provide arguments for a phonological account of reduplication by showing that over- and underapplication of mutation are not only compatible with, but in fact a logical consequence of a theory that assumes non-segmental affixation to be the sole trigger of non-concatenative morphology.

[1] In this particular context, reduplication and noun class morphology always occur together. Elsewhere, however, *o-* 'CL.1' and other class prefixes always trigger strictly local mutation.

1.1 Background

An intricate property of reduplication is its dual nature. Reduplication expresses a morphological category and reduplicated forms often seem to have a special status in the grammar that distinguishes them from other morphemes. At the same time, the shape of the reduplicant usually obeys very general phonological principles such as avoidance of marked structures and prosodic templates, which suggests that reduplicative morphemes are also partially phonological in nature. These observations have translated into hybrid approaches in which the copied material is diacritically marked as special or copying is entirely carried out by the morphology; the phonology is then merely concerned with refinement of surface form. Early autosegmental approaches (Marantz 1982, McCarthy and Broselow 1983) treat reduplication as the result of affixation of defective C- and V-slots, but this process is always coupled with a morpheme-specific rule of melody copying (see Zimmermann 2017a for discussion). Mester (1986) abandons melody copying, but his model crucially relies on the stipulation that skeletal units in a reduplicative morpheme occupy different tiers than the same units in non-reduplicative morphemes. The rule-based approach in Frampton (2009) confines the role of morphology to delineating a domain for copying and leaves all other aspects of reduplication to be handled by the phonology. However, the copy mechanism is implemented via special rules that are not motivated by any other grammatical process. Taking an even more radical position, the representational approach in Raimy (2000a) assumes that there is no copy operation in the first place; instead, certain phonological base material is simply spelled out more than once in reduplicated forms (see also Harrison and Raimy 2004, Samuels 2010, Idsardi and Raimy 2013). To represent multiple spell-out, however, Raimy's theory makes use of special symbols (such as the back arrow) and assumptions about linearization whose justifications outside of reduplication are at least questionable.

The opposite viewpoint to Frampton's and Raimy's models is advocated by proponents of Morphological Doubling Theory (MDT) (Inkelas and Zoll 2005, Inkelas 2008, 2014, Peterson and Maas 2009). An inherently sign-based approach, MDT assumes that copies are instantiated by the morphology proper and do not involve phonological replication. Reduplication is considered a special construction containing two instances of the same morpheme. The two daughters and the reduplicative construction as a whole have independent cophonologies, which empowers MDT to straightforwardly capture general as well as exceptional (construction-specific) processes. More importantly, since MDT states that copies are morphological in nature, MDT predicts that a reduplicative construction may contain phonologically radically different suppletive allomorphs of the same morpheme.

Base-Reduplicant Correspondence Theory (BRCT) (McCarthy and Prince 2001, 1994, 1995, 1999, Mc Laughlin 2000, Downing 2003, Urbanczyk 2006, Zimmermann and Trommer 2011) is a theory of reduplication within Optimality Theory (OT; Prince and Smolensky 2004). BRCT postulates a special RED morpheme which comes with a morpheme-specific constraint family overseeing faithfulness relations between base and reduplicant (see also Wilbur 1973a). Copying is a phonological operation driven by faithfulness constraints between the input and RED. The BRCT architecture was informed by three empirical observations: shape invariance, identity, and the emergence of the unmarked (TETU) (Kager 2004). *Shape invariance* refers to the tendency of reduplicants to be of equal size regardless of the shape of the base. Shape invariance can be enforced by RED-specific template constraints such as RED = σ_μ (McCarthy and Prince 2001). Alternatively, RED can be specified as a root or an affix, making it subject to general size restrictions that apply to the respective morphological categories (Urbanczyk 2006). *Identity* effects between base and reduplicant are captured by the BR-FAITH family, a specifically tailored set of faithfulness constraints. *TETU* is derived by an inherent asymmetry in the set of faithfulness constraints: since the reduplicant does not have a correspondent in the inupt, it is not protected by IO-FAITH and thus more vulnerable to markedness-driven modifications. BRCT predicts the reduplicant will always strive to be as unmarked as possible as long as it obeys the relevant size and faithfulness constraints.

A peculiar prediction of BRCT that has attracted much attention in the past two decades are *backcopying* effects, i.e. cases in which the form of a reduplicant influences the form of its base. Two types of backcopying need to be distinguished. *Phonological backcopying* denotes a transfer of a phonologically conditioned alternation from the reduplicant to a base where its application is opaque. The other type of backcopying, termed *morphological backcopying* by Hyman et al. (2009) and Zimmermann and Trommer (2011), involves the transfer of a morphologically triggered alternation from a reduplicant to a base. Numerous cases of morphological backcopying have been reported, including the case of Seereer-Siin agent nouns presented in (3).[2] BRCT offers a straightforward way to account for such cases: backcopying is optimal when BR-FAITH and the constraint responsible for mutation outrank IO-FAITH. This is illustrated in (5), where [F] stands for some feature triggering mutation.

(5) *Morphological backcopying in BRCT*

		$_{[F]}$ + RED + CV	BR-FAITH	MAX-FLOAT	IO-FAITH
	a.	CVCV		*!	
	b.	$C_{[F]}VCV$	*!		
☞	c.	$C_{[F]}VC_{[F]}V$			*

BRCT also predicts phonological backcopying, for which a toy example is presented in (6). As opposed to morphological backcopying, this particular prediction is far from uncontroversial, and none of the few reported cases of phonological backcopying are very convincing. The famous case of nasal spreading in Johore Malay, reported by Kenstowicz (1981) and presented as a paradigm example of backcopying by McCarthy and Prince (1995), Raimy (2000b), and Kager (2004), has been argued to be based on erroneous data (Kiparsky 2010). Another potential candidate for phonological backcopying is consonant dissimilation in Chaha (Kenstowicz and Banksira 1999), which Inkelas and Zoll (2005) convincingly argue is better conceived of as emerging from the interplay of independent processes. A range of other purported instances of backcopying such as overapplication of laxing in Javanese (Kager 2004) and underapplication of palatalization in Akan (Raimy 2000b) can eas-

[2]Not all reported cases of morphological backcopying are equally convincing. For example, Zimmermann and Trommer (2011) mention the case of Siroi (Papuan), based on data from Wells (1979). In Siroi adjectival plural formation, a fixed segment /g/ is infixed in both base and reduplicant: *maye* > *mage-mage* 'good'. The overapplication pattern in Siroi does not make a waterproof case of backcopying because it is not obvious which of the two identical copies is the base and which is the reduplicant, i.e. whether the fixed segment is copied from the base to the reduplicant or the other way round. It is also not clear what rules out an analysis that assumes the plural morpheme contains two identical segments with different anchor points.

ily be reanalyzed as the result of counterbleeding and counterfeeding opcacity if one adopts a derivational theory of grammar.

(6) *Backcopying of internal alternation* (adopted from Inkelas and Zoll 2005: 174)

a. Closed syllable laxing:
/kem-ta/ → [kɛm.ta]

b. Laxing overapplies to open syllable in base:
/RED-kema/ → kem.ke.ma → kɛm.ke.ma $\xrightarrow{\text{BACKCOPYING}}$ [kɛm.kɛ.ma]

The prediction of phonological backcopying is not the only weakness of BRCT. Maybe the most severe shortcoming of BRCT is its inadequacy in dealing with cases of reduplicative allomorphy. BRCT predicts that a RED morpheme will always manifest itself as copying base material but never as some other concatenative or non-concatenative process such as epenthesis or lengthening. Cases of phonologically predictable reduplicative allomorphy are, however, well attested. Consider the data from Kwak'wala in (7), which are extensively discussed in Saba Kirchner (2010).

(7) *Stem allomorphy in Kwak'wala*

LENGTHENING				
c'əx	'singe'	c'aːx-m'uːt	'hair singed off'	176
təp	'break'	taːp-m'uːt	'broken pieces'	180
REDUPLICATION				
kən	'scoop up'	kən-kə-muːt	'l.a. scooping up'	177
tiːɬ	'bait'	tiː-təɬ-m'uːt	'remains of bait'	180

The suffix *-m'uːt* triggers either lengthening or reduplication on a preceding stem. The contexts for these two (mutually exclusive) processes are in complementary distribution: when a stem ends in a /ə/ followed by one or two non-glottalized obstruents, *-m'uːt* is accompanied by lengthening; in all other cases, reduplication occurs. This pattern is summarized in (8).[3]

(8) *Stem allomorphy before -m'ut*

STEM SHAPE	LENGTHENING	REDUPLICATION
-əT(T)	✓	✘
elsewhere	✘	✓

Kirchner argues that the Kwak'wala data follow naturally from his theory of *Minimal Reduplication*, which treats reduplication as a phonological copy process to repair defective (non-integrated) prosodic material, given that empty prosodic nodes are highly marked structures. Depending on the ranking of the respective faithfulness constraints (INT, DEP, ...), a language may choose copying, epenthesis, or other strategies to accomodate a floating prosodic node. Kirchner analyzes the suffix *-m'uːt* in Kwak'wala as containing a non-integrated μ

[3]There are a number of orthogonal processes (including allomorphy in affixes, phonotactically driven repairs, and lowering of lenghtened vowels) and idiosyncratic exceptions in Kwak'wala, none of which devalidate Saba Kirchner's main argument, however.

that can be realized by lengthening or reduplication. The former is the default strategy, but whenever lengthening would create a super-heavy syllable (a structure that is categorically banned in Kwak'wala), copying is chosen as the next-best repair.

The Upriver dialect of Halkomelem (Central Salishan) exhibits an even more dramatic instance of phonologically conditioned reduplicative allomorphy (Zimmermann 2013a, 2017a). The continuative forms of verbs has four different types of stem allomorphs: stress shift ((9)-a), reduplication ((9)-b), vowel lengthening ((9)-c), and prefixation of *hV*- ((9)-d).

(9) *Verbal aspect in Upriver Halkomelem* (Zimmermann 2017a: 214f, citing Galloway 1993)

	NON-CONTINUATIVE		CONTINUATIVE	
a.	ts'ɛtɛ́ːm	'crawl'	ts'ɛ́təm	'crawling'
b.	q'ísət	'tie sth.'	q'íq'əsət	'tying sth.'
c.	ʔíməç	'walk'	ʔíːməç	'walking'
d.	mə́qət	'swallow'	hə́mqət	'swallowing'

As in Kwak'wala, stem allomorphy in Upriver Halkomelem is entirley predictable from the phonological shape of the non-continuative stem (10). Stress shift applies to all verbs with main stress on a non-initial syllable in the non-continuative form. The other three strategies apply to stems with initial stress. If the vowel in the first stressed syllable is /ə/, an (epenthetic) *hV*- is prefixed. In all other cases, the first σ is reduplicated unless the stem-initial syllable starts in a laryngeal consonant, in which case the V1 is lengthened and reduplication does not take place.

(10) *Predictable allomorphy in the continuative*

	ALLOMORPH	BASE FORM
a.	stress shift	V1 is unstressed
b.	*hV*-insertion	V1 = ə́
c.	lengthening	[{h, ʔ}V́
d.	reduplication	[CV́

Zimmermann shows that allomorphy in the continuative follows from affixation of a defective Φ. Stress shift is caused by full integration of the Φ into the prosodic structure of the stem and overwriting of all underlying prosodic structure. When overwriting is not possible because the underlying structure is proteced by higher ranked faithfulness constraints, one of the other three repairs apply, depending on which strategy gives the least marked result.

A welcome side effect of MR is that it does not predict phonological backcopying due to its lack of a RED morpheme and BR-FAITH constraints. Furthermore, as argued in Zimmermann (2017b), another advantage of MR is that it can offer an account of avoidance and superset effects in multiple reduplication.

1.2 My proposal

So far, I have argued that Minimal Reduplication is superior to BRCT because of its better empirical coverage: MR is powerful enough to derive reduplicative allomorphy but does not overgenerate phonological backcopying. There remains, however, one obvious gap: an account of over- and underapplication of morphologically induced alternations which uses the basic mechanism of repair-driven copying still constitutes a major desideratum. In this thesis, I will offer a solution to this problem. I will show how over- and underapplication of segmental mutation can be handled by a phonological theory of reduplication which is compatible with Kirchner's basic insight that copying is triggered by defective prosodic material and not the result of a RED morpheme. The table in (11) gives an overview of the main theoretical ingredients of my proposal.

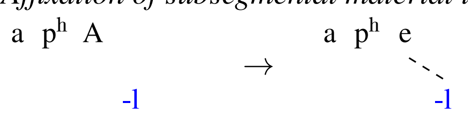
(11) *Core assumptions*

a.	*Copying*	Copying is a phonological operation available to the grammar for satisfying markedness constraints against defective nodes.
a.	*Modularity*	There is a strict division between phonology, morphology, and other modules of the grammar. There are no constraints in the phonological component indexed to specific morphemes.
c.	*Concatenation*	Both mutation and reduplication are the result of non-segmental affixation, and this informs the way these two processes interact with each other.

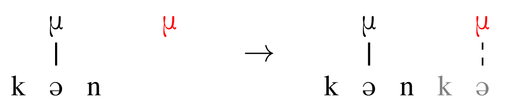
My main claim is that misapplication, as well as alleged cases of reduplication-specific cophonologies, receive a phonological explanation by appealing to the same grammatical building blocks that are independently motivated by other processes in the grammar.

Reduplication and mutation as GNLA In this thesis, I follow the research program of *Generalized Non-linear Affixation* (GNLA) (Bermúdez-Otero 2012). GNLA states that all non-concatenative morphology, including mutation and reduplication, traces back to non-segmental affixation. Previous research has accumulated an impressive body of evidence that the hypothesis of GNLA indeed holds for isolated morphonological phenomena; for reduplication see Saba Kirchner (2010) and Bye and Svenonius (2012); for morphological manipulation of length see Zimmermann (2017a); for morphologically triggered segmental alternations see Akinlabi (1996), Wolf (2007), Trommer (2011), and Kimper (2011). Accounts of vowel mutation and reduplication in terms of GNLA are illustrated in (12) and (13), using the Lakota data in (4) and the Kwak'wala data in (7).

(12) *Affixation of subsegmental material triggers segmental mutation*



(13) *Affixation of a empty prosodic node induces reduplication*



What is missing so far is a thorough investigation of whether GNLA is able to correctly derive the various types of interaction between reduplication and other non-concatenative processes. In what follows, I will sketch my solutions for the three main challenges that a

GNLA account faces: overapplication, underapplication, and divergent allomorphy. Each of the proposed analyses will be presented in greater detail in the case studies in chapters 3 – 5.

Overapplication I propose that there are (at least) three phonological explanations for mutation overapplication that do not rely on diacritic identity relations. The first explanation is deeply entrenched in the assumption of the derivational architecture of grammar. Any cyclic theory of grammar straightforwardly predicts that whenever a string of segments is affected by some process at an earlier level than reduplication, what will be copied is the outcome of that process, rendering the resulting output form non-surface-apparent.

An example of derivationally conditioned overapplication is discussed in Kiparsky (2010). Consider the data in (14). Sanskrit has a phonological process by which /s/ is changed into /ʂ/ after /r/, non-low vowels, and velars, an environment commonly referred to as *ruki*.

(14)
a. vaːc-su → vaːk-ʂu 'in words' (Morgenroth 1999: 61)
b. pur-su → puːr-ʂu 'in cities' (Morgenroth 1999: 61)
c. havis-aː → haviʂ-aː 'by the offerings' (Morgenroth 1999: 61)
d. RED-sic → si-ʂec 'to pour' (K ex. (8))

The crucial set of data is given in (15). The initial sibilant in *saɲɟ* undergoes regular retroflexation when it is preceded by the prefix *pari-*. When a prefixed form with a derived retroflex is reduplicated, the retroflex appears in the base and the copy, no matter whether or not the initial base C is still in a *ruki* environment. The reason why retroflexation overapplies in the opaque form *pariʂa-ʂa-ɲɟ* in (15-b) is that retroflexation has applied before reduplication.

(15)

	CYCLE 1	CYCLE 2	CYCLE 3		
a.	saɲɟ	saɲɟ	sa-saɲɟ	'to stick to'	(K ex. (8))
b.	saɲɟ	pari-ʂaɲɟ	pari-ʂa-ʂaɲɟ	'to be attached to'	(K ex. (8))

Kiparsky notes that a major advantage of such a derivational approach is that it avoids unattested backcopying in forms such as *si-ʂec* (14-d). Parallel BRCT makes the problematic prediction that if BR-FAITHFULNESS is ranked high enough, the consonantal change in *si-ʂec* is backcopied from the base to the reduplicant, yielding **ʂi-ʂec*. Under a derivational approach, this is impossible because the context for applying retroflexation only arises *after* reduplication has taken place. More cases of overapplication that lend itself to an account in terms of precedence relations are discussed in Mester (1986) and Raimy (2000a).

Not all cases of overapplication can be deduced to ordering effects, however. Another grammatical constellation that may give rise to overapplication is the absence of blocking. Blocking effects arise when a process that increases the harmony score of some markedness constraints cannot apply because it also incurs a violation of a higher-ranked faithfulness constraint. Reduplication may create a phonological context in which such a faithfulness restriction is circumvented, either because the relevant constraint only protects underlying material or because copying creates a unique combination of segments that is not proteced but happens not to occur outside of reduplication.

A third possible reason for overapplication is sensitivity to prosodic domains. A crucial prediction of the hypothesis that copying is a phonological repair operation is that there are in principle no size restrictions on copied material because the size of the copied portion is determined by the defective node, which may be anything from a μ to a phrase node. When a copy happens to include a domain which is part of the context definition of some other process (e.g. the edge of a prosodic word), overapplication follows from regular application of that process in all appropriate domains.

Note that the default pattern in parallel evaluations is local application. The reason for this is that the copy mechanism can only select material from the input for copying and does thus not automatically replicate changes induced on base material in a given candidate (see discussion in section 2.2). Chapter 3 presents one case study for each of the two non-cyclic causes of overapplication, i.e. general markedness and domain sensitivity. Chapter 4 discusses sequential ordering as the reason for overapplication of palatalization in Lakota. All three sources of overapplication rule out phonological backcopying.

Underapplication Cases of mutation underapplication in reduplicated forms do not follow from a derivational architecture alone. When a mutation process applies before reduplication, the result is overapplication, while the expected outcome of ordering mutation after reduplication is regular application. Parallel evaluation of the two processes in non-recursive domains may lead to simple or multiple application depending on the details of the copy mechanism, but never to underapplication. The theory of BMR adopted here explicitly predicts local mutation in such cases.

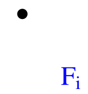
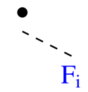
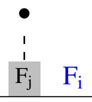
There are (at least) two more types of underapplication which both arise from scenarios in which reduplication creates a shortage of mutation triggers. The first type is a situation that I term the *Too Many Targets Problem* (TMTP) as defined in (16). In section 4.1, I argue that TMTP is responsible for underapplication of vowel mutation in Lakota.

(16) *The Too Many Targets Problem*
Let F be a feature that triggers a segmental alternation A and let T be a potential target for A. When there is an equal number of T's and F's, application of A is optimal. When there are more T's than F's, not applying A is optimal.

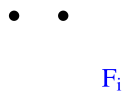
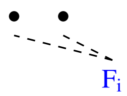
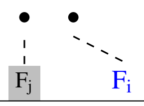
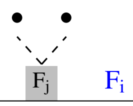
TMTP effects arise from conflicting demands on the association of certain nodes in the phonology. A situation which can be characterized in terms of TMTP is sketched in the tableaux in (17) and (18). Mutation (here: linking of the floating feature F_i to a $\bullet$) is triggered by the two synergetic constraints $\bullet\!\rightarrow$F and F$\rightarrow\!\bullet$. The latter constraint is ranked rather low, allowing non-integration of a floating F to become a potential winner. (17) illustrates normal application of mutation in a context where there is exactly one defective feature and one underspecified root node. Non-application of mutation in a. fatally violates $\bullet\!\rightarrow$F. Insertion of some other feature F_j to satisfy that constraint in c. fatally violates DEP(F), yielding normal application of mutation in b. as the optimal candidate. The candidates in (18), on the other hand, demonstrate how non-integration of a floating feature becomes optimal when there are more targets than there are triggers. Multiple linking of F is ruled out due to $*F_i^{2\bullet}$, but single linking of F_i and insertion of an epenthetic feature is worse than insertion of some other epenthetic feature that also satisfies $\bullet\rightarrow$F. The crucial subrankings are $\{\bullet\!\rightarrow$F, $*F_i^{2\bullet}\}$ $\gg$ DEP(F) $\gg$ $\text{DEP}_{\substack{\bullet \\ | \\ F}}$ $\gg$ F$\rightarrow\!\bullet$. Under the given grammar, it is impossible to satisfy both

•→F and F→• when there are two potential targets (root nodes) but only a single tirgger. Since F→• latter is ranked low, non-integration of the floating F_i is optimal when the constraint against line insertion, which is not violated by linking epenthetic nodes, is ranked high enough.

(17) *TMTP 1: Normal application with a single target*

Input = a.	• ↓ F	$*F_i{}^2•$	DEP F	DEP •¦F	• ↑ F
a. 	*!				*
☞ b. 				*	
c. 			*!		*

(18) *TMTP 2: Underapplication with two targets*

Input = a.	• ↓ F	$*F_i{}^2•$	DEP F	DEP •¦F	• ↑ F
a. 	*!*				*
b. 		*!		**	
c. 			*	*!	
☞ d. 			*		*

The second potential source of underapplication also follows directly from the two key assumptions of GNLA, viz. that segmental mutation is triggered by floating features and that reduplication is phonological copying driven by the need to repair empty prosodic nodes. These two assumptions together make a predition that has gone largely unnoticed in the literature and that I term the *Lossy Copying Hypothesis*:

(19) *The Lossy Copying Hypothesis*
Let D be a domain (stem, word, ...) containing unassociated subsegmental material S = {F_1, ...}. If parts of D are copied to satisfy a constraint demanding some node N_1 to be associated to a node N_2, the copy will never contain any elements from S and segmental alternations caused by the presence of S in D will not be induced by the copied material.

The idea behind the *Lossy Copying Hypothesis* is that if copying is minimal, material that does not directly serve the goal to repair a marked prosodic node, i.e. floating features and subsegments, is never copied. The lack of these structures in the copied string then mute the copy with respect to whatever morphonological alternation the base is a trigger of. In section 4.2, I discuss the case of Kulina, where the prediction of the *Lossy Copying Hypothesis* is precisely borne out.

Suppletive allomorphy Apparent cases of suppletive allomorphic relations between base and redupicant present one of the strongest arguments against copying in phonology. Consider the toy example in (20), where the allomorph *-pek* appears following the 1PL marker *su-* and the allomorph *-rimola* is used elsewhere. When the form *supek* in this hypothetical language is reduplicated, the copy contains the other stem allomorph, *-rimola*, meaning that what is copied must be a morphological entity and cannot be a phonological string.

(20) *Divergent allomorphy in reduplication*

{-rimola, -pek}	me-rimola	su-pek	su-pek-rimola
'to see'	'I see'	'we see'	'we see many times'

Patterns like the one in (20) would follow intuitively from constructionalist frameworks such as MDT. If reduplication is nothing more than a construction with two morphologically identical daughters, divergent allomorphy can be accounted for by simply specifying different stem types for each daughter, as shown in (21). The argument for the adequacy of reduplicative constructions as formal objects made in Inkelas and Zoll (2005) crucially hinges on the empirical reality of suppletive stem selection in reduplication.

(21) *Suppletive allomorphy as a morphological doubling construction*

[Semantics = '*x*' + '*y*']

[Semantics = '*x*' Stem type = I] [Semantics = '*x*' Stem type = II]

In the hypothetical data in (20), the two stem forms have strikingly different segmental and prosodic make-up. In many of the case studies discussed by Inkelas and Zoll (2005), however, the allegedly suppletive allomorphs are only minimally distinct, which suggests that they are in fact better analyzed as non-suppletive. Chapter 5 will look at putative cases of suppletive allomorphy and propose reanalyses in terms of phonologically predictable segmental alternations, reconciling them with the hypothesis of phonological copying.

1.3 Outline

The remainder of this thesis is structured as follows. Chapter 2 introduces the critical theoretical ingredients for my account of mutation in reduplication. Following a definition of crucial terms in section 2.1, section 2.2 presents the basic assumptions of Extended Stratal Containment and the mechanics of Bidirectional Minimal Reduplication. Chapters 3 – 5 contain detailed case studies of reduplication of five typologically diverse and unrelated languages. Section 3.1 presents the case of Seereer-Siin, one of the purported cases of morphological backcoyping. I show that there is no need for a grammatical building block tailored to derive backcopying as advertised in Mc Laughlin (2000); rather, overapplication in Seereer-Siin follows from a simple markedness requirement on the shape of obstruents. Section 3.2 discusses the case of overapplication in Fox, where word-initial raising overapplies in the reduplicant because the reduplicant constitutes its own ω domain. A considerable amount of that section is devoted to showing that this approach is consistent with the way reduplication and raising interact with other (morpho)phonological processes in the language.

Section 4.1 presents an analysis of mutation underapplication in Lakota. I argue, contra Saba Kirchner (2009), for a stratal account that captures most of the intricate patterns in the language. I also argue against the view that underapplication is a base-reduplicant identity effect; instead, I propose an analysis in terms of TMTP, i.e. a situation in which a floating feature has too many potential targets and remaining unassociating becomes optimal. The case of Kulina in section 4.2 lends additional support to the hypothesis that reduplication is a repair-driven process in the phonology: a copied trigger morpheme does not induce mutation on its own base because floating features are not copied alongside segmental material.

Section 5.1 discusses the putative case of verb root alternations in Sye, where the copy of a verb root contains a putatively suppletive allomorph. Suppletive allomorphy is one of the empirical pillars of Morphological Doubling Theory (Inkelas and Zoll 2005). I defuse this argument by showing that mutation in Sye follows from affixation of non-segmental material. A number of analogous cases are reanalyzed in section 5.2. Chapter 6 offers further discussion and points at potential theoretical and empirical extensions. Chapter 7 concludes this thesis.

(22) *Outline: Case studies*

Chapter 3	OVERAPPLICATION	
Section 3.1	Seereer	Markedness-driven effect
Section 3.2	Fox	Iterative application in every ω domain
Chapter 4	UNDERAPPLICATION	
Section 4.1	Lakota	TMTP: featural epenthesis is optimal
Section 4.2	Kulina	Lossy Copying: no copying of triggers
Chapter 5	SUPPLETION	
Section 5.1	Sye	No suppletion but phonologically regular alternation

The table in (22) gives an overview of the individual case studies discussed in this thesis and how they relate to the three main interaction types identified above; in addition, it sketches the phonological solutions I offer for each of them.

Chapter 2

Theoretical Background

2.1 Working definitions

2.1.1 Reduplication

At a descriptive level, *reduplication* refers to a process by which a string of segments is repeated to express a morphological category. While the basic pattern of reduplication is quite straightforward and can be schematized as in (23), the concrete reduplicative patterns in individual languages and their complex interaction with other grammatical processes often challenge well-established concepts in formal theories of grammar.

(23) *Reduplication as repetition of form*

FORM	F	$\longleftrightarrow$	$F + F'$,	F' is partially or totally identical to F
	$\updownarrow$		$\updownarrow$	
MEANING	‘x’	$\longleftrightarrow$	‘x + y’	

The examples in (24) – (28) show several types of reduplication that match the definition above. In Hinuq emphatic reduplication (24), a string of segments from the initial onset consonant to the vowel in the second base syllable is copied and the copy is prefixed to the base. In Bikol plural formation (25), a -VC- infix with an invariable consonant /r/[4] is inserted to the left of the first stem vowel and the infix vowel copies the pivotal stem vowel. The productivity of this process is evidenced by its extension to loanwords ((25)-ad). In Karuk iterative reduplication (26), the final syllable of a verb stem is reduplicated and an epenthetic vowel is inserted when reduplication creates an illicit consonant cluster ((26)-d). In the case of Hinuq, Bikol, and Karuk, the reduplicant is smaller than the base, making them instances of *partial* reduplication. *Full* or *total* reduplication, on the other hand, creates a copy of all base segments. Examples of full reduplication are given in (27) and (28).

[4] The rhotic may undergo metathesis with a stem-initial /l/, as in *r<al>ayog* < *layog* ‘fly’ (Mattes 2014: 60).

(24) *Initial CVCV-reduplication in Hinuq (North-East Caucasian)*

	BASE	REDUPLICATED	
a.	bat'iyaw	bat'i-bat'iyaw	'different, various'
b.	c'ik'araw	c'ik'a-c'ik'araw	'old, big'
c.	dahaw	daha-dahaw	'few, little'
d.	xiriyaw	xiri-xiriyaw	'dear, expensive'

(Forker 2013: 47)

(25) *Internal <Vr>-reduplication in Bikol (Austronesian)*

	BASE	REDUPLICATED	
a.	atender	ar-atender	'attend'
b.	tubo	t<ur>ubo	'grow'
c.	dipan	d<ir>ipan	'gather'
d.	trabaho	tr<ar>abaho	'work'

(Mattes 2014: 59–61)

(26) *Final syllable reduplication in Karuk (Hokan)*

	BASE	REDUPLICATED	
a.	mit	mit-mit	'pop'
a.	vupak	vupak-pak	'cut'
c.	fumpuh	fumpuh-puh	'blow'
d.	taxviʃ	taxviʃ-i-xviʃ	'scrape'

(Macaulay 1993: 64)

The iterative aspect in Nuuchahnulth involves reduplication of the full verbal root and the suffix *-ʃ* (27). The reduplicated root then serves as a base for further derivational and inflectional affixes. Reduplication of complex stems is observed in Mapuzungun, where a reduplicated verbal stem in combination with the suffix *-ye* denotes event repetition over an extensive period of time (28-a). A reduplicated nominal or adjectival stem including a number suffix is used in constructions meaning "different (kinds of)" (28-b).

(27) *Full root reduplication in Nuuchahnulth (Wakashan)*

a. *tʃ'it-tʃ'it-ʃ*
RED-sidewiwse-ITER
'it dodged from side to side'

b. *n'itɬχʷ-n'itɬχʷ-ʃ-ʃitɬ=ʔatɬ-we·ʔin*
RED-boil-ITER-MOM=NOW-3.QUOT
'bubbles began to come up out of the water' (Stonham 2007: 119)

(28) *Complex stem reduplication in Mapuzungun (isolate)*

a. *[ap-üm]-[ap-üm]-ye-n*
[RED]-[end-CAUS]-carry-NFIN
'finish up (tr.) bit by bit' (Zúñiga and Díaz-Fernández 2014: 27)

b. *[ka-ke]-[ka-ke] wingka kontupa-e-n-ew*
[RED]-[other-NSG] white.person come.to.see-INV-1SG.PAT-3.A
'Different (kinds of) white people come to see me.' (Zúñiga and Díaz-Fernández 2014: 21)

Not all cases of repetition, however, are regarded as reduplication in this thesis. Replicative processes are ubiquitous in (non-linguistic) natural systems such as biology and chemistry, but they also play a key role in mathematics, engineering, and sociology (Hein et al. 2016). It is therefore not surprising to find replicative processes in various guises in natural language, too, be it as spreading of features, copying of syntactic constituents, or accomodation in discourse. In the spirit of Hurch (2005a) and Frampton (2009), I conceive of reduplication as copying of segmental material to express a morphological category. The data in (29) – (32) below show examples of repetition of linguistic elements of different sizes that do *not* fall within the scope of the present work because they do not qualify as morphologically meaningful reduplication.

(29) *Echo epenthesis in Selayarese (Austronesian)*

a.	/lamber/	lamber**e**	'long'
b.	/luar/	luar**a**	'wide'
c.	/hallas/	hallas**a**	'suffer'
d.	/botor/	botor**o**	'gamble'

(Mithun and Basri 1986: 238)

(30) *[ATR] harmony in Päri (Nilotic; tones omitted)*

		2SG.POSS	3SG.POSS	2SG	
a.	/wɪɲɟ/	wɪɲɟ-ɪ	wɪɲɟ-ɛ		'bird'
b.	/riŋg/	riŋg-i	riŋg-e		'meat'
c.	/dɔːk/			ɪ-dɔːk	'return'
d.	/poːdo/			i-poːdo	'beat:APASS'

(Andersen 1989: 10f)

Selayarese has a ban on word-final /l/, /r/, and /s/ that invokes insertion of a vowel of the same quality as the one in the root-final syllable (29). This vowel is not the exponent of a morphological feature but a mere phonotactic filling (see also Kawahara 2007). In Päri, possessive and agreement affixes harmonize for [ATR] with the root vowel (30), which sometimes results in the occurrence of identical vowels in the root and the affix (*wɪɲɟ-ɪ*, *riŋg-i*). It is self-evident that in such cases, no copying of segments has taken place; rather, the [ATR] feature spreads outwards from the root to the suffix independently of the height and frontness specifications in the root and the affix vowels.

Another line that needs to be drawn is one between morphological reduplication and replication in syntax. Copying of syntactic constituents is found in a wide array of contexts in many languages. This includes verb doubling with and without fronting ((31-a), (32)), wh-copying (31-b), and DP-internal determiner doubling (31-c).[5] Note that in the verb doubling examples in (31-a) and (32), the two verbs have a different morphological make-up, suggesting that the mechanism at work here is indeed not simple repetition of phonological material.[6] Gil (2005) discusses further criteria for identifying syntactic copying, i.a. the possible lack of contiguity of copies and the size of the copied portion (typically greater than one word).

[5] Alexiadou (2010) observes that determiner doubling in Germanic and adjectival reduplication in Chinese share a number of interesting syntactic and semantic properties.

[6] Anderson and Harrison (2008) explicitly quote this example as a case of reduplication, however.

Nevertheless, copying of phrase-sized constituents is not necessarily always purely syntactic. Fully inflected adjectives in Sardinian can be reduplicated to express intensification (Stolz et al. 2011). Echo formation with fixed segments in Dravidian involves copying of large prosodic constituent corresponding to the vP (see the examples in (121) – (123) and discussion below). Moving away even further from morphology, repetition at the level of discourse may occur spontaneously without being the exponent of a grammatical feature (Inkelas and Zoll 2005, Hyman 2009). Often, discourse-level repetition is also used as a device for establishing textual cohesion and for an array of other interactional tasks (Watt 1968, du Bois 2014, Guzmán Naranjo and Paschen 2016). Obviously, such repetitions do not fall under the definition of reduplication, either.

(31) *Syntactic replication* (Hein et al. 2016: xii)

a. *Lirkod, Gil lo yirkod baxayim.*
to.dance Gil not will.dance in.the.life
'As for dancing, Gil will never dance.' (Hebrew)

b. *Kas misline kas o Demìri dikhlâ?*
who you.think who the Demiri saw
'Who do you think Demiri saw?' (Romani)

c. *ä ganz ä liebi Frau*
a really a lovely woman
'a really lovely woman' (Swiss German)

(32) *Verb doubling in causal subordination in Sora (Austroasiatic)*

kun asən kun sənna-dʊd-ən-ji raʔan-adɔʔɔŋ gɨj-an gɨj-le
DEF for DEF small-frog-N.SFX-PL elephant:N.SFX-OBJ see-N.SFX see-PST
bətɔŋ-le iersed-lɛ-ji
be.frightened-PST run.away-PST-PL
'Because of seeing the elephant, the small frogs were frightened and ran away.'

(Anderson and Harrison 2008: 346)

In this study, I also set aside the question of *pseudoreduplication*, i.e. cases that involve apparent repetition of some "base" that never occurs on its own. Due to the lack of a meaningful base and their low productivity, the reduplicative status of expressive pseudoreduplicated onomatopoeias and ideophones such as English *sh-sh-sh*, Hindi *gəɽ-gəɽ* 'thundering sounds' or Mizo *olɛp-olɛp* 'sticky' is dubious, although they are sometimes subsumed under the term reduplication as well (Abbi 1992: 17).[7] On the other hand, Zimmermann (2017c) notes that pseudoreduplicated stems in Nuuchahnulth and Manam behave as if they were transparently derived from a simple lexical base for certain grammatical processes. Zimmermann argues for a representational account by which pseudoreduplicants are present underlyingly but have

[7] Abbi (1992) defines reduplication as a word formation process and distinguishes between "morphological" and "lexical" reduplication. The former refers to the highly lexicalized class of pseudoreduplicated expressives, all of which contain a repetition of one or more syllables but are not morphologically analyzable and cannot be used in isolation. The latter refers to reduplication that expresses an inflectional or derivational category. This includes echo formation as in Tamil *puli-gili* 'tiger and the like' < *puli* 'tiger' (cf. section 2.2.3.4) and several types of "word reduplication" used for a wide range of functions such as adjectivization in Kharia (*goej'-goej'* 'dead' < *goej'* 'to die', ibid, 119), attenuation in Paite (*əthuk-əthuk* 'sourish', ibid, 71), and gerundive formation in Kurukh (*em-em* 'having taken a bath', ibid, 107).

a different color than their "bases", allowing the phonology to treat them as though they had a different morphological provenience from the remaining root material.

Conceiving of reduplication as copying of phonological material raises the question of how to treat morphologically meaningful segmental lengthening and gemination. At a terminological level, I am drawing a strict line between reduplication and length-manipulating morphology, contra Rubino (2013). At a formal level, the two processes have in common that they are both triggered by defective prosodic nodes. The crucial difference is that a change in phonological length results from a mere manipulation of association lines while reduplication involves the creation of a copy of phonological material. The formal proximity of the two processes is informed by the empirical argument of reduplicative allomorphy and is one of the cornerstones of purely phonological approaches to reduplication within Optimality Theory that refute the notion of a RED morpheme. This argument will be discussed in more detail in section 2.2.

2.1.2 Mutation

Mutation is another well-known non-concatenative process by which a morphological feature is not (exclusively) expressed by segmental affixation but by a modification of phonological material. I adopt the broad definition of mutation morphology in Wolf (2007) and Trommer (2011) and treat any morphologically triggered phonological alternation as an instance of mutation morphology.

The examples in (33) show the broad major classes of mutation morphology. Initial consonant hardening in Nivkh (a.) applies in certain morphosyntactic contexts when the preceding word ends in a fricative or a nasal. Gradation in Pite Saami (b.) lenites stem-medial consonants (and simplifies consonant clusters) in certain morphological environments such as the genitive. Ablaut in Hidatsa (c.) changes the quality of a stem-final vowel before certain suffixes, e.g. the coordinative marker -*g*. Umlaut in German (d.) triggers fronting of vowels in the final syllable of certain stems in certain morphological contexts. Plural in Ngbandi preterite verbs (e.) may be expressed by tonal overwriting with a H tone. Somali (f.) marks plural on nouns by shifting the position of stress ("tonal accent" in Hyman's 1981 wording) to the right. The imperative in Gidabal (g.) is formed by lengthening of a final vowel. Plural marking in Diegueño (h.) follows the opposite strategy, viz. shortening of a long stem vowel.

The data in ((33)-e) and ((33)-f) are instances of suprasegmental mutation morphology (see i.a. Myers 1987, Donohue 1997, Yip 2002). The examples in ((33)-g) and ((33)-h) present cases of Morphological Length Manipulation (MLM), an empirical field that is extensively documented and discussed in Zimmermann (2017a). MLM is of theoretical relevance to the current study because it and reduplication derive from the same basic mechanism, viz. affixation of defective prosodic nodes. It is, however, not within the empirical scope of this dissertation. Rather, I shall confine myself to cases of segmental mutation: initial, medial, and final consonant and vowel mutation, as illustrated by ((33)-a) – ((33)-d).

(33) *Segmental and non-segmental mutation*

	CONSONANT MUTATION		
a.	**χ**a-	'shoot'	Nivkh, Paleosiberian (Shiraishi 2006: 83)
	cxɨf **qʰ**a-	'shoot a bear'	
b.	dɔʰ**pe**	'house.NOM.SG'	Pite Saami, Uralic (Wilbur 2014: 75)
	dɔ**pe**	'house.GEN.SG'	
	VOWEL MUTATION		
c.	nuwii**ri**	'to twist sth.'	Hidatsa, Sioux (Park 2012: 50.115)
	ma-ruwiir**a**-g	'I twisted it and ...'	
d.	Br**u**der	'brother'	German, Indo-European (own knowledge)
	Br**ü**der	'brothers'	
	TONE/STRESS MUTATION		
e.	nz**ì**	'stole.SG'	Ngbandi, Atlantic–Congo (Kamanda 1989: 188)
	nz**í**	'stole.PL'	
f.	k**á**lax	'ladle'	Somali, Afro-Asiatic (Hyman 1981: 172)
	kal**á**x	'ladles'	
	LENGTH-MANIPULATING MUTATION		
g.	gida	'tell'	Gidabal, Pama-Nyungan
	gidaː	'tell:IMP'	(Geytenbeek and Geytenbeek 1971: 21ff)
h.	saːw	'eat:SG'	Diegueño, Cochimi-Yuman (Wolf 2007: 54)
	saw	'eat:PL'	

2.2 Mutation and reduplication as GNLA

In this thesis, I defend the view that reduplication and mutation follow from the affixation of defective phonological nodes. This is not a new claim: it is the core assumption of the broader research program of *Generalized Non-linear Affixation* (GNLA) (Bermúdez-Otero 2012). GNLA "aims to derive all productive cases of non-concatenative morphology from the concatenative affixation of phonologically defective material such as floating tones or empty foot nodes" (Trommer and Zimmermann 2014: 465). The fundamental architectural assumption underlying GNLA is that morphological exponence is inherently item-based and not procedural (Bye and Svenonius 2012). The central innovation that I propose here is that over- and underapplication of mutation in reduplicated forms, often believed to be a paradigm cases of morpheme-specific subgrammars, are entirely phonological in nature and follow from the exact same principles as the two processes in isolation.

2.2.1 Phonologically defective representations

2.2.1.1 Prosodically Defective Morphemes

The most basic background assumption about the organization of prosodic structure is the *Prosodic Hierarchy* (34). The Prosodic Hierarchy states that prosodic nodes are organized in a hierarchical manner on separate tiers, building on insights from autosegmental and prosodic phonology (Goldsmith 1976, Liberman and Prince 1977, Hayes 1989).

(34) *The Prosodic hierarchy* (Nespor and Vogel 1986)

φ
|
ω
|
Φ
|
σ
|
μ
|
●

Much of the work in this dissertation is based on the theory of Prosodically Defective Morphemes (PDM, Zimmermann 2017a). The central idea of PDM is that the phonological content of morphemes may contain, or consist entirely of, isolated or at least not fully specified prosodic and/or segmental root nodes. Under certain grammars, defective prosodic nodes react with other phonological material and cause – sometimes dramatic – changes, in a similar fashion as segmentally defective features are involved in mutation morphology. Zimmermann (2017a) discusses segmental lengthening, shortening, deletion, epenthesis, stress shift, reduplication, and blocking of independent processes as possible outcomes of such reactions. What sets PDM apart from other approaches to prosodic morphology such as lexically indexed constraints (Pater 2009), cophonologies (Orgun 1996), REALIZE MORPHEME (Kurisu 2001), and transderivational anti-faithfulness (Benua 2000) is that PDM derives the whole range of MLM from the evaluation of concatenated phonological objects in the phonological component. The only contribution of the morphology is providing the phonological material for optimization. That such material may contain defective structures is independently predicted by ROTB.

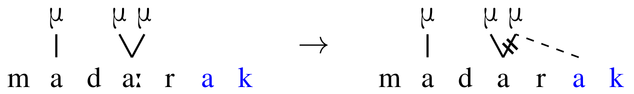
Consider the case of vowel shortening/deletion in Hungarian in (35) below. The plural suffix -*Vk* triggers deletion of a final short stem vowel (a.) and shortening (b.). Some stems, however, resist the subtractive effect of -*Vk* (c.).

(35) *Hungarian* (Stiebels and Wunderlich 1999: 273–285)

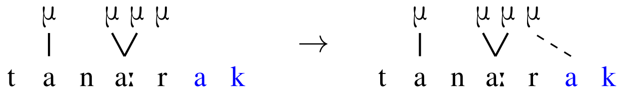
a.	bokor-Vk	bokrok	‘bushes’
	terem-Vk	termek	‘halls’
	borju-Vk	borjak	‘calves’
b.	mada:r-Vk	madarak	‘birds’
c.	perem-Vk	peremek	‘edges’
	tana:r-Vk	tana:rok	‘teachers’

Zimmermann (2017a) analyzes the Hungarian data as affixation of prosodically defective segments. Stems that undergo shortening/deletion do so because the suffix vowel is not associated to a mora underlyingly and therefore needs to link to the rightmost stem mora (“mora usurpation”). Stems that are immune are equipped with an additional mora at their right edge which is also defective. That mora is usurped by the prosodically defective suffix vowel without causing a visible change in the stem form. The figures in (36) and (37) illustrate the interplay of normal and excretive stems with prosodically defective segments.

(36) *Vowel shortening* (Zimmermann 2017a: 101)



(37) *Stems without a second form* (Zimmermann 2017a: 148)



2.2.1.2 Floating features and subsegments

Affixation of non-segmental material is also what gives rise to segmental mutation. Just like triggers of MLM and reduplication, morphemes that cause mutation do not have a special status in the grammar. The only aspect in which they differ from other morphemes is that they contain a certain marked structure, viz. a defective feature or subsegment, which interacts with underlying phonological material and induces some sort of alternation.

Consider the case of Nuer (Western Nilotic) in (38). The verbal paradigm displays a four-way mutation pattern affecting stem-final consonants. The consonantal alternations involve changes in voicing and continuancy. In the PST.PTCP and NEG.PRES.PTCP, mutation is the sole exponent of the respective grammatical category. Wolf (2007) shows that all four patterns can be straightforwardly accounted for if one assumes that each morpheme contains a floating voice feature ([±v]) and a floating continuant feature ([±c]).[8] The respective morpheme representations for each mutation pattern are given in the last column of (38). The tableau in (39) illustrates how multiple feature mutation is driven by constraints against unassociated features.[9]. Follow the convention in Trommer (2011), I indicate nodes marked invisible by a black background.

(38) *Multiple feature mutation in Nuer* (Wolf 2007, citing Crazzolara 1933)

	'overtake'	'hit'	'pull out'	'scoop hastily'		
INFINITIVE	cob	jaaç	guð	kɛ̂p		
3SG.IND.PRES.ACT	cóbɛ́ jɛ	jaayɛ̀ jɛ̀	gúðɛ́ jɛ̀	kɛ́bɛ́ jɛ̀	↔	[+v,+c] ɛ
1PL.IND.PRES.ACT	còɔfkɔ jɛ	jaaçkɔ jɛ	gwɔ̀θkɔ̀ jɛ	kɛ̀afkɔ̀ jɛ	↔	[-v,+c] kɔ
PST.PTCP	cof	jaaç	guθ	kɛ̀f	↔	[-v,+c]
NEG.PRES.PTCP	còp	jaac	gut̪	kɛp	↔	[-v,-c]

[8]But see Trommer (2008) and Akinlabi (2011) for alternative accounts.

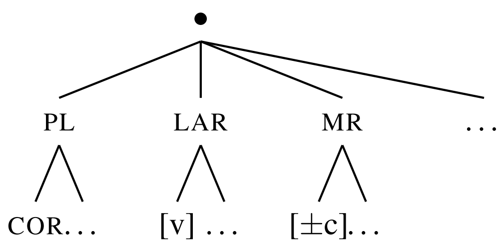
[9]Optimization of phonological structure is not limited to strings of segments but naturally extends to autosegmental graphs, cf. Hagstrom (1997), Myers (1997), Rose (2000), Rubach (2000), Bateman (2007), Kawahara (2007), Trommer (2011), Zimmermann (2017a).

(39) *Optimal multiple feature mutation*

Input = a.	[-c]→•	[-v]→•	DEP|	MAX|
a. g u ð [+v] [+c] [-c] [-v]	*!	*		
b. g u θ [+v] [+c] [-c] [-v]	*!		*	*
c. g u d [+v] [+c] [-c] [-v]		*!	*	*
☞ d. g u t̪ [+v] [+c] [-c] [-v]			**	**

Following a long tradition of autosegmental work (Clements 1985, Sagey 1986, McCarthy 1988, Halle 1992, Clements and Hume 1995, Halle et al. 2000, Staun 2003, Morén 2003, Moisik and Esling 2011), I assume that non-major class features are organized on designated tiers such as the place (PL), laryngeal (LAR), and manner (MR) tiers.[10] The general geometrical architecture is illustrated in (40). Representations as in (39) and constraints such as [-c]→• in (39) should thus be read as convenience abbreviations for "Assign * for each [-c] not associated to a LAR node associated to a •', or, more generally, "Assign * for each [-c] not associated to a • via an uninterrupted path of association lines".

(40) *Feature geometry*



The case of Nuer above reveals that there is no upper limit for the number of floating features contained in a morpheme. Another consequence of feature geometry is that there are no size restrictions on defective phonological material. These two insights are stated explicitly in (41). Evidence for defective subsegmental and prosodic structures exceeding a single empty node has been put forward by Zoll (1996), Iosad (2014), Zimmermann (2017b). Later on, I will discuss the case of multiply quirky mutation in Sye (section 5.1) and the case of non-mutating stems in Seereer (section 3.1) that crucially rely on defective structures that are larger than a single feature.

[10] The MR tier was proposed by Clements (1985) but was abandoned in most later studies on feature geometry. It is, however, crucial for my account of verb root mutation in Sye and will be discussed in more detail in chapter 5.

(41) *Possible morpheme representations*
A morpheme may contain any combination of nodes linked via any type of lines (visible, invisible, none).

Unassociated subsegmental material is commonly referred to as a *floating feature* (Akinlabi 1996 and much subsequent work), a convention that is also adopted in this thesis. However, "floating" is to be understood merely as a label to refer to a certain structural configuration. Crucially, it does not correspond to a grammatical feature: structural markedness constraints may make reference to the association status of certain phonological nodes but not to floating elements as such (e.g. with the constraints *FLOAT or MAXFLOAT argued for in Bickmore 1996, Yip 2002, and Wolf 2005). This difference is important because otherwise, floating material could be abused to introduce what are essentially morphological rules through the backdoor. To avoid this, I adopt Trommer's meta-restriction on constraints in (42):

(42) *No Explicit Floating* (Trommer 2011: 5)
No phonological constraint may refer specifically to floating structure (to phonological nodes not associated underlyingly to segments).

Chapters 3 – 5 will be dedicated to showing how piece-based approaches can account for the interaction of reduplication and mutation. It will be argued that by confining the role of morphology to supplying defective representations, not only do reduplication and mutation patterns in isolation receive a natural explanation, but it is also possible to account for the intricate ways these two processes interact with one another.

2.2.2 Extended Stratal Containment with Full Rebirthing

2.2.2.1 Containment

The GEN component The theoretical framework that my account of reduplication and mutation is couched in is *Extended Stratal Containment* (ESC, Trommer 2011), which in turn is based on *Containment Theory*, a version of Optimality Theory (Prince and Smolensky 2004, van Oostendorp 2006, 2007, Trommer 2015, Zimmermann 2017a). The fundamental difference between Containment and Correspondence Theory (McCarthy and Prince 1995, Kager 2004) is that in Containment, GEN cannot remove phonological nodes (43). The generative power of GEN is restricted to adding new nodes and modifying association lines between nodes. This massively reduces the number of possible candidates that need to be evaluated and at the same time calls for specific versions of constraints on association relations between phonological nodes. As a consequence, EVAL normally evaluates only output structures and does not need the input structure as a point of comparison. The only exception are comparative markedness constraints, which will be discussed below.

(43) *Containment* (Prince and Smolensky 2004: 111)
The input is literally contained in the output, with no losses.

A complete list of operations that GEN can perform is stated in (44).[11] I depart from the definitions in Trommer (2011) and Trommer and Zimmermann (2014) in that only association lines present in the input are eligible for being marked as phonetically invisible, i.e. GEN cannot insert invisble epenthetic lines. The copy mechanism will be described in greater detail below.

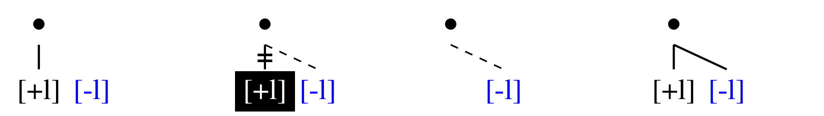
(44) Possible operations of GEN (Trommer 2011: 30, Trommer and Zimmermann 2014: 472, Zimmermann 2017a: 78)

a. Mark association lines present in the input as phonetically invisible.
b. Insert epenthetic association lines.
c. Insert colorless nodes.
d. Copy a continuous string of phonological elements of the same tier from M-structure.

Sub-representations With Trommer (2011), I distinguish three principal substructures for candidates: M-structure, P-structure, and I-structure. *M-structure* (or "morpheme structure") refers to the input representation contained in a candidate, i.e. the result of mere morpheme concatenation. *P-structure* (or "phonetic structure") refers to the phonetically visible substructure of a candidate, i.e. all nodes which are dominated through an uninterrupted path of phonetic association lines by an ancestral node. *I-structure* (or "integrated structure") is a substructure that neutralizes the difference between visible and invisible association lines. Constraints may make reference to any of these sub-representations. In addition, the term *S-Structure* is used to redundantly refer to an entire candidate as generated by GEN. The figures in (45) illustrate the differences between the four substructures.

(45) *Sub-representations in Containment*

M-STRUCTURE ("input")	S-STRUCTURE ("candidate")	P-STRUCTURE ("output")	I-STRUCTURE



Types of constraints Due to its heavy reliance on autosegmental representations, Containment makes ample use of constraints on association lines. The most common line constraints on downwards and upwards linking are defined in very general terms in (46) and (47). The constraint [-l]→•, for instance, should be read as "Assign * for each [-l] feature not associated to a • node". Another set of constraints inspired by the classical faithfulness constraints MAX and DEP are given in (48) and (49). DEP| militates against inserted association lines and MAX| is a faithfulness constraint[12] protecting underlying association lines.

[11] Zimmermann (2017a) lists a fifth option, fusing of color indices with nodes on the same tier. This operation is not relevant here because I assume that pivotal positions for infixes are directly encoding in the lexical representations of morphemes.

[12] I refer to DEP| and MAX| constraints by the intuitive term "faithfulness constraints", although they would be more accurately categorized as markedness constraints because they only evaluate the output, not the input.

(46) $\begin{array}{c}\alpha\\ \downarrow\\ \beta\end{array}$ Assign * for each node α
not associated to a node β.

(47) $\begin{array}{c}\alpha\\ \uparrow\\ \beta\end{array}$ Assign * for each node β
not associated to a node α.

(48) $\text{MAX}^{\alpha}_{\mid\beta}$ Assign * for each invisible association line
between a node α and a node β.

(49) $\text{DEP}^{\alpha}_{\mid\beta}$ Assign * for each inserted association line
between a node α and a node β.

In (50) – (51), I give general definitions of other constraints that I use frequently in my case studies. Another crucial constraint, the NCC, is discussed further below.

(50) *MIX Assign one * for each triple of nodes (N_1, Z_1, Z_2) such that
N_1 is associated to Z_1 via an underlying and to Z_2 via an inserted line.

(51) $*\alpha^{k\beta}$ Assign * for each node α such that
α is associated to k or more β nodes.

The cloning hypothesis I adopt Trommer's cloning hypothesis in (52). The cloning hypothesis states that for every markedness constraint that refers to integrated structure there exists another markedness constraint that refers to pronounced structure only (cf. cloning in Correspondence Theory, McCarthy and Prince 1995).

(52) *The Cloning Hypothesis* (Trommer 2011: 46)
Every markedness constraint has two incarnations, a P-clone and an I-clone:
The I-clone refers exclusively to I-Structure.
The P-clone refers only to P-Structure.

The figures in (53) illustrate cloning of constraints. P-structure versions are conventionally marked by underlining while I-structure constraints are not marked by a special symbol.

(53) *Constraint cloning in Containment*

Input = a.	$*\underline{\bullet_{2[l]}}$	$*\bullet_{2[l]}$
a. ● | [+l] [-l]		
b. ● ǂ [+l] [-l]		*
c. ● [+l] [-l]	*	*

Comparative Markedness Comparative Markedness constraints (McCarthy 2003) instantiate yet another level of cloning: for each markedness constraint on (a subset of) S-structure, there is a cloned version that compares M- and S-structure and assigns violations only if the constraint definition is met in S but not in M (if it is "new"). The constraint formulations in (54) show this difference in very general terms (Trommer 2011: 66; see also Albright 2018).

(54) a. $\overset{*}{_{\text{O}}}\text{C}$ Assign * for every λ in S for which the conditions R hold in S and M.

b. $\overset{*}{_{\text{N}}}\text{C}$ Assign * for every λ in S for which the conditions R hold in S but not in M.

Comparative Markedness does not only play a role in deriving grandfather effects by delimiting the locus of a constraint to new structures. It is of particular relevance to reduplication because it predicts the base to be more protected from modification than the reduplicant. The reason for this lies in the comparative version of MAXǀ in (55). Copied material will vacuously satisfy (55) because, all else being equal, marking lines invisible in a copied string will harmonically bound marking lines invisible in the base, because the copied structure is not present in M.

(55) $_{\text{N}}\text{MAX}^{\alpha}_{\beta}$ Assign * for every invisible line in S that is visible in M.

Line crossing The No Crossing Condition (NCC), one of the hallmarks of autosegmental approaches, is traditionally regarded an inviolable principle (Goldsmith 1976, Clements 1985), or, in OT terms, an inbuilt restriction on GEN (Zimmermann 2017a). On the other hand, structures in which a visible line crosses an invisible one are sometimes assumed to be possible even when line crossing is otherwise disallowed (e.g. Zimmermann 2013b). Here, I will adopt a more radical standpoint, following a proposal by Kimper (2011), and argue that all structures violating the NCC are potential candidates generated by GEN and that the NCC is nothing more and nothing less than a violable constraint (see also Frampton 2009).[13] The implicit assumption is that since they are highly marked, structures in which association lines cross are strongly dispreferred in the vast majority of cases; in some instances, however, these structures may become optimal due to the pressure to satisfy a higher-ranked constraint. The NCC in its most general form can be defined as follows:

(56) $*\times^{\alpha}_{\beta}$ Assign one * to every ordered pair of α nodes (α_1, α_2) such that:
(i) α_1 is associated to the node β_2 and α_2 is associated to the node β_1,
(ii) $\alpha_1 \prec \alpha_2$ and $\beta_1 \prec \beta_2$.

The empirical motivation for the violability of the NCC in Kimper (2011) comes from trigger exceptionality in harmony processes. Consider the data in (57). Finnish possesses a process of backness harmony whereby the backness feature of a suffix vowel depends on the backness feature of the rightmost non-neutral stem vowel. /a, o, u/ are back vowels, /æ, ø, y/ (represented in the orthography as <ä>, <ö>, and <y>, respectively) are front vowels, and /i,

[13] Other examples of analyses in which the NCC is a violable constraint are Trommer (2011), Trommer (2014), and Trommer and Zimmermann (2014). In none of these analyses, however, does the fact that the NCC is violable matter because there is never an optimal candidate which violates it.

e/ are neutral. Stems that contain only neutral vowels count as front. The following example illustrates the basic harmony patterns with the partitive singular suffix *-(t)a*/*-(t)ä*:

(57) *Transparent harmony in native and nativized Finnish vocabulary*

a.	raha-a	'money'	d.	väri-ä	'color'
b.	yö-tä	'night'	e.	ilme-ttä	'facial expression'
c.	murhe-tta	'sorrow, grief'	f.	leikki-ä	'play (activity)'

In the native vocabulary, lexical roots with disharmonic vowels are rare. Recent loanwords, however, often contain vowels with conflicting backness specifications. The general rules for backness harmony in suffix vowels are usually not affected by root-internal feature clashes, with one notable exception: disharmonic loanwords that have a back vowel in the antepenultimate, a front vowel in the penultimate, and the vowel /i/ in the final stem syllable. With such stems, both the front and the back versions of harmonizing suffixes occur:

(58) *Trigger variability in Finnish disharmonic loanwords* (Kimper 2011: 184)

a.	hieroglyfi-a	~	hieroglyfi-ä	'hieroglyph'
b.	marttyyri-a	~	marttyyri-ä	'martyr'
c.	jonglööri-a	~	jonglööri-ä	'juggler'
d.	amatööri-a	~	amatööri-ä	'amateur'
e.	miljonääri-a	~	miljonääri-ä	'millionaire'
f.	afääri-a	~	afääri-ä	'affair'

Disharmonic stems pose a serious problem to standard autosegmental approaches (see Goldsmith 1985 on regular harmonic stems in Finnish). The figures in (59) illustrate this dilemma. On these grounds, Kimper (2011: 214) concludes that "it is impossible to account for the patterns of transparency in Finnish loanwords while maintaining an inviolable prohibition on crossed association lines".

(59) *Line crossing in disharmonic stems*

Harmony with a local trigger	Harmony with a non-local trigger

Harmony systems in which potential targets are skipped are no rarity. Another example comes from Canadian French laxing harmony (60). The harmony process can be described as follows: a lax high vowel ([ɪ], [ʏ], [ʊ]) in the final syllable may optionally cause laxing of a high vowel in a non-final open syllable (the lax vowel in the final syllable arises from an independent process of closed-syllable laxing). Poliquin (2006) reports a considerable degree of variation in locality for laxing harmony: for some speakers, only the local target in the penultimate syllable may undergo harmony, while for other speakers, harmony applies across the board. A third group of speakers does not harmonize at all. The interesting fact is that there is a fourth group of speakers for whom only the initial syllable is a possible target, and if laxing harmony applies, it skips the high vowel in the penult. This pattern is similar to

Finnish backness harmony (the harmonizing feature is not contrastive in Canadian French, though).

(60) *Variability in laxing harmony in Canadian French words containing three high vowels* (Poliquin 2006: 58–59):

		NO HARMONY	1 TARGET, LOCAL	1 TARGET, NON-LOCAL	ITERATIVE	
a.	*juridique*	[ʒy.ʁi.dᶻɪk]	[ʒy.ʁɪ.dᶻɪk]	**[ʒʏ.ʁi.dᶻɪk]**	[ʒʏ.ʁɪ.dᶻɪk]	'judicial'
b.	*cyrillique*	[si.ʁi.lɪk]	[si.ʁɪ.lɪk]	**[si.ʁɪ.lɪk]**	[sɪ.ʁɪ.lɪk]	'cyrillic'
c.	*limousine*	[li.mu.zɪn]	[li.mʊ.zɪn]	**[lɪ.mu.zɪn]**	[lɪ.mʊ.zɪn]	'limousine'
d.	*dissimule*	[dᶻi.si.mʏl]	[dᶻi.sɪ.mʏl]	**[dᶻɪ.si.mʏl]**	[dᶻɪ.sɪ.mʏl]	'dissimulate'

van Oostendorp (2014) argues that the linearity argument against line-crossing (especially Sagey 1986) is a weak one because dominance plays a more important role in phonology than precedence. While I do not believe that precedence relations can be done away with, I do concur with van Oostendorp in that structures violating the NCC do not pose a problem for phonetic realization. The Seereer-Siin and Lakota data discussed in sections 3.1 and 4.1 provide further evidence for the permissibility of line crossing.

Infixation If the hypothesis of GNLA that all non-concatenative phenomena can be traced back to concatenative affixation is true, the question arises how infixation can be dealt with. Here, I adopt Yu's Pivot Theory (Yu 2007), which identifies edge- and prominence-based pivots for affixation that may result in a situation where an affix is inserted between two stem elements (61). The main empirical motivation for pivot theory is the observation that infixes do not occur at random positions (such as "between two onset consonants in the third syllable from the left") but always target points of high prominence within or at the edges of relevant domains.[14]

(61) *Possible pivots for infixation* (Yu 2007: 52)

a. **Initial pivot**
   (i) First consonant/onset
   (ii) First vowel/nucleus
   (iii) First syllable
b. **Final pivot**
   (i) Final vowel/nucleus
   (ii) Final syllable
c. **Prominence pivot**
   (i) Stressed syllable
   (ii) Stressed vowel/nucleus

[14]An obvious alternative would be phonological dislocation combined with violable indexed ALIGN constraints. Pivotal effects would then become epiphenomenal and dependent on the inventory of ALIGN constraints. Dislocation is highly problematic for cases where infixation is not phonologically optimizing (Inkelas 2014). In Containment, dislocation is ruled out simply because GEN is not able to scramble phonological nodes.

Pivotal positions are inscribed in the lexical entries of a morpheme, in the exact same manner as is the distinction between prefixes and suffixes. The toy morpheme representations in (62) – (64) illustrate how lexically encoded pivots yield edge alignment (prefixation/suffixation) and stem-internal alignment (infixation).

(62) M_{prefix} ↔ /i/ ALIGN(/i/, R, $S_{1ST\text{-}STEM}$, L)

(63) M_{infix} ↔ /i/ ALIGN(/i/, L, $C_{1ST\text{-}STEM}$, R)

(64) M_{suffix} ↔ /i/ ALIGN(/i/, L, $S_{LAST\text{-}STEM}$, R)

Linearization Related to the problem of infixation is the more general question of how complex phonological structures are linearized. This issue becomes particularly relevant when a phonological string contains defective nodes at an edge to which some other string is aligned. I assume that morphonological alignment is controlled for by a general *Contiguity* constraint (65) which states that contiguous strings of nodes are preferred over non-contiguous ones.

(65) CONT(IGUITY) (cf. McCarthy and Prince 1995, Bye and Svenonius 2012)
Assign * to every node of color χ_1 intervening between two nodes of color χ_2, where $\chi_1 \neq \chi_2$.

Assume the morpheme representations for a lexical root M1 in (66) and a suffix M2 in (67). M1 contains a root node and some floating feature [F] at its right edge. The alignment entry of M2 only specifies linearization with respect to • but not [F]. In the tableau in (68), CONTIGUITY ensures that the • from M2 does not end up in between the final root segment and the floating [F] in the winning candidate b. While CONTIGUITY is defined as a violable constraint, it is always obeyed in all of the case studies in the following chapters.

(66) M1 ↔ •
|
[F] [F]

(67) M2 ↔ •
|
[F] ALIGN(•, L, $\bullet_{LAST\text{-}STEM}$, R)

(68) *Optimal alignment*

	M1 + M2	CONT	• ↑ F
☞ a.	• • | | [F] [F] [F]		*
b.	• • | | [F] [F] [F]	*	*

A related issue is the alignment of copied material. I will address this issue in section 2.2.3.1 below.

2.2.2.2 Morphological colors

The theory of morphological colors (van Oostendorp 2006) and its translation into Containment Theory, *Colored Containment* (van Oostendorp 2007, Trommer 2011, 2015), heavily restricts the amount of morphological information accessible to the phonology. Phonological constraints can identify whether phonological entities have the same or a different morphological affiliation but they cannot trace back which individual morpheme they belong to or whether they are roots or affixes. This rules out morpheme-specific constraints and sub-grammars. Colored Containment predicts that any case of apparent morpheme-specific exceptionality must result from independent processes in the grammar.

The most well-known types of color-sensitive processes are Derived Environment Effects (DEE) and Nonderived Environment Blocking (NDEB) (Kiparsky 1993, Łubowicz 2002, van Oostendorp 2007, Kula 2008). DEE and NDEB were one of the motivations for the Strict Cycle Condition in Lexical Phonology (Mascaró 1976, Kiparsky 1982b, Rubach 1984).[15] I will briefly illustrate the benefit of morphological colors using the case of velar palatalization in Polish. The data in (69) come from Rubach (1984) (see also Łubowicz 2002).[16] Polish velars alternate with coronals when they occur before a front vowel of a different morphological affiliation (a.). No palatalization is observed within morphemes (b.). Crucially, roots that resist tautomorphemic palatalization regularly undergo palatalization when they are suffixed with a suitable trigger (c.).

(69) *Velar palatalization in Polish*

a.	/krok + ek/	[krotʃek]	'step (diminutive)'
	/ɕɲeg + ica/	[ɕɲeʒica]	'snow-storm'
	/strax + itɕ/	[straʃitɕ]	'to frighten'
b.	/kef'ir/	[kef'ir]	'kefir'
	/agent/	[agent]	'agent'
	/xem'ik/	[xem'ik]	'chemist'
c.	/xem'ik + ek/	[xem'itʃek]	'chemist (diminutive)'

In Colored Containment, blocking of palatalization in Polish follows from the principle of ALTERNATION which states that phonological material may only interact with nodes of a different morphological color. I formalize ALTERNATION as a violable constraint that penalizes insertion of epenthetic association lines between two nodes of the same color.[17] Departing

[15] Kiparsky (1993) presents an approach to NDEB which builds on the assumption that alternating sounds are underspecified underlyingly. In the case of Finnish assibilation, for instance, two ordered rules derive assibilation from underspecified /T/ but never from /t/: (i) T → s / __ i; (ii) T → t. See Burzio (2000) and Rasin (2016) for criticism of underspecification approaches to DEE and NDEB. See Trommer (2011) and Zaleska (2018) for accounts of DEE and NDEB in Containment.

[16] In the interest of readability, I have simplified the transcription of Polish segments and I am ignoring orthogonal processes such as yer deletion, primary palatalization, and spirantization.

[17] The original definition of ALTERNATION in van Oostendorp (2007: 138) makes explicit reference not only to node but also to line colors: "If an association line links two elements of color α, the line should also have color α". In my version of ESC, association lines do not have a morphological color.

from the general definition in (70), specific versions for individual pairs of nodes can be defined as in (71).

(70) ALT Assign * for every epenthetic line that links two nodes of the same color.

(71) $\text{ALT}_{\alpha | \beta}$ Assign * for every epenthetic line that links two nodes α and β such that α and β have the same color.

Palatalization can be analyzed as simple spreading and overwriting of a place feature. NDEB in Polish then follows from a high-ranked ALT constraint militating against tautomorphemic spreading. In the tableau in (72), ALTERNATION outranks the markedness constraint triggering palatalization, $*_{\text{DOR}}\text{CV}_{\text{COR}}$. Since ALTERNATION does not ban insertion of epenthetic lines per se, the COR feature from the V can spread to a dorsal consonant in a derived environment (b.) without violating ALT.

(72) *Application and blocking of palatalization*

	Input = a./a'	ALT	$*_{\text{DOR}}\text{CV}_{\text{COR}}$	DEP|	MAX|
	a. … k e k (k–DOR, e–COR)		*!		
☞	b. … ʧ e k (DOR delinked, COR spread)			*	*
☞	a'. k e … (k–DOR, e–COR)		*		
	b'. ʧ e … (DOR delinked, COR spread)	*!		*	*

Another crucial assumption of Colored Containment is that the DEP| constraint family is only active for nodes that have some color χ, i.e. non-epenthetic nodes. Epenthetic nodes are inserted by the phonology and have no color. Insertion of association lines between a colorless node and some other node – be it colorless or of some color χ – does not incur a violation of DEP|. ALT and DEP| are thus in a Paninian relationship: whenever the former is violated, the latter is violated as well. The table in (73) provides an overview of the violation profiles for different line insertion scenarios. Following Trommer (2011), colorless material is visualized by gray shading throughout this thesis.

(73) *Violation profiles for* ALTERNATION *and* DEP|

	ALT	DEP|
α ¦ β	*	*
α ¦ β (blue)		*
α ¦ β (shaded)		

While markedness constraints can make reference to morphological colors, the power of GEN is very limited when it comes to colors. The reason for this is the *Consistency of Exponence* principle (74), which I interpret such that GEN can assign new colors to new elements but it cannot alter the color of material present in the input.

(74) *Consistency of Exponence*
No changes in the exponence of a phonologically-specified morpheme are permitted. (McCarthy and Prince 2001, 1994, van Oostendorp 2007)

What has been said so far allows us to distinguish three main types (*palettes*) of colors: colors assigned by some morpheme (χ_M), colors assigned by GEN (χ_C), and the "null" color (ε). This gives rise to the typology in (75). An important restriction on the χ_C type is that it can never contain a color that is identical to one of the χ_M type; in other words, GEN cannot assign a new node the same morphological affiliation as material in the input.

(75) *Color palettes of phonological nodes*

	χ_M	χ_C	ε
Has a color	✓	✓	✘
Erased by FULL REBIRTHING	✓	✓	✓
Color assigned by	Morphology	GEN	n/a
Relation to other palettes	$\chi_M \cap \chi_C = \emptyset$	$\chi_C \cap \chi_M = \emptyset$	n/a

Association lines define relations between phonological nodes and do therefore not have a color. The only dimensions that are relevant for lines are phonetic visibility and underlying presence, as shown in (76). Note that inserted invisible lines cannot be generated by GEN in one go. Inserted lines are visible as a default and may only be marked as invisible if they are present in the input. Epenthetic lines may be present in the input for two reasons: they have been inserted at an earlier level and are fully rebirthed (see below), or they are present underlyingly. The latter, i.e. the occurrence of all lines types in morpheme representations, is straightforwardly predicted by ROTB. In section 3.1, I discuss the case of non-mutation stems in Seereer-Siin which provides evidence for invisible lines in the input.

(76) *Typology of association lines*

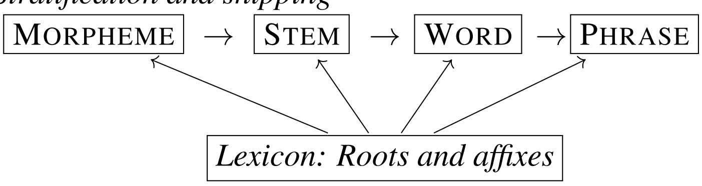
<table>
<tr><th></th><th>PHONETICALLY VISIBLE</th><th>PHONETICALLY INVISIBLE</th></tr>
<tr><td>UNDERLYING</td><td>α
|
β</td><td>α
ǂ
β</td></tr>
<tr><td>INSERTED</td><td>α
⋮
β</td><td>α
⋮ǂ⋮
β</td></tr>
</table>

On a final note, it should be stressed that the choice of individual colors is a purely aesthetic one. In this thesis, I adhere to the following coloring conventions: lexical roots and rebirthed material are shown in **black**, reduplication triggers are represented by a red color, and morphemes that in one way or the other trigger mutation processes are identified by a blue color. Copied material is indicated by gray coloring (see section 2.2.3.1). Other colors are used to further distinguish between morphemes where necessary.

2.2.2.3 Stratal Optimality Theory

The general architecture ESC is a modular feed-forward architecture which embraces the idea of phonological stratification from Stratal Optimality Theory (SOT) (Kiparsky 2000, Bermúdez-Otero 2012), which in turn has its roots in Lexical Phonology (Pesetsky 1979, Mohanan 1982, Kiparsky 1985, Pulleyblank 1986) and is similar to Derivational Optimality Theory (DOT) (Rubach 2000, 2003, 2008). The underlying hypothesis of SOT is that morphological structure building is spread across several independent strata which each have their own grammar. The output of one stratum is shipped to the next stratum and re-evaluated in a feed-forward manner. While there is no a priori restriction on the number and types of strata in an individual language and there is some evidence that the number of strata may indeed vary across languages (see e.g. Odden 1996 and Jones 2014, and Kiparsky 2015 for discussion), I adopt a more conservative stance and assume with Trommer (2011) that four phonological strata are sufficient to describe most morphonological phenomena: the MORPHEME (or ROOT) level, the STEM level, the WORD level, and the PHRASAL level (77).

(77) *Stratification and shipping*



One of the central descriptive arguments for a stratal organization of grammar is divergent affix behavior. Consider the data in (78). In Mayak (Western Nilotic), the past tense suffix *-u* and the antipassive suffix *-ir* behave strikingly differently. The former reliably triggers regressive [ATR] harmony but no raising. The latter raises a stem-final mid vowel and also harmonizes with the stem (harmony is regressive only if the stem contains an underlying high vowel, otherwise it is progressive). Trommer (2016b) argues that this divergent behavior can be accounted for if one assumes that the two affixes belong to different phonological strata.

Trommer shows how two independent evaluation cycles can derive compound chain-shifting harmony on the stem level and [ATR] harmony on the word level.

(78) [ATR] *harmony and mutation in Mayak* (Andersen 1999: 16)

	ROOT	WL -*u* 'PST'	SL -*ir* 'APASS'	
/ɪ/	ʔɪt̪	ʔið-u	ʔit̪-ir	'shape'
/ɛ/	ɗɛc	ɗej-u	ɗɪj-ɪr	'grind'
/a/	ʔam	ʔam-u	ʔʌm-ɪr	'eat'
/ɔ/	kɔc	koj-u	kʊj-ɪr	'take'
/ʊ/	gʊt̪	guð-u	gut̪-ir	'untie'

Another well-known example of divergent affix behavior is the case of "level 1" vs. "level 2" affixes in English. The former are subject to the stem level phonology, which requires forms to strictly adhere to the principles of English stress assignment (*géneral* → *generálity*). The latter belong to the word stratum where no such constraints are active and no stress shift occurs (*mémory* → *mémorylessness*) (Siegel 1974, Kiparsky 1982a, Bermúdez-Otero 2018).

Another line of argumentation in favor of stratification comes from the cross-stratal interaction of processes. One case in point is Yeri, a Nuclear Torricelli language of Papua New Guinea. Yeri has a process of final /e/-deletion before vowel-initial morphemes, as shown in (79) for the plural suffix -*i*. That /e/-deletion is a general phonological process is evidenced by the fact that it is triggered by all vowel-initial morphemes and applies to stems from all word classes (data from Wilson 2017).

(79) *Yeri /e/-deletion*

	SG.M	PL		
lope	w-lope-n	w-ei-lop-i	'big'	W90
awode	awode-n	awod-i	'birth'	W90
ogera	ogera-we-n	ogera-w-i	'chase'	W90
te	te-n	t-i	'(third person pronoun)'	W90

Yeri also has both full and partial reduplication expressing distributive, intensifying, and iterative meanings. Partial reduplication prefixes a σ- or Φ-sized copy to a stem, indicated by square brackets in (80). As is evident from examples ((80)-b) and ((80)-c), the base for reduplication is a complex stem form containing the lexical root and inflectional affixes (prefixes, suffixes, infixes). This suggests that reduplication applies at the word level, at a point when all stem-level processes have taken place.

(80) *Yeri reduplication*

a.	tupi	tu-[tupi]	RED-top	'way up high'	W115
	sapiten	sa-[sapiten]	RED-many	'very many'	W116
b.	asolkia	was-[w-asolkia]	RED-3PL-do-badly.REAL	'they do it very badly'	W117
	nobia	nom-[no<me>bia]	RED-talk.REAL<IPFV>	'is crowing and crowing'	W117
c.	ogiwa	hogi-[h-ogiwa]	RED-1PL-ask.REAL	'we asked and asked'	W116
	ayomia	yayo-[y-ayomia]	RED-2PL-hide.REAL	'you (pl) really hide it'	W116

This claim is further substantiated by the observation that reduplication does not only copy segmental material from inner inflectional affixes but also the output of phonological processes that are triggered by them: when a base has undergone /e/-deletion before a V-initial suffix, the reduplicant does not copy the underlying /e/ but takes the stem and the trigger suffix as a base instead (81).

(81) *No copying of deleted vowels*

a.	nabe	w-nabe-[nabe]	REL-RED-good	'very good (food)'	W117
		w-ei-nabi-[nab-i]	REL-PL-RED-good-PL	'(the) very good (ones)'	W118
b.	lope	w-lope-[lope-n]	REL-RED-big-SG.M	'a lot (of rice)'	W117
		w-ei-lopi-[lop-i]	REL-PL-RED-big-PL	'very very big'	W118

A stratal derivation as sketched in (82) can straightforwardly account for why the reduplicant copies the plural *-i* but not the underlying stem-final vowel. While identity effects between base and reduplicant would also follow from morpheme-specific constraints in BRCT, the fact that stratification is justified on independent grounds by the data in (80) makes a strong case for a derivational account. Cases in which overapplication cannot be traced back to a feeding relation will be discussed in chapter 3.

(82) *Deletion applies before reduplication: Overapplication*

STEM LEVEL	*in*:	nabe + i	Affixation of inner inflectional affixes
	out:	nabi	Optimal candidate with /e/-deletion
WORD LEVEL	*in*:	RED + nabi	Affixation of outer derivational affixes
	out:	nabinabi	Optimal candidate with multiple /e/-deletion

The relationship between morphological domains and phonological strata Another peculiarity of the Yeri data is that affixes expressing inflectional categories are evaluated at the stem level whereas reduplication with its lexical and TAM meanings is hosted by the word level phonology. This shows that morphological domains do not necessarily correspond to phonological strata, and a lexical entry of a morpheme may specify a stratal affiliation that is different from what would be expected from morphosyntactic constituency.[18]

Cyclic reapplication Stem-level domains are recursive (Kiparsky 2000, 2010, 2015). Recursiveness denotes cyclic reapplication of phonological optimization after each morphological operation. Again, English stress assignment provides good empirical motivation for the recursiveness of stem-level domains (*órigin* → *oríginal* → *orìginálity*).[19]

Evaluation domains later than the stem level are non-recursive. An example of the non-recursiveness of the word-level domain comes from spirantization in German, as discussed

[18]The hypothesis that morphosyntactic structure determines order and stratum of phonological concatenation is explicitly formulated in Bermúdez-Otero (2018): "The order of P-function application is [...] intrinsically determined by morphosyntactic constituency". There is good empirical evidence which shows that this statement is too strong and should rather be seen as a default assumption about interleaving that can be overridden by the lexical specifications of individual morphemes.

[19]Bermúdez-Otero (2012, 2013) have coined the term *stem-level syndrome* to refer to the peculiar set of properties (internal cyclicity being one of them) that are characteristic of the stem stratum. Bermúdez-Otero's offers an explanation of stem-level recursiveness in terms of non-analytic listing of stem forms.

in (Bermúdez-Otero 2018). Resyllabification of coda obstruents before V-initial suffixes and enclitics such as *-es* 'it' is a word-level process that blocks syllable-final spirantization of word-level suffixes such as *-ig* 'ADJZ' (83). Assuming the word level to have a cyclic domain structure would lead us to expect that resyllabification counterbleed spirantization, which would result in ungrammaticality ((83)-b). Only a parallel evaluation of the combination of the output of the stem-level phonology (in this case, the bare root) and all affixal material yields the desired output lacking spirantization ((83)-a).

(83) *Non-recursiveness at* WL (Bermúdez-Otero 2018)

		a. *Correct domain structure*	b. *Incorrect domain structure*
		[$_{WL}$ *fett-ig-es*]	[$_{WL}$ [$_{WL}$ *fett-ig*] *-es*]
P_{WL}	1st cycle	fɛ.tɪ.gəs	fɛ.tɪç
	2nd cycle	—	*fɛ.tɪ.çəs

2.2.2.4 Full Rebirthing

A central assumption of ESC is *Rebirthing* (84), a post-stratal clean-up operation that translates the notion of *Stray Erasure* from Lexical Phonology to SOT and ESC.[20] Stray Erasure was motivated by autosegmental analyses of tone that rely on the deletion of non-integrated material after some or all levels. Examples of Stray Erasure in Lexical Phonology are Clark's analysis of Igbo tone in which she argues for a general rule of cyclic free feature (= tone) deletion (Clark 1990), and Yokwe's rule of post-lexical L tone deletion in Bari (Yokwe 1987).

(84) REBIRTHING (Trommer 2011: 76)
At the end of each stratum:

a. Replace the output O of the stratum (i.e., S-structure) by its P-structure (O) ('Phonetization')

b. Assign the same unique color to all nodes and association lines of O ('Morpheme Merger')

What I will argue for here is a revised version of Rebirthing that I dub *Full Rebirthing* (FR) (85). The main difference between FR and Trommer's Rebirthing is that FR disposes of Phonetization. Therefore, the input of a stratum S_n contains exactly the same phonological nodes and lines (modulo colors) as the output of a stratum $S_{n\text{-}1}$. Since association lines do not have colors, they are rebirthed fully faithfully: invisible lines are not erased but remain invisible (ǂ → ǂ), while inserted lines remain marked as inserted (¦ → ¦). My analysis of paradigm uniformity in Lakota (section 4.1.6.2) motivates this particular assumption.

(85) FULL REBIRTHING
At the end of each stratum:

a. Transfer the output O of the stratum (i.e., S-structure) to the next stratum

b. Assign the same unique color to all nodes of O

[20] See Trommer (2011: 76) for a discussion of the relation between Correspondence-theoretic SOT (Bermúdez-Otero 2012) and ESC.

The conceptual argument for FR is that it resolves an inherent contradiction in ESC, where the non-deletion axiom of Containment holds only within strata but is overridden by REBIRTHING at the interface between two strata. More importantly, there are also a number of good empirical arguments for FR, two of which are discussed in chapter 3. In Seereer, the initial C of some reduplicants lack the [v] feature present in the base because the [v], albeit being introduced on the stem stratum, remains unassociated until the phrase stratum. When reduplication applies on the word stratum, what is copied is a voiceless segment, which is why the copy does not include the [v]. In Fox, a PHAR feature is introduced at the stem level but can only associate to a • at the word level, as evidenced by the fact that it does not block raising.

Bermúdez-Otero (2014) demonstrates how French liaison provides additional motivation for the retention of non-integrated material across strata. Liaison occurs with masculine singular nouns preceding a vowel-initial head noun (86). Bermúdez-Otero argues that adjectives such as *petit* contain a latent consonant in addition to their fully specified segments (/pəti/) in their underlying representation, following proposals by Clements and Keyser (1983) and Wetzels (1987). Latent consonants are defective in the sense that they are specified for segmental features but are not linked to the relevant structural position required for phonetic interpretation.[21]

(86) *Latent consonants in French liaison*

			M.SG (in isolation)	F.SG	M.SG (liaison)	
a.	*joli*	'pretty'	ʒɔli	ʒɔli	ʒɔli ami	'pretty friend'
b.	*petit*	'small'	pəti	pətit	pətit ami	'small friend'
c.	*grand*	'great'	grɑ̃	grɑ̃d	grɑ̃t ami	'great friend'
d.	*nouveau*	'new'	nuvo	nuvɛl	nuvɛl ami	'new friend'

A subsegment account of liaison is only viable under FULL REBIRTHING because it has to assume that the defective material is present at the root level but remains unintegrated until the phrase level. The crucial evidence for this comes from the observation that pauses and intonational phrase boundaries may be inserted before a liaison consonant but not before an underlying healthy consonant (87). Integration of subsegmental material at the phrase level is only possible if there is no erasure of phonetically invisible material between strata.

(87) *Post-pausal liaison consonants*

a.	M.SG	Liaison:	[pəti ‖ tɔm]	*petit homme*	'little man'
b.	F.SG	No liaison:	[pətit ‖ istwaʁ]	*petit histoire*	'little story'

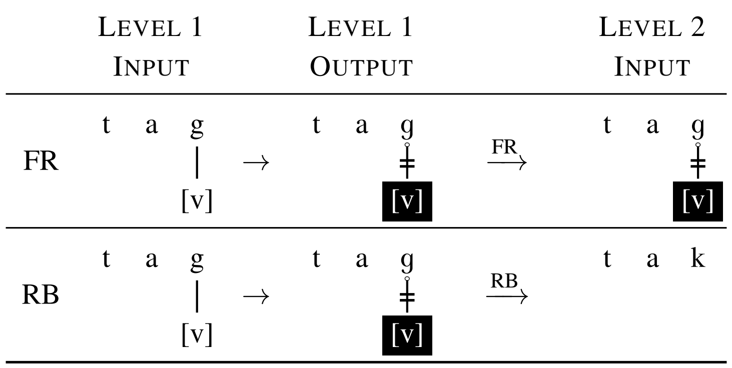
It is worth pointing out that cases of non-erasure between levels are not unknown in the Lexical Phonology literature, either. One example is the analysis of gemination in Lakota in Kyle (1994). Another example is Pulleyblank's analysis of Tiv, in which a rule of post-

[21] Accounts in terms of latent segments are not the only approaches to French liaison. There exist an impressive number of alternative analyses in a variety of frameworks, see i.a. de Jong (1990) for an account that focuses on the role of prosodic constituency, Steriade (1999) for a proposal that relies on listed allomorphs, Bybee (2001) for a usage-based perspective, Bonami et al. (2014) for an HPSG analysis, and Smolensky and Goldrick (2016) for an argument in favor of gradient representations.

lexical L metathesis presupposes that floating L tones are not erased on earlier levels or at the interface between them (Pulleyblank 1986).

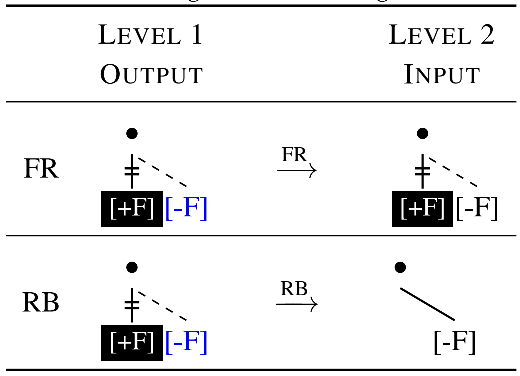
Another aspect in which FR deviates from Rebirthing is that there is no inter-stratal modification of association lines. In ESC with FR, GEN can insert visible epenthetic lines and mark underlying lines as invisible, but invisible lines are not erased between strata, and neither are epenthetic lines merged with underlying lines. An empirical argument for line preservation is the well-known case of incomplete final devoicing which, at least in some European languages, applies at the lexical level (van Oostendorp 2005b, 2008). The standard assumption is that devoicing means marking a line between a • and a [v] feature invisible. Under Rebirthing, the line linking the [v] and the •, as well as the [v] itself, will be removed before as the structure enters the next stratum, completely neutralizing the distinction between voiced and voiceless sounds. This problem vanishes under FR. The treatment of association lines in FR places it in the proximity of Turbidity Theory (Goldrick 2000, Revithiadou 2007). (88) shows how FR can be successfully applied to incomplete devoicing. Additional motivation for limiting Morpheme Merger to nodes instead of lines comes from a paradigm uniformity effect in Lakota, which will be discussed in chapter 4.

(88) *Incomplete devoicing under Full Rebirthing and Rebirthing*



The table in (89) summarizes how Rebirthing and FR differ in their treatment of invisible lines, epenthetic lines, and unpronounced features. FULL REBIRTHING is an inter-stratal operation which does not apply at the interface between cyclic domains within the same stratum.

(89) *Full Rebirthing vs. Rebirthing*



As stated above, association lines do not have morphological colors. Consequently, the status of association lines is not subject to post-stratal adjustments: an invisible line will be shipped to the next stratum as such, and the same holds for an epenthetic line. An interesting prediction that follows from this is that given ROTB, invisible association lines (and their respective nodes) which are present at the root level will be carried along through all subsequent strata. See my analysis of blocking of voicing mutation in Seereer-Siin in chapter 3 for an example of a grammatical process that shows that this assumption has beneficial effects.[22]

2.2.3 Bidirectional Minimal Reduplication

In what follows, I present my theory of Bidirectional Minimal Reduplication (BMR). BMR is an extension of Minimal Reduplication (Saba Kirchner 2010, 2013) with two main modifications. The central addition in BMR is the notion of bidirectionality: a defective prosodic node may not only trigger copying of lower-level but also of higher-level nodes. On the technical side, BMR is a translation of MR from Correspondence Theory to Colored Containment.

2.2.3.1 The copy mechanism

Recall from section 2.2.2.1 that GEN has the generative power to create copies of phonological material (90).[23] I assume the pied-piping axiom in (91), which states that when a node on tier T_n is copied, all associated structure dominated by that node is copied, too. For instance, it is not possible to copy a σ node linked to a μ without also copying that μ and the association line between them.[24] Pied-piping in copying obeys the same transitivity principle as phonetic spell-out: if a node N on tier T_n is phonetically invisible, nodes dominated by N on lower tiers are also invisible unless they are dominated by another visible node.

(90) *Copying as an ability of* GEN (cf. (44))
. . . GEN can copy a continuous string of phonological elements on the same tier T_n from M-structure.

(91) *The pied-piping axiom of copying*
Copying of a node N on tier T_n entails copying of all nodes on tier T_{n-1}, on tier T_{n-2} etc. which are linked to N via an uninterrupted path of association lines below T_n.

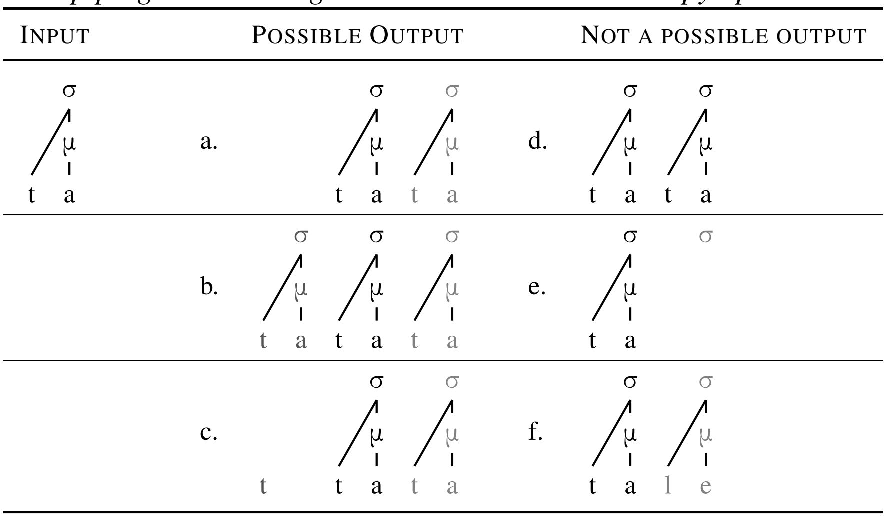
[22] Zaleska (2018) discusses the case of incomplete neutralization in Igede. Zaleska analyzes coalescence of /ye-ɔ/ → [yɔ̹ː] as a two-level process: at the word level, the association line between V_1 and its μ are marked as invisible, while at the phrase level, the [+ATR] feature from V_1 associates to the • of V_2. Since Zaleska assumes Trommer's REBIRTHING, she has to make the additional assumption that the [+ATR] associates to the • of V_2 at the word level lest it be erased at the interface to the phrase level. FULL REBIRTHING would allow for a more elegant analysis of the Igede data because there is no need to rescue the [+ATR] by linking it to a pronounced root node once one abandons the notion of Stray Erasure.

[23] The idea that copying involves selection of a continuous substring from an underlying representation is conceptually similar to the notion of string-based selection in Frampton (2009).

[24] Zimmermann (2017b) proposes a family of faithfulness constraints (e.g. FAITHσ-S: "Given $σ_1$ dominating segment S_x in the input. Assign * for every output syllable $σ_1$ not dominating S_x in the output.") which have a similar effect as (91) to derive what she dubs "maximal copying". The important difference to BMR is that Zimmermann's constraints are violable. I remain skeptical towards the prediction that there exist grammars which only ever copy single nodes.

Copied and epenthetic material share the property that both are not present in M-structure and that they both undergo inter-stratal morpheme merging. There are however two major differences between copying and epenthesis. The first difference is that copied material has a color while epenthetic material is colorless. Each copy operation assigns its individual color (χ_{C1}, χ_{C2}, ...) to the copied nodes. This does not conflict with Consistency of Exponence because GEN does not alter the morphological affiliation of underlyingly present material. When multiple copy operations apply in parallel, each copied string will therefore have a unique color. Copy colors are erased by FULL REBIRTHING in the same fashion as χ_M colors. Copied material is marked by a gray text color throughout this thesis; different copy colors are distinguished by different gray shades. The table in (92) illustrates possible and impossible copy operations by GEN. GEN may copy the same string of nodes once (a.) or multiple times (b.). It may also copy different strings in parallel (c.). Not allowed are assigning a color from the input to a copied node (d.), copying without pied-piping (e.), and copying of material not present in the input (f.).

(92) *Pied-piping and coloring as restrictions on* GEN*'s copy operation*



The second major difference between copying and epenthesis is that the latter process can insert any node while copying can only replicate strings present in the input. And even though BMR does not include faithfulness constraints indexed to the base and the copy, EVAL must have some mechanism at its disposal to identify which node in the input a copied node belongs to. For that reason, I assume that GEN assigns each copied and each original node a unique identifier that enables EVAL to recognize pairs of base and copied nodes. This mechanism is based on the idea of string-internal correspondence in Walker (2000) and Hansson (2001); for a conceptually similar implementation in terms of invisible horizontal association lines, see Zimmermann (2017a).

These indices serve the sole purpose of assessing locality of copying. There is no constraint in BMR that evaluates identity or other faithfulness relations between two co-indexed nodes as in BRCT. In line with Zimmermann (2017a), I define the constraint against copying in Containment as a constraint against material of a certain color. Following the OT tradition, I use the label INTEGRITY for this constraint (93-a). Owing to (91), violations of INTEGRITY will only be counted for nodes on the highest copied tier.

The most frequent type of reduplication is local reduplication, where the copied string is directly adjacent to its base (Marantz 1982, McCarthy and Prince 2001, Zuraw 2002). However, a considerable number of languages also attest non-local reduplication, the most common subtypes of which are infixing reduplication (McCarthy and Broselow 1983, Riggle 2004, 2006), multiple reduplication (Urbanczyk 1996, 1999, Shaw 2005), and wrong-side reduplication (Nelson 2003, 2005, Bobaljik 2006, Kusmer and Hauser 2016). In BMR, GEN can create copies of M-structure substrings anchored to any position in M-structure, but non-adjacency between copied and base material is penalized by LOCAL(ITY)$_{C(OPY)}$ (93-b) (cf. LOCALCOPY in Bye and Svenonius 2012: 455). The interplay of INT and LOCAL$_C$ in (93) predicts that local copying is the default case that can however be overridden if constraints favoring non-local copies are ranked high enough.[25] The mechanim for tracing locality is illustrated in (94).

(93) *Generalized integrity and locality*

a. INTEGRITY
Assign * for each node of a χ_C color on the highest tier in a copied string.

b. LOCALITY$_{COPY}$
Assign * for each node that intervenes between the rightmost or leftmost node of a copied string and the leftmost or rightmost node of the base string.

LOCAL$_C$ does not only check the highest tier in a copied string, which means that more specific versions of that constraint may make reference to a specific tier. For that reason, the constraint allows to derive a default linearization pattern that CONTIGUITY (65) is unable to capture: when a string is copied to a position where a defective node N on a tier T_n resides, and N has a different color than the base, CONTIGUITY does not apply, and some additional constraint is needed to determine the optimal linearization strategy (95). In such a situation, LOCAL$_C$ ensures that ((95)-b) will be the default outcome.

(94) *Adjacency is preferred …*

Input = a.	Loc$_c$	INT ●
a. ●$_1$ ●$_2$		
b. ●$_1$ ●$_2$ ●$_2$		*
c. ●$_1$ ●$_2$ ●$_1$	*	*

(95) *… on all tiers*

Input = a.	Loc$_c$	INT ●
a. ●$_1$	F$_1$ F$_2$		
b. ●$_1$ ●$_1$		F$_1$ F$_1$ F$_2$		*
c. ●$_1$ ●$_1$		F$_1$ F$_2$ F$_1$	*	*

Another important property of BMR is that it applies exclusively to M-structure representations. In other words, the copy mechanism will always create an identical copy of a substructure in the input, regardless of its S-structure shape. This has the consequence that BMR

[25] Nelson (2003, 2005) claim that all purported cases of wrong-side reduplication are epiphenomenal and can be reanalyzed as either non-reduplicative copying to meet a prosodic template or total copying and subsequent truncation. Kusmer and Hauser (2016) argue that this claim is too strong and that genuine wrong-side reduplication is attested in Koasati (Muskogean).

cannot produce overapplication patterns by virtue of automatic replication of modifications made to a base in S-structure. Empirically attested cases of overapplication must thus result from independent processes in the grammar, as hinted at in chapter 1.

The tableau in (96) illustrates the mechanism of M-structure copying and pied-piping. Copying of higher nodes automatically triggers a copy of associated lower nodes, (c. – f). Replication of base modifications in the copy incurs additional violations of the respective faithfulness constraints (f.) and is harmonically bounded by non-modification (e.).

(96) *Violation profiles of copied (sub-)structures*

Input = a.	INT α	INT β	INT γ	DEP δ	MAXI
a. γ_1 – β_1 – α_1					
b. γ_1 – β_1 – α_1; α_1	*				
c. γ_1 – β_1 – α_1; β_1 – α_1		*			
d. γ_1 – β_1 – α_1; γ_1 – β_1 – α_1			*		
e. γ_1 – β_1 ≠ α_1, β_1 – δ; β_1 – α_1		*		*	*
f. γ_1 – β_1 ≠ α_1, β_1 – δ; β_1 ≠ α_1, β_1 – δ		*		**	**

Violating INT may be optimal under a number of circumstances. First, copying may be the preferred strategy to satisfy a minimality requirement, as for instance in the Kharia masdar (Peterson and Maas 2009). Second, copying may be driven by phonotactic constraints, as in Hausa (Newman 2000). The most common scenario for the data discussed in this thesis, however, is copying to fill an empty prosodic node. In Kirchner's original version of MR, copying is always downwards, meaning that the defective node that triggers reduplication always heads the copied structure. As stated above, BMR allows both downward and upward copying. Upward copying is given when a high-ranked constraint of the type $N_1 \rightarrow N_2$, $T(N_1) < T(N_2)$, demands a defective node to be linked to a higher node. Pied-piping poses an obvious problem for upward copying: upward copying should be harmonically bounded by not copying at all because simply replicating a complex structure present in M does not help satisfy the relevant markedness constraint against unassociated nodes. To save upward copying, I propose the principle of Defective Node Merging in (97). This principle states that a complex copied structure can be conflated with a defective node at no additional cost if that node is a proper subset of the copied structure. The defective trigger node retains its original color. Defective Node Merging is conceptually close to Mester's (1986) Tier Conflation, an operation which unifies two separate tiers such that subset structures are consumed by superset structures.

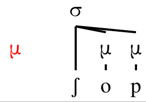
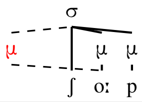
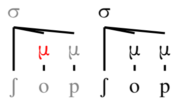
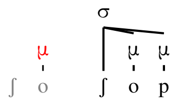
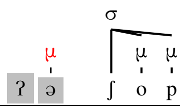
(97) *Defective Node Merging*
Let S_1 and S_2 be phonological structures in M. When GEN creates a copy of S_1, GEN can conflate the copy with S_2 iff all of the following hold:
(i) No node in S_2 is linked to a node outside of S_2 via any kind of line;
(ii) The highest node of S_2 is on tier T and the highest node of S_1 is on tier T+1;
(iii) S_2 is a proper substructure of S_1.

The definition in (97) includes a statement about the relation between the tiers of the copied and the defective structure (ii) in order to prevent it from applying outside the context of upward copying. Without that statement, Defective Node Merging would predict excessive underapplication because copied material could be accidentally conflated with floating features which happen to be identical to those contained in the copied structure. As will be argued later, underapplication is caused by not copying floating features; "disarming" floating features by adding structure around them would be both unwanted and unnecessary.

One of the main insights of MR is that defective nodes do not automatically trigger reduplication, which is an important difference to the RED morpheme in BRCT. This has the empirically desirable effect that it offers an elegant way of accounting for reduplicative allomorphy, as mentioned in section 1.1. Apart from copying, a defective prosodic node may remain floating (a.) or associate to a lower or higher node (b.). The multi-tableau in (98) shows a (non-exhaustive) list of possible repairs for defective nodes under different grammars. The different repairs result from different rankings of DEP, DEP|, INT, and N→M constraints.

Candidate c. illustrates the process of full syllable copying, a type of domain reduplication that has been claimed not to exist in influential autosegmental work on reduplication (Moravcsik 1978, Marantz 1982). Syllable copying is, however, attested in a number of languages, e.g. in Mundurukú existentials (Picanço 2005), Yaqui habituals (Haugen 2005), Kaingang plurals (Bye and Svenonius 2012), and in Lakota, which will be discussed in greater detail in section 4.1 (see also Gordon 2016: §8). Copying of prosodic constituents of the size of a σ is predicted under upward copying in BMR given high-ranked upward markedness constraints and low-ranked INTEGRITY. Under high-ranked downward markedness constraints, minimal segmental copying becomes optimal (d.). As shown in candidate e., epenthesis is optimal when INTEGRITY outranks DEP.

(98) *Possible repairs for defective nodes become optimal under different grammars*

Input = a.	DEP σ	DEP S	DEP σ–μ	DEP μ–S	INT σ	INT S	σ ↑ μ	μ ↓ S
☞ a. 							*	*
	DEP σ	DEP S	σ ↑ μ	μ ↓ S	INT σ	INT S	DEP σ–μ	DEP μ–S
☞ b. 								**
	σ ↑ μ	DEP σ	DEP σ–μ				INT σ	
☞ c. 							*	
	μ ↓ S	DEP S	INT σ				INT S	
☞ d. 							**	
	μ ↓ S	INT S	INT σ	DEP μ–S			DEP S	
☞ e. 							**	

2.2.3.2 TETU

As pointed out in the previous section, TETU effects in BMR follow from the fact that copying is a repair-driven process triggered by defective prosodic nodes. Since each copied element incurs a violation of the respective INT constraint, only the minimal amount of structure that is sufficient to carry out the repair will be copied. In addition, TETU may also follow from a faithfulness asymmetry between base and reduplicant due to comparative markedness.

One of the myriad cases of TETU in reduplication is presented in (99). Hup (Nadahup) iterative reduplication involves a CV-sized copy affixed to the left of a verbal stem. Assuming the iterative morpheme contains an empty mora (100), the shape of the reduplicant reflects the minimal amount of structure that needs to be copied to integrate the defective node. The tableau in (101) shows the interplay of the relevant constraints.

(99) *Iterative reduplication in Hup* (Epps 2008: 579)

kot	ko-kot	'go in an arc'
wat	wa-wat	'pass through, visit a village'
ʔɨd	ʔɨ-ʔɨd	'speak'
tãw	tã-tãw	'hit with stick'

(100) [ITER] ↔ μ

(101) *TETU under downward copying*

	Input = a.	μ ↓ S	DEP S	$*S^{2\mu}$	INT S
	a. μ μ μ k o t	*!			
	b. μ μ μ k o t k o t				**!
☞	c. μ μ μ k o k o t				*

Another case of TETU is shown in (102).[26] In Sanskrit intensive reduplication, initial consonant clusters are simplified in reduplicants. The reduplicant has a fixed size of two moras and is never closed by a coda consonant. To satisfy the bimoraic template, diphthongs are copied faithfully and monophthongs are lengthened.

(102) *Complex onset simplification in Sanskrit intensive reduplication*

tvais	tai-tvais	'stir'	S108
dyaut	dau-dyaut	'shine'	S108
svap	saː-svap	'sleep	S108
grabʱ	gaː-grabʱ	'seize'	S108
stan	tan-stan	'thunder'	S113
ɕcaut	cau-ɕcaut	'drip'	S113

(Steriade 1988)

Assuming that reduplication in Sanskrit is triggered by two defective moras (103), it is possible to account for the cluster simplification with the two-level markedness constraint in (104).[27] As shown in the tableau in (105), the defective μ nodes trigger full syllable copying, including all segments dominated by the σ node. Since $_{\text{N}}$MAXl ≫ {*CODA, *CXONS} ≫ MAXl, TETU is observed only in the copied structure but not in the base (f.).

[26] Examples show verb roots in the full grade. Reduplication in the zero grade works analogously.

[27] The crucial difference between two-level markedness and the faithfulness asymmetry between base and reduplicant in BRCT is that the latter is due to constraints tied to a specific morpheme while the former is blind to morphological indices. Two-level MAXl constraints apply to both copied and epenthetic structures, within and outside the context of morphological reduplication.

(103) [INTENS] ↔ μ μ

(104) $_{\text{N}}\text{MAX}^{\sigma}_{S}$ Assign one * for every pair of nodes (N_1, N_2) such that:
(i) N_1 is a • and N_2 is a σ,
(ii) N_1 and N_2 are linked via an invisible line in S that is visible in M.

(105) *Optimal onset simplification*

	Input = a.	μ ↓ S	$_{\text{N}}\text{MAX}^{\sigma}_{S}$	*CODA	*CX ONS	MAX^{σ}_{S}	$*_{\sigma}$(Z	$*_{\sigma}$(S
	a. μ μ sva^{μ}p^{μ}	*!*		*	*			*
	b. sva^{μ}p^{μ}-sva^{μ}p^{μ}			**!	**			**
	c. svaː$^{μ\,μ}$ p -sva^{μ}p^{μ}			*	**!	*		**
	d. s vaː$^{μ\,μ}$ p -sva^{μ}p^{μ}			*	*	**	*!	*
☞	e. s v aː$^{μ\,μ}$ p -sva^{μ}p^{μ}			*	*	**		**
	f. s v aː$^{μ\,μ}$ p -s v aː$^{μ\,μ}$ p		*!*			****		**

My analysis follows the basic idea in Steriade (1988) that Sanskrit reduplication involves a full copy that is subject to further simplifications.[28] Steriade's generalization is that only the first member of an onset cluster is preserved in the reduplicant, which poses a problem for clusters of decreasing sonority as in *tan-stan* 'thunder'. For these data, Steriade draws on the additional stipulation that the initial /s/ is extrametrical. In the OT-analysis in (105), deletion of Cs with the highest sonority follows from the subranking in (106), which states that Cs with lower sonority are preferred in syllable-initial position. This subranking, which mimics the well-known sonority hierarchy, ensures that the least sonorous onset C survives irrespective of its position within a cluster.[29]

(106) *Non-sonorous segments preferred at the left syllable edge*
$*_{\sigma}$(Z ≫ $*_{\sigma}$(S ≫ $*_{\sigma}$(T

2.2.3.3 (A-)Templatic effects

Templatic copying in Mokilese Another classical example of a template satisfaction effect that has been discussed extensively in the literature is Mokilese (Austronesian, Oceanic) (Harrison 1973, 1976, Moravcsik 1978, Levin 1985, McCarthy and Prince 1986, 1988, Steriade 1988, Blevins 1996, Raimy 2000a, Frampton 2009). Consider the data in (107). Mokilese forms the progressive by prefixing a 2 μ heavy copy of the initial two or three stem segments.[30] The progressive copies as much material from the base as it needs to satisfy

[28] See Kager (2004: 214ff) for an alternative view in terms of BR-CONT.

[29] The shape of the reduplicant of STVX-initial roots shows considerable variation across ancient Indo-European languages. Zukoff (2017) identifies three main patterns: V-STVX- (Ancient Greek), STV-STVX- (Gothic), and TV-STVX- (Sanskrit). All of these patterns are easily derivable with the constraint system employed here: The non-contiguous Ancient Greek pattern follows from high-ranked INT(S) and low-ranked CONT; the Gothic pattern follows from the opposite ranking and a high-ranked MAXLINE; the Sanskrit pattern follows from the same ranking as in Gothic but with a low-ranked MAXLINE.

[30] As a recent innovation, younger speakers tend to form the progressive by prefixation of a fixed CV:-shaped copy, regardless of stem shape (Harrison 1976).

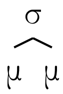
the heavy syllable template, ignoring syllable boundaries. The reduplicant itself, however, is strictly monosyllabic.

(107) *Mokilese progressive reduplication*

	STEM	PROGRESSIVE	
a.	pɔdɔk	pɔd-pɔdɔk	'plant'
b.	kasɔ	kas-kasɔ	'throw'
c.	pa	paː-pa	'weave'
d.	wia	wiː-wia	'do'
e.	caːk	caː-caːk	'bend'
f.	onop	on-nonop	'prepare'
g.	andip	and-andip	'spit'

(Levin 1985: 35)

A BMR analysis of Mokilese that starts from the morpheme representation for the progressive in (108) proceeds as follows. A high-ranked μ→S demands moras to dominate a segment. Copying (C)VC sequences is preferred over creating long vowels ((107)-ab), but when the stem only has a size of CVː, the two μ's link to a single V due to DEP(S) ≫ *Vː ((107)-c). DEP(σ) and INT(σ) are undominated, and for that reason, the reduplicant cannot be bigger than the one syllable that is introduced by the prefix, again resulting in creation of a long Vː ((107)-d). The tableau in (109) illustrates how templatic copying is optimal in Mokilese.

(108) [PROG] ↔ 

(109) *Template filling*

	Input = a.	INT σ	DEP σ	DEP S	μ → S	*Vː	INT S
	a. σ(μ μ) σ(k a μ) σ(s ɔ μ)				*!*		
	b. k a σ(μ μ) σ(k a μ) σ(s ɔ μ)				*!		**
☞	c. k a s σ(μ μ) σ(k a μ) σ(s ɔ μ)						***
	d. k aː σ(μ μ) σ(k a μ) σ(s ɔ μ)					*!	**

An interesting question is why a long vowel in the base always yields a long vowel in the reduplicant even when the stem-initial base syllable is closed (e.). This conundrum is also known as *quantitative* or *non-linear transfer* and has been argued to reflect a pressure to preserve the lexical contrast between short and long vowels (McCarthy and Prince 1988). The standard solution for this offered by templatic morphology is the stipulation that what is copied is all prosodic structure dominated by the highest node, which is the σ in Mokilese (McCarthy and Prince 1986). While this mechanism can be adopted more or less felicitously into Correspondence Theory (Blevins 1996), it is not available in Containment; furthermore, preservation of lexical contrast would call for output-output correspondence which is likewise not accessible in the modular framework advocated here. What I would like to argue for instead is that the behavior of superheavy syllables stems from the more general constraint in (110), which militates against sequences of closed heavy/super-heavy syllables and should be conceived of as a member of the class of repetition avoidance constraints (Yip 2002).[31] To the best of my knowledge, such sequences are indeed rare, if non-existent, in Mokilese.[32] As long as the constraint in (110) outranks *Vː, we correctly predict that /RED-caːk/ will yield *caː-caːk*, not **cak-caːk*.

(110) *2C3C
Assign * to each closed σ linked to 2 or more μ followed by another closed σ linked to 3 or more μ in P ("No sequences of a closed heavy syllable followed by a closed super-heavy syllable").

There are two additional minor complications pertaining to the occurrence of excessive copying (f.) and gemination (g.). I suggest that the former receives a straightforward explanation if we analyze NC sequences as unitary segments while the latter is the result of a simple onset effect. Since onsetless syllables are in principle well-formed in Mokilese, the relevant ONS constraint has to be ranked lower than DEP(S). The reason why gemination is not observed upon prefixation of C-final prefixes to V-initial bases (/uk-eŋ/ blow-wind → *ukeŋ* 'windy', L40) is due to differences in their prosodic prespecifications: the reduplicative affix contains moras but *no* segments while prefixes such as *uk-* contain *only* segments. Since inserting moras is very costly, the final prefix C is syllabified to the onset of the stem syllable but does not geminate. Crucially, the main generalization that all reduplicants adhere to a bimoraic template extends to the patterns in e.–g. as well.

A-templatic copying in Temiar Temiar (Austroasiatic, Aslian) presents a case of a-templatic reduplication. In the continuative, monosyllabic roots prefix a (vowelless) copy of the root while bisyllabic roots infix a copy of the coda consonant of the second syllable into the first syllable (111). The shape of the reduplicant thus depends on the shape of the base and does not follow a fixed segmental or prosodic template.

(111) *Full copying and coda copying*

STEM	CONT	
gəl	gl.gəl	'to sit down'
s.lɔg	sg.lɔg	'to lie down'

(Gafos 1998a: 517)

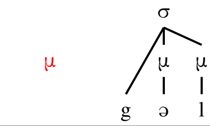
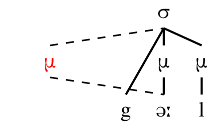
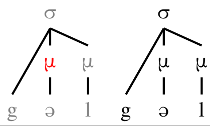
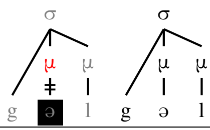
While the reduplicative pattern in Temiar is a-templatic, the size of the reduplicant is never smaller and never bigger than one mora. Assuming the continuative affix contains a defective μ, it is possible to derive the pattern in the following way. First, the absence of the

[31] Blevins (1996) argues that there is independent evidence for NOCODA in Mokilese.
[32] Superheavy syllables only occur word-finally in Mokilese.

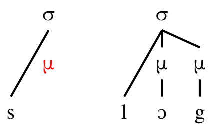
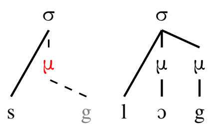
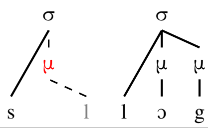
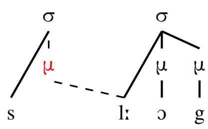
vowel in the reduplicant follows from a more general pressure for sesquisyllabicity found in all Aslian languages (Kruspe 2004, Kruspe et al. 2015) that is captured by the constraint in (112). Second, integration of the defective μ is regulated by a number of markedness constraints against long segments (*GEM, *VV), sequences of identical segments ($*C_\alpha C_\alpha$), and superheavy syllables ($*\sigma_{3\mu}$).

(112) *PREFINAL-V (Gafos 1998a: 520, Gafos 1998b: 235)
Prefinal (= unstressed) vowels are not allowed.

(113) *Syllable copying*

Input = a.	μ→σ	μ→S	DEP σ	DEP S	*P-V	$*\sigma^{3\mu}$	INT σ	INT S	LOC_C S
a. 	*!	*							
b. 						*!			
c. 					*!		*		
☞ d. 							*		

(114) *Coda copying*

Input = a.	μ→σ	μ→S	*C:	$*C_\alpha C_\alpha$	*P-V	$*\sigma^{3\mu}$	INT σ	INT S	LOC_C S
a. 	*!	*							
☞ b. 								*	*
c. 				*!				*	
d. 			*!					*	

The tableaux in (113) and (114) show how integration of the defective μ proceeds depending on the root shape. High-ranked μ→σ and $*\sigma_{3\mu}$ conspire to trigger full syllable copying with monosyllabic bases (113). Additional markedness constraints and a high-ranked μ→S conspire to trigger non-local copying of the coda consonant in (114).

2.2.3.4 Fixed segmentism

Reduplication with fixed segmentism (FSR) is a widespread subtype of reduplication whereby a reduplicant contains invariant segments that are not copied from its base (Marantz 1982, McCarthy and Prince 1986, Steriade 1988, Yip 1992, Bruening 1997, Alderete et al. 1999). Following Marantz (1982), a basic distinction can be made between proper FSR such as English /ʃm-/ reduplication (115) and fixed feature or subsegment reduplication as in the case of Mundurukú (118). Another type of FSR is TETU-driven FSR, which can be accounted for using the mechanisms layed out in the previous section (cf. Alderete et al. 1999).

A famous example of edge-bound FSR is English /ʃm/-reduplication (Yip 1992, Alderete et al. 1999, Ghomeshi et al. 2004, Nevins 2005, Zimmermann and Trommer 2011). /ʃm/-reduplication expresses derision or irony and involves full word copying and overwriting of the initial onset (cluster) by the segments /ʃm/ (115).

(115) *English /ʃm/-reduplication*

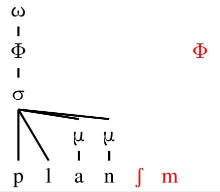
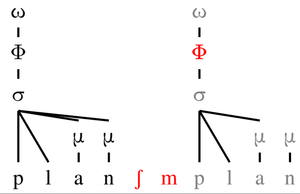
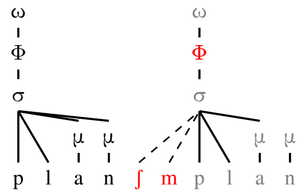
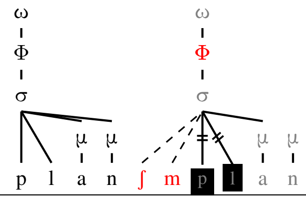
a.	Oedipus	Oedipus-Shmoedipus	(Alderete et al. 1999: 355)
b.	table	table-shmable	(Alderete et al. 1999: 355)
c.	marriage	marriage-shmarriage	(The Simpsons, season 23, episode 16)
d.	plan	plan-shman	(Zimmermann and Trommer 2011: 562)
e.	string	string-shming	(Zimmermann and Trommer 2011: 562)

I analyze /ʃm/-reduplication in English as affixation of a segmentally defective foot and prosodically defective segments (116). Under this assumption, the overwriting effect can be analyzed as a conspiracy of two basic principles: the pressure to integrate defective nodes into the prosodic structure on the one hand and phonotactic restrictions on consonant clusters on the other hand. In the tableau in (117), the former pressure is captured by the constraints S→σ and Φ→ω, the latter of which triggers ω copying. Since S→σ is an I-structure constraint, the invisible lines in candidate d. do not incur violations of this constraint. A phonotactic cover constraint, abbreviated here as ONS, militates against illicit onset clusters in English, in particular against sequences of /ʃmC(...)/. Being sensitive to P-structure only, ONS is only violated in candidate c. and not in the optimal candidate. Note that duke-of-york overwriting is not possible in BMR because, unlike in PDM, new epenthetic lines cannot be made invisible.

(116) [DEPRECATIVE] ↔ Φ /ʃm/

An analysis in terms of defective nodes avoids predicting backcopying effects (see Nevins 2005). Zimmermann and Trommer (2011) argue that a BRCT-style approach which does not favor unattested forms such as **shmable-shmable* is possible by resorting to constraints sensitive to the distinction between roots and affixes. This kind of morphological look-up is not necessary under the BMR analysis that I propose here.

(117) */ʃm/-reduplication as segmental overwriting*

	Input = a.	$\overset{\omega}{\underset{\Phi}{\uparrow}}$	$\overset{\sigma}{\underset{S}{\uparrow}}$	DEP$^{\omega}_{\Phi}$	<u>ONS</u>	MAX$^{\sigma}_{S}$
a.		*!	**			
b.			*!*			
c.					*!	
☞ d.						**

I now turn to a case of fixed feature or subsegment reduplication. In Mundurukú (Tupian) attenuative reduplication, the final stem syllable is copied and the vowel is replaced by a H-toned /ə́/ (118). The reduplicant preserves the nasality of the original vowel, however. Mundurukú attests full syllable copying, a pattern that is predicted under upward copying in BMR and that is optimal under any grammar in which μ→σ is ranked sufficiently high and DEP(σ) is ranked sufficiently low.

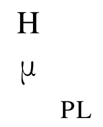
(118) *Mundurukú attenuative reduplication*

a.	i-pak	i-pak-pə́k	‘not so red’
b.	yo-boŋ	yo-boŋ-bə́ŋ	‘not so big’
c.	y-apĩ́n	y-apĩ́n-pə̃́n	‘not so short’
d.	i-rẽm	i-rẽm-rə̃́m	‘not so blue’

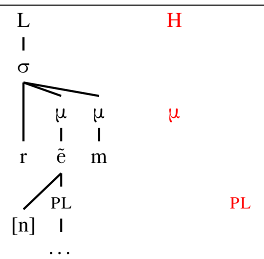
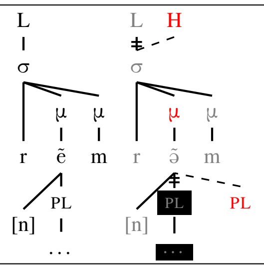
(Picanço 2005: 382)

FSR in Mundurukú can be analyzed as an instance of multiple featural overwriting, assuming the representations in (119). The attenuative morpheme contains an empty PL node, a floating H tone, and an empty mora. The mora triggers syllable copying and the PL node overwrites the vowel specifications of the copied vowel. A vowel with no place features is interpreted as /ə/. I assume that the feature [nasal] does not reside under a place node and is hence not affected by overwriting (see my case study on Sye in section 5.1 for a similar argument). The fact that nasality is preserved is the crucial piece of evidence for a subsegmental overwriting account as opposed to one where the attenuative morpheme contains a fully specified vowel.

The H tone also overwrites the tonal specifications of the copied syllable.[33] The tableau in (120) shows how the same basic constraints on I-structure integration as in English drive overwriting in Mundurukú FSR.

(119) ATTEN ↔ 

(120) *Fixed (sub-)segmentism as multiple overwriting*

Input = a.	σ ↑ μ	H ↓ σ	• ↑ PL	*CONTOUR	MAXI
a. 	*!	*	*		
☞ b. 					**

The morpheme representations in (116) and (119) suggest that FSR can affect reduplicants of any size, and in fact, this is exactly what we find empirically. Recall the case of Dravidian echo formation mentioned in section 2.1.1. In (121) – (123), some typical examples of echo formation are given. From a syntactic point of view, the level at which reduplication applies is obviously variable, ranging from single words – irrespective of their part of speech – to full-fledged vPs. From a phonological perspective, echo formation involves copying of a constituent that can be the phonological word or the phonological phrase.

(121) *Echo formation in Tamil*

a.	puli	'tiger'	puli gili	'tiger and the like'
b.	pəcːə	'green'	pəcːə gicːə	'green and the like'
c.	niː	'you'	giː niː	'you, etc.'
d.	paːʈːu	'sing'	paːʈːu giːʈːu	'sing, etc.'

(Abbi 1992: 21)

[33] I assume that the syllable is the TBU in Mundurukú, contra Picanço (2005), who argues that the mora is the TBU. Picanço does not provide language-internal arguments for her assumption. Since Mundurukú has no diphthongs or distinctive vowel length, and sonorant codas cannot bear a tone, there seem to be no valid language-internal reasons to discard my σ-based account.

(122) *Echo formation in Telugu*

a.	preːma	'love'	preːma giːma	'love, etc.'	
b.	cinːa	'small'	cinːa ginːa	'small, etc.'	
c.	tundərəga	'fast'	tundərəga gindərəga	'fast, etc.'	
d.	vinʈam	'to hear'	vinʈam ginʈam	'to hear, etc.'	(Abbi 1992: 21f)

(123) *Echo formation in Kannada*

a. *nanːu [baːgil-anːu much-id-de] [giːgilanːu muchide] anta heːɭa-beːɖa*
I-NOM [door-ACC close-PST-1S] [RED] that say-PROH
'Don't say that I closed the door or did related activities.'

b. *pustav-anːu [meːjin-a meːle] [giːjina meːle] noːɖ-id-e*
book-ACC [table-GEN on] [RED] see-PST-1S
'I saw the book on the table and in related places.' (Raimy 2000a: 53)

Echo formation is extensively discussed in Raimy (2000a). Raimy correctly points out that the data in (121) – (123) show that reduplication can target the output of different stages of a derivation. This is compatible with a stratal theory of grammar, assuming the 'etc.' morpheme is stratally underspecified and contains a likewise underspecified prosodic node Π^{max} that calls for a copy of the highest node accessible in the input structure on the respective strata, i.e. a ω node on the word level and a φ node on the phrase level. Segmental overwriting by /gi(ː)-/ then follows from the same principles as English FSR.[34]

2.2.4 Implications

Adopting a piece-based approach to non-concatenative processes makes certain predictions as to the nature of the interaction between such processes. As hinted at in section 1.2, the possibility of misapplication patterns is in fact predicted by my theory of Bidirectional Minimal Reduplication and my version of ESC. For example, overapplication may result from a simple ordering relation where reduplication applies later than some other process. On a more general level, BMR and ESC have the following implications regarding the interaction between mutation and reduplication:

1) *Base independence*: There is no mechanism in the grammar that could force a process to apply to both base and reduplicant, or compel the output form of one to match the other.

2) *Stratification*: Misapplication is closely connected to the derivational nature of grammar. Overapplication can arise as a consequence of mutation applying at an earlier level than reduplication. Transparent application is the default case when mutation applies at the same or at an earlier level than reduplication. Underapplication cannot arise as a direct consequence of stratification.

[34] Yip (1992) raises the issue that echo formation in some Dravidian languages such as Kannada seems to involve genuine overwriting because a mere concatenation of the fixed and the copied onset C would not always result in illicit clusters. Yip proposes an account in terms of cophonologies that distinguishes native (or more restrictive) and non-native (less restrictive) layers of the lexicon. Without resorting to cophonologies, Yip's basic insight is readily translatable into ESC using constraints against pronounced C clusters wearing more than one color.

3) *Limited accessibility*: GEN can copy material from M-structure but not from S-structure. Overapplication thus never results from automatic replication of modifications to a base at the same level of evaluation.

4) *Base priority*: Given two-level markedness, reduplicants are more susceptible to modifications than underlyingly present material.

5) *Sandboxing*: Reduplication is a purely phonological copying operation and can therefore not be affected by morphological features.

1) has the desired effect that it does not overgenerate unattested backcopying patterns, a feature that my theory shares with MDT. At the same time, it raises the question of what conditions attested cases of misapplication. Chapter 4 presents case studies of underapplication that demonstrate how identity between base and reduplicant follows from the assumption of defective representations. Stratification may entail desired overapplication patterns (2) while the principle of M-structure copying rules out pathological backcopying (3). Chapter 3 deals with other potential sources of overapplication. 3) is also the reason why local application can be considered the default case, cf. the discussion of Initial Change in Fox (section 3.2) and quirky mutation in Sye (section 5.1). 2) and 3) together make the interesting prediction that there are two varieties of multiple reduplication: non-recursive and recursive. As will be demonstrated in section 3.2 for the latter and in section 4.2 for the former, this prediction is borne out. 4) is a consequence of ESC and predicts similar TETU effects as BRCT. There is a certain degree of redundancy here, as a fair amount of TETU effects can be accounted for by downward copying in BMR alone. However, this is not necessarily a caveat, because BMR also includes the possibility of upward copying, paving the way for subsequent TETU-driven repairs in the spirit of Steriade (1988). The modular (5) and feed-forward (2) architecture of grammar, combined with the possibility of defective representations in GNLA, should be sufficient to account for all morphonological processes without resorting to lexically indexed constraints.

Chapter 3

Overapplication

This chapter presents two case studies of mutation overapplication that, at least at a descriptive level, involve "backcopying" of a morphologically induced segmental change from a reduplicant to a base. As was discussed in chapter 1, mutation overapplication can have three phonological sources: mutation applying at an earlier level than reduplication, non-reduplication-specific iterative application of mutation, and "accidental" overapplication due to markedness conspiracies. The first type was illustrated by retroflexation in Sanskrit (section 1.2) and vowel deletion in Yeri (section 2.2.2.3); another relevant overapplication pattern from Lakota will be discussed in section 4.1.4.2. The other two sources of overapplication will be examined in this chapter. In the case of Meskwaki Fox, word-initial vowel raising applies in base and reduplicant because both base and reduplicant are phonological words and the relevant process blindly applies in all ω domains. In Seereer-Siin, the interaction of several markedness constraints creates a situation in which a single [-c] node associates to more than one root node, causing mutation in a base segment and in a reduplicant segment. What Sanskrit, Yeri, Lakota, Fox, and Seereer-Siin have in common is that an overapplication pattern arises from the interplay of defective representations and general phonological constraints on association relations. Morpheme-specific constraints or cophonologies that enforce identity between a base and a reduplicant are not necessary in any of these cases.

3.1 Root node greediness in Seereer-Siin

3.1.1 Optional "backcopying" and unexpected devoicing in derived agent nouns

Seereer-Siin presents two unexpected mutation patterns in derived agent nouns. Agent nouns in Seereer-Siin involve a CVː-sized reduplicant prefixed to a verbal root and affixation of a noun class prefix which regularly triggers mutation on the immediately following consonant. The first observation is that continuancy mutation may optionally affect the initial base consonant, too, even though the base is not adjacent to the noun class prefix (124).

(124) *Optional backcopying of continuancy mutation* (MM334)

INFINITIVE	AGENT NOUN			
waːɗ	o-**b**aa-waaɗ	~	o-**b**aː-**b**aːɗ	'search / researcher'
fec	o-**p**eː-fec	~	o-**p**eː-**p**ec	'dance / dancer'
riw	o-**t**iː-riw	~	o-**t**iː-**t**iw	'weave / weaver'
xoːx	o-**q**oː-xoːx	~	o-**q**oː-**q**oːx	'cultivate / farmer'

Second, there is the case of seemingly unwarranted devoicing in the reduplicant of agent nouns derived from verb stems with an initial voiced stop (125). While a number of productive consonantal alternations are attested in Seereer-Siin, devoicing is not found anywhere outside of agent noun reduplication.

(125) *Devoicing of voiced initial stops* (MM334)

INFINITIVE	AGENT NOUN	
bind	o-**p**iː-bind	'write / writer'
dap	o-**t**aː-dap	'launder / launderer'
gaʔ	o-**k**aː-gaʔ	'see / seer'
ɟik	o-**c**iː-ɟik	'buy / buyer'

The overapplication pattern in Seereer-Siin is a case of backcopying and has been put forward as an empirical argument for BRCT with its RED-specific faithfulness constraint family (Mc Laughlin 2000, Zimmermann and Trommer 2011). The devoicing pattern seems to further strengthen the argument for morpheme-specific constraints in general: if it can be shown that two exceptional patterns independently require the same formal device – a constraint tied to a particular morpheme or group of morphemes – the argument for employing this powerful machinery becomes more convincing and less stipulative. At the same time, the Seereer-Siin data also seem suitable to provide an argument for reduplicative cophonologies because both exceptional patterns are confined to the reduplicant.

What I will argue for in this section is that the Seereer-Siin data neither follow from indexed constraints nor from cophonologies. Instead, both mutation overapplication and devoicing in reduplicants follow from affixation of defective segmental and prosodic material and basic markedness constraints. My account of Seereer-Siin agent noun morphology provides a strong argument in favor of a modular and stratally organized phonology with no inter-stratal deletion (FULL REBIRTHING).

The remainder of this section is structured as follows. In section 3.1.2, I introduce some relevant grammatical properties of Seereer-Siin and give some general background on the language. Section 3.1.3 presents my phonological account of mutation, reduplication, and the interaction of the two processes. Section 3.1.4 gives a critical discussion of a potential alternative account in BRCT based on Mc Laughlin (2000).

3.1.2 Phonological and morphological background

Seereer (alternate spellings: Sereer, Serer, Sérère) is an Atlantic language spoken by approximately 1.5 million people in Senegal and The Gambia. The Seereer language has several dialects; the variety under discussion here is Seereer-Siin, named after the Siin (alternate spelling: Sine) dialect. One of the features that distinguish Seereer-Siin from other dialects is its voiceless implosive stop series, which participates in (and further complicates) the system of initial consonant mutation (ICM).

Data discussed in this section mainly come from two sources: Mc Laughlin (1994), which contains a detailed description of the facts of ICM, and Mc Laughlin (2000), which discusses transparent and opaque mutation patterns in reduplicated agent nouns. Both papers are based on original fieldwork in Fatick, Senegal. Additional sources I have consulted are: (i) the study of nominals in Fal (1980), a study based on the variety of Seereer-Siin spoken in Jaxaaw that is very similar to the one spoken in Fatick (Mc Laughlin 1994: 282); (ii) the study of verb doubling in Heath (2014); (iii) the Seereer-English/English-Seereer dictionary in Merrill and Loum (2015) based on the Saloum dialect spoken in the town of Péthie.[35]

Phonology Seereer-Siin distinguishes five qualities and two quantities for vowels (126). The consonant system of Seereer-Siin has a four-way phonation contrast including voiceless implosives for the bilabial, alveolar and palatal stop series (127).[36] It also attests voiced prenasalized stops at all five oral places of articulation. The fricative system is considerably less rich than the stop system, containing only the three voiceless members /f/, /s/, and /x/.

(126) *Seereer-Siin vowel inventory* (Fal 1980: 61)

i iː		u uː
e eː		o oː
	a aː	

(127) *Seereer-Siin consonant inventory* (adapted from Mc Laughlin 1994: 281)

p b	t d	c ɟ	k g	q	ʔ
ɓ̥ ɓ	ɗ̥ ɗ	ʄ̥ ʄ			
mb	nd	ɲɟ	ŋg	NG	
f	s		x		
m	n	ɲ	ŋ		
w	r̥ r l	j			

[35] I am using the following abbreviations: F = Fal (1980), M = Mc Laughlin (1994), MM = Mc Laughlin (2000), H = Heath (2014), DIC = Merrill and Loum (2015).

[36] See Mc Laughlin (2005b) for a detailed acoustic description of the typologically rare voiceless implosives.

The table in (128) summarizes the notational differences in the transcription of Seereer-Siin. My transcription follows the IPA. I deviate from previous work on Seereer-Siin by using the symbols for the implosive stops combined with the subscript ring for the voiceless implosives.[37]

(128) *Notational differences in the transcription of Seereer-Siin*

Fal (1980)	Mc Laughlin (1994)	Mc Laughlin (2000)	Heath (2014)	Merrill and Loum (2015)	IPA (used here)
t̬	c	c	c	c	c
d̬	j	ɟ	j	j	ɟ
ʰɓ	ƥ	ƥ	ƥ	ƥ	ɓ̥
ʰɗ	ƭ	ƭ	ƭ	ƭ	ɗ̥
ɗ̬	ʃ	ʄ	ʄ	ƴ	ʄ
ʰɗ̬	ƈ	ƈ	ƈ	ƈ	ʄ̥
n̬	ɲ	ɲ	ñ	ñ	ɲ
C̃	NC	NC	NC	NC	NC
y	y	j	y	y	j
ʔ	ʔ	ʔ	’	’	ʔ
Vː	VV	VV	VV	VV	Vː

Syllables in Seereer-Siin follow a (C)V(ː)(C) template, with prenasalized stops counting as single segments. Heterosyllabic CC clusters are attested, but complex onsets or codas do not occur (Fal 1980: 63–65) and heterosyllabic clusters of more than two consonants are not allowed. Heterorganic vowel sequences are frequently found at morpheme junctions but they are not attested root-internally in the native vocabulary.[38] Word stress is not distinctive and always falls on the first stem syllable, which means that noun class prefixes are unstressed (Fal 1980: 66f.78). Words that are longer than two syllables display secondary stress on the ultima. Stress is phonetically weak and does not have any functional load other than indicating stem boundaries.

Morphology Seereer is a synthetic language with a rich verbal but a much less complex nominal morphology. The most notable aspect of Seereer nominal morphology is its noun class system that comprises 15 noun classes marked by a combination of class marker prefixes, ICM, and determiners that mark definiteness and proximity and agree with the head

[37] The available sources differ to some extent in their treatment of the phonetic nature of individual consonants. Fal (1980) describes the voiceless implosives as aspirated glottalized (“aspirés glottalisées”), a judgment that she abandoned later on (Mc Laughlin 1994: 282). Fal also characterizes /w/ and /j/ as voiced fricatives and /s/ as dorso-alveolar, in contrast to the other anterior coronal non-continuants (/n/, /t/ etc.), which she describes as apical. Heath (2014) gives [ʧ] and [ʤ] as phonetic realizations of /c/ and /ɟ/, which suggests that these consonants are in fact affricates. This, however, blatantly contradicts the treatment of affricates in Mc Laughlin (1994), where a phonologically active “affricate blocking rule” (pp. 298ff) prohibiting the emergence of affricates by any morphonological process is proposed.

[38] Hiatus across word boundaries is resolved by V2 deletion in casual speech. In some cases, the dispreference against vowel sequences has been grammaticalized, cf. the first person subject suffix *-(u)m* that takes the shape *-um* when it follows a C and *-m* when it follows a V (Heath 2014: 216f).

noun for noun class (129).[39] The ICM system features three grades (a, b, c), each of which involves a distinct set of consonant alternations. Not all noun classes are marked by overt prefixes, which means that in some cases, only C mutation and determiner agreement reveal a noun's class.

(129) *Seereer noun classes* (Mc Laughlin 2000: 361)

CLASS	PREFIX	DETERMINER	GRADE	
1	o-	oxe	b	HUMAN SINGULAR
2		we	a	HUMAN PLURAL
3a	a-	ale	a	SINGULAR
3b	a-	ale	c	AUGMENTATIVE SINGULAR
4	a-	ake	b	PLURAL
5		le	a	SINGULAR
6		ne	c	SINGULAR
7		feː	a	SINGULAR
8	fo-	ole	a	PLURAL
9		ke	b	PLURAL
10	o-	ole	a	SINGULAR
11	xa-	axe	b	PLURAL
12	o-	ONGE	c	DIMINUTIVE SINGULAR
13	fo-	ne	c	DIMINUTIVE PLURAL
14	fa-	feː	c	SINGULAR
15	pa-	ke	b	PLURAL

Affiliation to a certain noun class is lexically specified for each noun. However, most nouns can appear in different classes to express inflectional or derivational categories, mainly number, diminutive, and augmentative (130).

(130) *Nominal paradigms showing prefixes and ICM across different noun classes*

CLASS	GRADE	'milk bowl' /roːn/	'village' /saːx/	'horn' /can/	(M280, M283)
3a	c	a- **nd**oːn			AUGMENTATIVE SINGULAR
4	b		a-**c**aːx		PLURAL
5	a		**s**aːx		SINGULAR
10	a	o- **r**oːn		o-ɟan	SINGULAR
11	b	xa-**t**oːn		xa-**c**an	PLURAL
12	c	o- **nd**oːn	o-ɲɟaːx		DIMINUTIVE SINGULAR
13	c	fo-**nd**oːn		fo-ɲɟan	DIMINUTIVE PLURAL

Seereer has a rich inflectional verbal morphology. A lexical root can be preceded by a subject agreement prefix and followed by TAM, negation, and object agreement suffixes:

[39] The determiners are labelled enclitic elements by Mc Laughlin (2000). Here, I follow Heath (2014) in assuming that they constitute seperate words.

(131) a. *a-meːɓ-ax-am*
3SG-SG:lift-PFV-1SG.O
'he lifts me' (H224)

b. *gar-k-eː*
SG:come-FUT-NEG
'he won't come' (H223)

Verb stems are subject to ICM, too. Infinitive and singular stem forms appear in the a-grade, while plural stems forms appear in the c-grade; relevant examples are given in (132) and (133). Plurality may additionally be indicated by the optional element *(j)oː* following the verb.

(132) a. *a-xon-a*
3-die.SG-PFV
's/he died'

b. *a-NGon-a*
3-die.PL-PFV
'they died'

c. *a-gaʔ-a*
3-see.SG-PFV
's/he saw'

d. *a-ŋgaʔ-a*
3-see.PL-PFV
'they saw' (M280)

(133) *Verbal paradigms showing two grades of ICM*

INFINITIVE A-GRADE	SINGULAR A-GRADE	PLURAL C-GRADE	
bug	**b**ug-u	**mb**ug-u	'want, like'
ɓaf	**ɓ**af-a	**ɓ̥**af-a	'pour out waste water'
waːɗ	**w**aːɗ-a	**mb**aːɗ-a	'look for'
duʔ	**d**uʔ-a	**nd**uʔ-a	'stutter'
ɗeg	**ɗ**eg-a	**ɗ̥**eg-a	'cut'
ref	a-**r**ef-u	a-**nd**ef-u	'be'
ɟir	**ɟ**ir	**ɲɟ**ir	'be ill'
gen	a-**g**en-u	a-**ŋg**en-u	'live'
xoːx	a-**x**oːx-u	a-**NG**oːx-u	'cultivate, farm'

(MM338)

3.1.2.1 Initial consonant mutation

The consonant mutation system in Seereer-Siin involves three mutation grades, each invoked by a specific morphological context such as INFINITIVE or CLASS.1. The table in (134) provides an overview of all consonant alternations across the three mutation grades.[40]

(134) *Seereer-Siin consonant mutation*

	UR	p	b	ɓ̥	w	f	t	d	ɗ̥	r̥	c	ɟ	ʄ̥	k	x
a.	*voicing*	b	b	ɓ	w	f	d	d	ɗ	r	ɟ	ɟ	ʄ	g	x
b.	*continuancy*	p	b	ɓ̥	b	p	t	d	ɗ̥	t	c	ɟ	ʄ̥	k	q
c.	*nasal*	mb	mb	ɓ̥	mb	mb	nd	nd	ɗ̥	nd	ɲɟ	ɲɟ	ʄ̥	ŋg	NG

[40]Excluded from this table are the non-productive gradation sets *s∼c∼ɲɟ* (cf. (130)) and *w∼k∼ng*, the latter of which is restricted to a single lexical item (*-kiːn∼-wiːn∼-ŋgiːn* 'person'). Also not included is the alternation pattern *h∼k∼ŋg*, which is only found in some dialects that distinguish /x/ and /h/ (Merrill 2014: 15). The variety described in Mc Laughlin (2000) seems to attest /h/ and the respective mutations while the one discussed in Mc Laughlin (1994) does not.

The feature common to all members of the b-grade is [-cont]. The primary characteristic of the a-grade is voicing; the presence of voiceless fricatives *f*, *s*, and *x* is due to the general lack of voiced fricatives in Seereer-Siin. The c-grade contains homorganic prenasalized voiced stops, with the exception of underlying voiceless implosives that escape prenasalization. This is in line with a cross-linguistic dispreference against glottalized prenasalized consonants.

The ICM paradigm as presented here differs from the account in Mc Laughlin (1994, 2000) in that it unifies two sub-paradigms, one with voiced initial plosives and the other with voiced continuants and fricatives in the a-grade. Here, I adopt the proposal in Mc Laughlin (1994) and choose the b-grade of the former group and the a-grade of the latter group as the underlying representations. I depart from Mc Laughlin in that I treat partially mutating stems as non-exceptional and include them in the general paradigm (see discussion below). The idea of a unified treatment of ICM in Seereer-Siin is also put forward by Merrill (2014) and Merrill and Loum (2015). The crucial difference to my analysis is that Merrill and Loum (2015) equate the a-grade ("grade I") with the underlying forms for all alternation sets. Under such a view, b-grade ("grade II") mutation may comprise not only a change from a continuant to a non-continuant (as in *f*∼*p*) but also a change from a voiceless to a voiced segment (as in *b*∼*p*). By adopting the alternation sets in (134) and by distinguishing underlying and surface representations, we can associate changes in phonation and continuancy with different grades, which greatly simplifies a unified analysis of ICM in terms of featural affixation.

3.1.2.2 Reduplication and mutation overapplication

Deverbal agent nouns in Seereer-Siin are formed by creating a CV:-sized copy of the first verb stem syllable and prefixing a noun class marker to the reduplicated stem. The class 1 morpheme for human singular nouns contains the prefix vowel /o/ and triggers continuancy mutation on the initial consonant in the base. Bases with an initial continuant show optional overapplication of continuancy mutation in the reduplicant (135).[41] Bases with a voiced initial stop additionally devoice the initial C in the reduplicant; the voiceless consonant only appears in the reduplicant and never in the base (continuancy mutation applies vacuously in these cases) (136).

The class 2 morpheme for human plural nouns does not have a fixed segmental exponent but it triggers a-grade mutation. The examples in (137) show that mutation in the plural is fully transparent: voicing mutation vacuously applies to voiced initial obstruents in the reduplicant and, as expected, fails to apply to initial fricatives. Crucially, no optionality, backcopying, or any other exceptional segmental changes can be observed.

[41] To the best of my knowledge, both variants are equally acceptable and there are no semantic or pragmatic differences between them (Mc Laughlin 2000, Jevon Heath, pc).

(135) *Agent noun formation with optional overapplication* (MM334)

INFINITIVE	AGENT NOUN			
waːɗ	o-**b**aː-waːɗ	∼	o-**b**aː-**b**aːɗ	'search / researcher'
war	o-**b**aː-war	∼	o-**b**aː-**b**ar	'kill / killer'
fec	o-**p**eː-fec	∼	o-**p**eː-**p**ec	'dance / dancer'
fiʔ	o-**p**iː-fiʔ	∼	o-**p**iː-**p**iʔ	'act / actor'
reːf	o-**t**eː-reːf	∼	o-**t**eː-**t**eːf	'follow / follower'
riw	o-**t**iː-riw	∼	o-**t**iː-**t**iw	'weave / weaver'
xaʄ	o-**q**aː-xaʄ	∼	o-**q**aː-**q**aʄ	'shoot / shooter'
xoːx	o-**q**oː-xoːx	∼	o-**q**oː-**q**oːx	'cultivate / farmer'

(136) *Agent noun formation with additional devoicing* (MM334)

INFINITIVE	AGENT NOUN	
bind	o-**p**iː-bind	'write / writer'
ɓoɗ̥	o-**ɓ̥**oː-ɓoɗ̥	'strangle / strangler'
dap	o-**t**aː-dap	'launder / launderer'
ɗis	o-**ɗ̥**iː-ɗis	'sew / tailor'
ɟal	o-**c**aː-ɟal	'work / worker'
ɟik	o-**c**iː-ɟik	'buy / buyer'
gaʔ	o-**k**aː-gaʔ	'see / seer'
gim	o-**k**iː-gim	'sing / singer'

(137) *No devoicing and no optionality in the plural*

INFINITIVE	AGENT NOUN SG	AGENT NOUN PL		
xoːx	o-**q**oː-{**q, x**}oːx	**x**oː-**x**oːx	'cultivate / farmer(s)'	F152
riːw	o-**t**iː-{**t, r**}iw	**r**iː-**r**iw	'weave / weaver(s)'	MM359
gaʔ	o-**k**aː-**g**aʔ	**g**aː-**g**aʔ	'see / seer(s)'	MM359
ɟal		**ɟ**aː-**ɟ**al	'work / workers'	H209

Seereer has other productive reduplication processes which, however, do not interact with ICM and will only briefly be mentioned for the sake of completeness.[42] The first process is a derivational process similar to agent noun formation: Affixation of a CVː-sized copy of an initial stem syllable turns a locational noun into a demonym ((138)-a). In some cases, the semantic relation between the base and the derivative is not predictable (albeit still transparent) and the reduplicated forms must be considered lexicalized ((138)-b).

[42] To the best of my knowledge, Seereer-Siin, unlike other languages with ICM (e.g. Kießling 2010 on Celtic), does not attest mutation at the phrase level (see also Fal 1980: 120ff).

(138) *Demonym derivation and lexicalized reduplication* (F112)

a.	maː-marut	<	marut	‘a person from the village of Marut’	<	‘Marut’
	ɟaː-ɟaxaːw	<	ɟaxaːw	‘a person from the village of Jaxaaw’	<	‘Jaxaaw’
	ɟiː-ɟiloːr	<	ɟiloːr	‘a person from the village of Jiloor’	<	‘Jiloor’
b.	saː-saːx	<	saːx	‘village chief’	<	‘village’
	maː-maːg	<	maːg	‘sailor’	<	‘sea’
	juː-juːx	<	juːx	‘oyster shell’	<	‘oyster’

The second process is full verb root reduplication in the pretendative construction, which obligatorily contains the suffix *-loːx*. The extended pretendative stem can serve as the base for inflectional markers. I follow Heath (2014) in glossing the second and not the first stem as RED, but nothing would in principle rule out an analysis in which the reduplicative morpheme is a prefix.

(139) *Full reduplication in the pretendative*

a.	ɗaːn	ɗaːn-ɗaːn-loːx	H209
	sleep	sleep-RED-PRET	
	‘to sleep’	‘pretend to sleep’	
b.	ɟaw	a-ɟaw-ɟaw-loːx-aː	H214
	cook	3S-cook-RED-PRET-PROG	
	‘to cook’	‘He pretends to cook.’	

Heath (2014) discusses the possibility of yet another type of reduplication in the assertive construction. In this type of construction, a fully inflected verb form is followed by a morphologically less rich copy of the same verb. The copied form also lacks most of the inflectional morphology of its base (140-a), while initial consonant mutation (nasal grade mutation is unsuccessful in (140-b)) and applicative morphology do appear on the copy (140-b). The assertive construction is more restrictive than other multi-verb constructions in Seereer-Siin in that it does not allow any large syntactic constituents to intervene between the inflected verb stem and its copy and the maximal number of verb stem copies is one. The plural marker *(j)oː* may however optionally stand between the two copies (140-b). Heath concludes that the assertive construction combines properties of reduplication and syntactic doubling, but based on the fact that inflectional affixes and the plural marker may intervene between the two copies I consider it being in fact an instance of the latter.

(140) a. *a-moːf-a moːf taftaf*
3S-SG:sit-PFV sit quickly
‘He sat quickly.’ (H219)

b. *a-d̥eːt-k-a (joː) d̥eːt-ik*
3S-PL.see-APPL-PFV PL PL.meet-APPL
‘they are going to visit (someone)’ (H213, H220, H221)

3.1.3 A phonological account of overapplication and devoicing

I now present my analysis of mutation and its peculiarities in agent noun reduplication. My analysis of mutation closely follows that in Mc Laughlin (2000) but my account of reduplication differs substantially from previous accounts (Mc Laughlin 2000, Zimmermann and Trommer 2011). My main claim is that overapplication is driven by root node greediness: the pressure for • to dominate a [-c] feature that can only be satisfied if certain phonological conditions are met.

3.1.3.1 The three mutation grades

Following Mc Laughlin (1994, 2000), I assume that ICM in Seereer-Siin is triggered by floating features (141). These floating features are contained in the noun class morphemes introduced at the word level and in the infinitive and number morphemes introduced at the stem level.

(141) *Mutation triggers*
   a. *a-grade* ↔ [v]
   b. *b-grade* ↔ [-c]
   c. *c-grade* ↔ [n]

Nasal mutation I begin my analysis of consonant mutation with nasal (c-grade) mutation. Nasal mutation turns all consonants into a homorganic prenasalized voiced stop, with the exception of implosives, which remain unaffected (142).

(142) *Nasal mutation*

	Non-implosives								*Implosives*		
UR	p	w	f	t	r̥	c	k	x	ɓ̥	ɗ̥	ʄ̥
C-GRADE	mb	mb	mb	nd	nd	ɲɟ	ŋg	NG	ɓ̥	ɗ̥	ʄ̥

Nasal mutation is driven by the constraint in (143) which militates against floating [n] features. The dichotomy between implosives and non-implosives results from the undominated constraint in (144) which penalizes root nodes linked to both a [n] and a [cg] feature. Since that constraint checks I-structure, it generally forbids association of either feature to a • that is associated to the other feature.[43]

(143) •
↑
[n] Assign * for every [n] not associated to a • in I.

(144) *[n]•[cg] Assign * for every • associated to both [nas] and [cg] in I.

The fact that nasal mutation does not only cause prenasalization but also affects continuancy and voicing follows from cross-linguistically well-documented NT effects (Padgett 1994, Pater 1999, Riehl 2008). Mc Laughlin (2000) shows how these effects translate into the

[43] The fact that the lateral /l/ does not participate in ICM follows from similar reasons: a- and b-grade mutation apply vacuously, but an undominated constraint *[n]•[lat] prohibits association of [n].

feature co-occurrence constraints in (145). Ranking those constraints above the respective DEP constraints will result in epenthesis of [v] and [-c].[44] In addition, I assume that DEP• is undominated in Seereer-Siin, ruling out insertion of a rescuer root node.

(145) a. *[n]•¬[v] Assign * for each • associated to [n] but not to [v] in P.
b. *[n]•¬[-c] Assign * for each • associated to [n] but not to [-c] in P.

The tableaux in (146) – (147) illustrate how the feature co-occurrence constraints derive NT effects in c-grade mutation. Nasal mutation applies at the stem and the word levels upon affixation of a verbal plural morpheme or a noun class prefix containing a [n] feature.

(146) *Nasal mutation blocked:* fo 'DIM.PL.13' + ɓ̥aj *'hand'* (MM345)

WL	Input = a.	*[n]•[cg]	• ↑ [n]	*[n]•¬[v]	DEP [v]	MAX•[cg]
☞	a. f o ɓ̥ a j; [n] [cg]		*			
	b. f o mɓ̥ a j; [n] [cg]	*!		*		
	c. f o mb a j; [n] [cg] [v]	*!			*	*

(147) *Nasal mutation enforcing [v] epenthesis:* fo 'DIM.PL.13' + koːr *'man'* (MM346)

WL	Input = a.	*[n]•[cg]	• ↑ [n]	*[n]•¬[v]	DEP [v]	MAX•[cg]
	a. f o k o r; [n] [-c]		*!			
	b. f o ŋk o r; [n] [-c]			*!		
☞	c. f o ŋg o r; [n] [-c] [v]				*	

I attribute the fact that /l/ and /j/ are not prenasalizable to the co-occurrence constraints in (148) which state that laterals and approximants must not coexist with a [n] feature under the same root node, similar to (144) above.

(148) a. *[n]•[+appr] Assign * for each • associated to [n] and to [+appr] in I.
b. *[n]•[+lat] Assign * for each • associated to [n] and to [+lat] in I.

[44] *[n]•¬[-c] is the only constraint in Seereer-Siin that outranks DEP([-c]) (see the paragraph on continuancy mutation below for reasons why DEP([-c]) must outrank all other markedness constraints).

I assume that /w/ is specified for [-appr] and [-son] in Seereer-Siin. The way this sounds patterns in the various mutation grades in fact resembles what would be expected of a /v/ (which Seereer-Siin does not attest), but regardless of its featural decomposition, the default phonetic interpretation of /w/ is that of a labio-velar approximant.[45]

Voicing mutation Voicing or a-grade mutation induces voicing of underlyingly voiceless stops but does not affect voiceless fricatives (149).

(149) *Voicing mutation*

	Stops become voiced								*Fricatives are unaffected*		
UR	p	ɓ̥	t	ɗ̥	ɗ̥	c	ʄ̥	k	f	s	x
A-GRADE	b	ɓ	d	ɗ	r	ɟ	ʄ	g	f	s	x

Voicing mutation is triggered by a floating [v] feature. Successful voicing mutation results from simple integration of the floating [v] into the feature geometry of a voiceless segment. Fricatives resist voicing due to the constraint in (150) that militates against voiced fricatives and is undominated at all levels (I assume the rhotic is not specified for [+c] in Seereer-Siin). For reasons that will become clear later on, I assume that unassociated [v] features introduced at the stem or word levels are dormant and are only integrated at the phrase level.

(150) *[+c]•[v] Assign * for each • associated to [+c] and [v] in I.

The tableaux in (151) and (152) illustrate the different treatment of [v] by the word- and phrase-level phonologies. At the stem and word levels, DEP[v]–• is undominated, which is why the floating [v] cannot associate to a • (I assume that DEP(•) is very high-ranked, too). When the optimal candidates from the stem and word level evaluations are shipped to the next level, FULL REBIRTHING ensures that unassociated material is preserved. For that reason, the floating [v] is still present at the phrase level, where DEP[v]–• is ranked low and [v] can be realized. I additionally assume that voicing mutation applies vacuously to underlyingly voiced sounds such as /l/ because there is no high-ranked constraint against multiple [v] features under a single • in Seereer-Siin.

(151) *Voicing mutation blocked at* WL*:* [v] '*HUM.PL.2*' + kawul '*griot*'

WL	Input = a.	DEP•[v]	• ↑ [v]
☞ a.	k a w u l [v]		*
b.	g a w u l ⁄ (dashed) [v]	*!	

[45]This decomposition is in a way the mirror image of what has been proposed for the labio-dental fricative in Russian, which has a default pronunciation of [v] but patterns like a sonorant for the process of voice assimilation (Jakobson 1956, Halle 1971).

(152) *Voicing mutation succeeds at* PL

PL	Input = a.	• ↑ [v]	DEP•[v]	ALT
	a. k a w u l [v]	*!		
☞	b. g a w u l [v] (dashed association line)		*	*

There are both stem-level and word-level morphemes containing a floating [v]. At the word level, all noun class prefixes that are accompanied by a-grade mutation have a floating [v]. At the stem level, the infinitive and singular morphemes likewise induce a-grade mutation on verbal roots. The crucial difference between noun class prefixes and the verbal inflection morphemes is that the latter infixes anchored to the right of the first stem consonant. This assumption is crucial for correctly predicting the locus of devoicing in some agent nouns and will be motivated in section 3.1.3.4.

Continuancy mutation The consonant inventory of Seereer-Siin displays a strong dispreference against continuant obstruents. The only continuant obstruents are the voiceless fricatives /f, s, x/. I capture this asymmetry by the greediness constraint in (153), which militates against continuant obstruents. This constraint is also supported by the cross-linguistic observation that fricatives are less frequent in the world's languages than plosives.[46]

(153) [-son] ↓ [-c] Assign * for every [-son] root node not linked to a [-c].(GREEDINESS)

This constraint is the main driving force of continuancy mutation (154). In the absence of an unassociated [-c] feature, (153) cannot be satisfied because all potential repair strategies are ruled out due to higher-ranked markedness and faithfulness constraints. When an unassociated [-c] feature is present, however, a non-continuant • associates to it and b-grade mutation applies. This is exemplified in the tableaux in (155) – (156).

(154) *Continuancy mutation*

	Continuants become stops					*Non-continuants are unaffected*						
UR	w	f	r̥	s	x	p	ɓ̥	t	ɗ̥	c	ʄ̥	k
B-GRADE	b	p	t	c	q	p	ɓ̥	t	ɗ̥	c	ʄ̥	k

[46]The empirical foundation of this claim lies in notable distributional asymmetries. First, there isn't a single language in the UPSID language sample (Maddieson 1984) that lacks stops altogether, while there are a few languages (6.87%) which do not attest a single fricative. About every fourth language in the sample (23.73%) has ten oder more stops, but only 5.99% have the same amount of fricatives. Second, in many languages, fricatives occur only in a subset of positions in which stops may occur (de Lacy 2006, Jenny et al. 2015).

(155) *Root node greediness has no effect in the absence of a free [-c]*

WL	Input = a.	DEP [-c]	*MIX	[-son] ↓ [-c]	• ↑ [-c]	DEP $\overset{\bullet}{\underset{\text{[-c]}}{\vert}}$
☞	a. • • • ; [+c] [-c]			*		
	b. • • • ; [-c] [+c] [-c]	*!				
	c. • • • ; [+c] [-c]		*!			*

(156) *Root node greediness quenched*

WL	Input = a.	DEP [-c]	*MIX	[-son] ↓ [-c]	• ↑ [-c]	DEP $\overset{\bullet}{\underset{\text{[-c]}}{\vert}}$
	a. • • • ; [-c] [+c] [-c]			*!	*	
☞	b. • • • ; [-c] [+c] [-c]					*
	c. • • • ; [-c] [+c] [-c]		*!		*	

What drives locality of b-grade mutation (with the exception of reduplicated forms, see below) are the four high-ranked constraints in (157) – (159). These constraints also explain why b-grade mutation never affects a non-initial • when the initial C is an underlying stop: the floating [-c] does not link to the underlying stop because it satisfies (153) vacuously; however, it cannot associate to any other root node, either. For that reason, no mutation is more harmonic than non-local mutation (160).

(157) $*\times\overset{\bullet}{\underset{\text{[c]}}{\vert}}$ Assign one * to every ordered pair of [c] nodes ($[c]_1$, $[c]_2$) such that: (i) $[c]_1$ is associated to $\bullet_2$ and $[c]_2$ is associated to $\bullet_1$ via visible lines, (ii) $[c]_1 \prec [c]_2$ and $\bullet_1 \prec \bullet_2$.

(158) MAX$\overset{\bullet}{\underset{\text{[-c]}}{\vert}}$ Assign * for each invisible association line between a • and a [-c].

(159) $*\text{[-c]}\boxed{2\bullet}$ Assign * for each [-c] linked to two root nodes of the same color.

(160) *ICM must obey locality*

WL	Input = a.	MAX •ǀ[-c]	*[-c] 2•	*× •ǀ[c]	[-son] ↓ [-c]	• ↑ [-c]
☞ a.	• • • / [-c] [-c] [+c]				*	*
b.	• • • / [-c] [-c] [+c]			*!		
c.	• • • / [-c] [-c] [+c]	*!				
d.	• • • / [-c] [-c] [+c]	*!	*			

As mentioned previously, the fact that /w/ and /r̥/ pattern as fricatives with respect to continuancy mutation suggests that they are specified as [-son]. Also, we can see from the mapping of /x/ to /q/ that the posterior fricative is phonologically specified for uvular place of articulation even though it may have a variable phonetic realization given that it does not contrast with other posterior fricatives.

3.1.3.2 Reduplication

Agent noun formation involves both CV:-sized reduplication and noun class morphology at the word level. The agentive morpheme (161) contains two empty moras which trigger minimal copying of the initial (C)V sequence of the stem that they are prefixed to (162).

(161) [AGENT] ↔ μ μ (WORD LEVEL)

(162) *Reduplication in agent nouns (not showing mutation)*

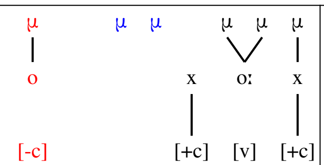
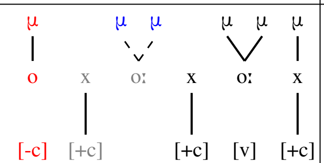
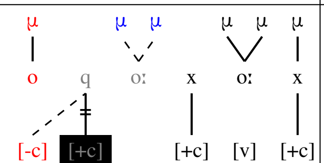
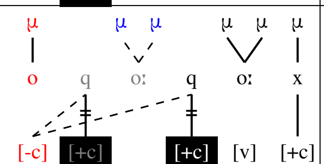
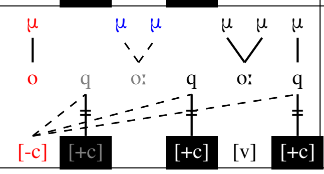
WL	Input = a.	μ ↓ S	DEP S	*MIX μ•	INT S
a.	μ μ μ μ / f e c	*!*			
☞ b.	μ μ μ μ / f eː f e c				**
c.	μ μ μ μ / f e c f e c				***!
d.	μ μ μ μ / f e f eː c			*!	**

3.1.3.3 Continuancy mutation overapplication in agent nouns

The only phonological environment in which root node greediness successfully drives multiple linking of a single [-c] feature is when a defective [-c] feature is adjacent to two [+c] root nodes of different colors. This is exactly the environment of singular agent nouns, where underlying material, copied material, and a [-c] feature from the class 1 prefix are present. The word level is a non-recursive domain, which is why the verbal stem, the noun class prefix, and the agentive morpheme are evaluated in parallel.

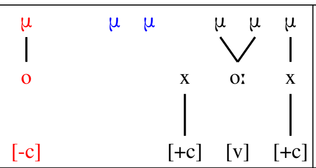
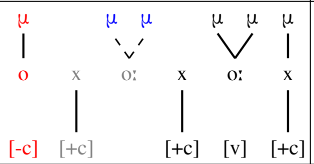
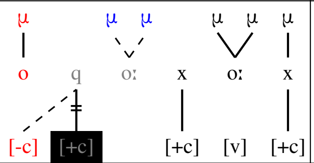
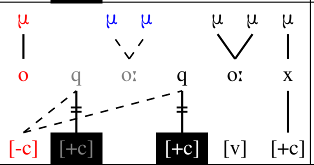
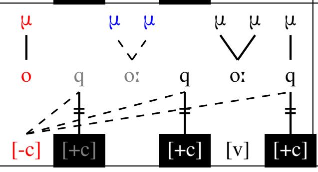
The tableau in (163) shows how the overapplication pattern is derived. The fully faithful candidate in a. fatally violates μ→σ. Candidate b. applies reduplication but no mutation. Since the copied C also dominates a [+c] feature, b. incurs a total of three violations of [-son]→[-c]. The crucial competition is between candidates c. and d. The former applies local mutation, violating GREEDINESS twice. The latter mutates the initial C in both base and reduplicant, satisfying *[-c]$^{\boxed{2\bullet}}$ and the P-structure version of the NCC but violating the I-structure version of the NCC. It follows from GREEDINESS ≫ NCC that candidate d. is optimal compared to candidate c. under the given grammar. ATB mutation in e. is eliminated because it fatally violates *[-c]$^{\boxed{2\bullet}}$.

(163) GREEDINESS ≫ NCC: *Overapplication* (xo:x → oqo:qo:x *'farmer'*)

WL	Input = a.	μ ↓ S	*× • [c]	*[-c]$^{\boxed{2\bullet}}$	[-son] ↓ [-c]	*× • [c]	• ↑ [-c]
a.		*!*			**		*
b.					**!*		*
c.					**!		
☞ d.					*	*	
e.				*!		**	

Mutation overapplication is not an obligatory process. I assume with Anttila (2007) and Kaplan (2016) that variability in grammar results from different subrankings (partially ordered grammars). In (163) above, the greediness constraint [-son]→[-c] outranks the NCC, resulting in overapplication. The reverse ranking heavily restricts line crossing and enforces strict locality of continuancy mutation. The effect of this subtle difference is shown in (164), where the strictly local candidate c. is the optimal output.

(164) NCC ≫ GREEDINESS ⇒ *No overapplication* (xoːx → oqoːxoːx *'farmer'*)

WL	Input = a.	μ ↓ S	*× • [c] (crossed line)	*[-c] 2•	*× • [c]	[-son] ↓ [-c]	• ↑ [-c]
a.		*!*				**	*
b.						***!	*
☞ c.						**	
d.					*!	*	
e.				*!			

It is important to understand that deverbal agent nouns are the only morphological context in Seereer where a floating [-c] may cause overapplication. The complex verbal morphology of Seereer-Siin would in principle provide a fertile ground for multiple linking of [-c] because multiple linking is allowed for • nodes of different colors. However, verbal mutation only involves the a- and the c-grades but not the b-grade, therefore a floating [-c] is never present in non-nominalized verb forms. Post-nominal elements such as determiners in (cf. (129)) are only evaluated in parallel with nouns and class prefixes at the phrase level, which has a strict ban on line insertion to [c] nodes. For these reasons, greedy linking to a [-c] node is only observed in agent noun formation.

A final issue that needs to be addressed is the peculiar non-interaction between b-grade mutation overapplication and a-grade mutation. Why is it that at the phrasal level, the [v] from the infinitive morpheme only affects an underlying plosive but not a derived plosive? For example, why does the output of a WL grammar favoring overapplication (*oqoːqoːx*, ...) not become (**oqoːɢoːx*, ...) at the phrase level? The answer is that interstratal clean-up is not destructive as FULL REBIRTHING does not erase invisible nodes or association lines. The underlying [+c] feature in the derived stop is still present and connected to the • via an invisible association line at all subsequent strata. Recall from section 3.1.2.1 that the

I-structure constraint *[+c]•[v] in (150) is undominated at PL. For that reason, a C that was associated to a [+c] at some point in the derivation will never be amenable to voicing mutation regardless of whether or not that association line has been marked as invisible at some intermediate stage.

3.1.3.4 Devoicing

Underlyingly non-continuant Cs show a voiceless C in the reduplicant but a voiced C in the base even though no obvious trigger of devoicing is present in this context (165).

(165) *Devoicing of voiced initial stops* (= (125))

INFINITIVE	AGENT NOUN	
bind	o-**pi**ː-bind	'write / writer'
dap	o-**ta**ː-dap	'launder / launderer'
gaʔ	o-**ka**ː-gaʔ	'see / seer'
ɟik	o-**ci**ː-ɟik	'buy / buyer'

The seemingly unmotivated discrepancy in the reduplicated forms receives a straightforward explanation once we have a closer look at the internal morphological structure of agent nouns and accept two assumptions. The first assumption is that the initial plosives in the infinitive stems seen in (165) and (136) are underlyingly voiceless. I attribute this to stratal preprocessing at the root level that prohibits voiced initial obstruents in verbal roots. Evidence for this comes from examples such as (166), where nasal mutation in the plural of inflected verbs is regularly blocked from applying to implosives and the underlying root form with a voiceless initial C surfaces.

(166) *a-ɗ̥eːt-k-a* *(joː) ɗ̥eːt-ik* (= (140-b))
3S-PL.see-APPL-PFV PL PL.meet-APPL
'they are going to visit (someone)' (H213, H220, H221)

The second assumption is that agent noun morphology is not built around the bare verbal root but the infinitive stem, which consists of the root and the INF morpheme: [$_{\text{STEM}}$ INF [$\sqrt{v}$]]. The INF morpheme with the lexical entry in (167) is infixed to the right of the first root consonant. The complete picture of the internal structure of agent nouns is given in (168).

(167) [ITER] ↔ [v] ALIGN([v], L, $C_{\text{1ST-STEM}}$, R)

(168) *Morphological structure of agent nouns*
(/pind/ 'write' → *bind* 'write:INF' → *opiːbind* 'writer')

[	WORD	[	STEM		]	]	]
[CL.1	[AGEN	[INF		$\sqrt{v}$	]	]	]
o [-c] +	μ μ +	[v] +		**pind**			

In unreduplicated words such as *bind* 'write', the floating [v] feature attaches to the first consonantal root node, yielding the D-initial stems seen above. Defective [v] nodes behave strikingly different from other floating material in Seereer-Siin: while the [v] from the INF morpheme enters the derivation at the stem level, it is only integrated into segmental structure at the phrase level. Since agent noun formation is a word-level process, it is ordered after infixation of [v] but before [v] links to a root node. If the [v] node associated to the C before reduplication takes place, reduplication would be expected to create a copy of the voiced stop. The fact that only one C is voiced in forms such as *opi:bind* shows that this ordering cannot be correct (169).

(169) *Incorrect derivational history of agent nouns*

	SL *in*	SL *out*	WL *in*	WL *out*	
/pind/	p$_{[v]}$ind	bind	bind	bind	'write'
/pind/	p$_{[v]}$ind	bind	o $_{[-c]}$ $^{\mu\mu}$ bind	o bi: bind ↯	'writer'

Instead, the copied onset C is voiceless. At the phrasal level, [v] transparently triggers local mutation on the base C after reduplication has taken place, leaving the voiceless C in the reduplicant C unaffected. Voicing mutation overapplication is therefore counterfed by late integration of [v]. The derivations of simple verbs and reduplicated agent nouns are summarized in (170).

(170) *Actual derivational history of infinitives and agent nouns (root level input = /pind/)*

SL *in*	SL *out*	WL *in*	WL *out*	PL *in*	PL *out*	
p$_{[v]}$ind	p$_{[v]}$ind	p$_{[v]}$ind	p$_{[v]}$ind	p$_{[v]}$ind	**bind**	'write'
p$_{[v]}$ind	p$_{[v]}$ind	o $_{[-c]}$ $^{\mu\mu}$ p$_{[v]}$ind	o pi: p$_{[v]}$ind	opi:p$_{[v]}$ind	**opi:bind**	'writer'
p$_{[v]}$ind	p$_{[v]}$ind	$_{[v]}$ $^{\mu\mu}$ p$_{[v]}$ind	$_{[v]}$ pi: p$_{[v]}$ind	opi:$_{[v]}$p$_{[v]}$ind	**obi:bind**	'writers'

In light of this, "exceptional devoicing" is neither exceptional nor devoicing: it is local voicing which remains local in the context of reduplication. Non-overapplication of voicing follows directly from a basic assumption of BMR, viz. the view that repair-driven copying is minimal and floating material is not pied-piped along the relevant prosodic and segmental nodes. Absence of voicing in reduplicants in Seereer-Siin thus follows from the same principles as mutation underapplication in Lakota and Kulina (chapter 4) and adds support to the GNLA approach to mutation and reduplication in general.

(171) *No devoicing and no optionality in the plural* (= (137))

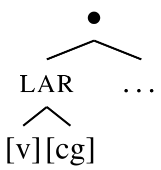
INFINITIVE	AGENT NOUN SG	AGENT NOUN PL		
xo:x	o-**q**o:-**{q, x}**o:x	**x**o:-**x**o:x	'cultivate / farmer(s)'	F152
ri:w	o-**t**i:-**{t, r}**iw	**r**i:-**r**iw	'weave / weaver(s)'	MM359
gaʔ	o-**k**a:-**g**aʔ	**g**a:-**g**aʔ	'see / seer(s)'	MM359
ɟal		**ɟ**a:-**ɟ**al	'work / workers'	H209

The analysis presented also offers an explanation for the lack of devoicing in the plural. Recall that in the plural form of agent nouns, both the initial C in the base and in the reduplicant are voiced (171). The reason for this is that the class 2 morpheme for human plural nouns has a floating [v] feature. At the phrase level, the infixed [v] from INF associates to the base C and the prefixed [v] from the noun class morpheme associates to the reduplicated C. Voicing identity between base and reduplicant is thus an epiphenomenon of two distinct operations, but in contrast to continuancy mutation overapplication, two identical trigger features are present (169).

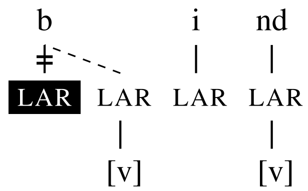
3.1.3.5 Partially mutating and non-mutating stems

A geometrical refinement of [v]-infixation It is necessary to return once more to the case of [v]-infixation and the question of representation. From a standard autosegmental perspective, anchoring the position of the floating [v] from the INF morpheme to a • is problematic, as the floating [v] should only have a fixed position with respect to homoplanar [v] nodes. In fact, one of the central arguments in my account of Sye mutations in section 5.1 is that the linear order of heteroplanar defective phonological material can only be established if there is some tier T_n with the nodes $N_1, \ldots,$ to which the nodes whose order is to be defined are linked. The representations used for Seereer-Siin so far should therefore be taken as convenience abbreviations for what is actually a more complex geometry, which is shown in full detail in figure (172). In this geometry, all phonologically active laryngeal features reside under a LAR node instead of being directly linked to a •.

(172) *Laryngeal geometry*



(173) *Voicing mutation as overwriting*



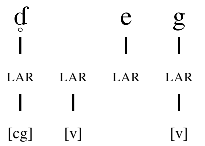
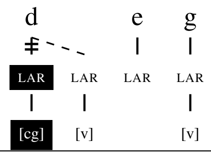
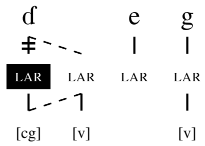
Adopting this geometry makes it possible to refine the representation of the infinitive morpheme as a LAR node linked to a [v] feature and re-define its pivotal position as in (174). Assuming that each segmental • dominates a LAR even if the segment in question is not contrastively specified for [v] or [cg], successful integration of the defective structure from the infinitive morpheme will always result in mutation on the root-initial C and never on any other C node (173).

(174) [INF] ↔ $\overset{\text{LAR}}{\text{[v]}}$ ALIGN($\overset{\text{LAR}}{\text{[v]}}$, L, $\text{LAR}_{\text{1ST-STEM}}$, R)

The fact that voiceless implosives remain faithful to their [cg] when they undergo voicing mutation is due to the undominated constraint in (175) which requires a [cg] feature that is phonetically visible in the input to be also visible in the output. As shown in the tableau in (176), the effect of MAX([cg]) is that a [cg] under a non-pronounced LAR node immediately re-associates to a pronounced LAR node under the same root node.

(175) MAX [cg] Assign * for every [cg] node such that [cg] is phonetically visible in M but not in P.

(176) *Faithfulness to* [cg]

PL	Input = a.	$*\bullet_{2\text{LAR}}$	MAX [cg]	$\bullet$ ↑ LAR	DEP $^{\text{LAR}}_{[\text{cg}]}$	MAX $^{\bullet}_{\text{LAR}}$
	a. 			*!		
	b. 		*!			*
☞	c. 				*	*

Partially mutating stems Adopting the enriched representations with the LAR tier is not only a technical refinement. It also makes it possible to account for the behavior of not fully mutating roots, a small but not insignificant number of roots that exceptionally resist voicing and/or nasal mutation. The table in (177) gives some relevant examples of nominal roots that resist voicing mutation in the a-grade.[47]

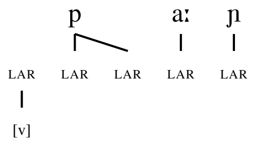
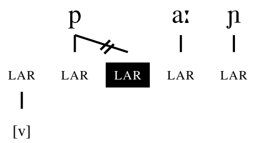
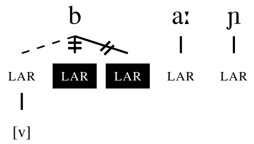
(177) *Partially mutating nominal roots: Lack of voicing in the a-grade*

A-GRADE (CL.10)	B-GRADE (CL.11)	C-GRADE (CL.3b)		
paːɲ (CL.7)	paːɲ (CL.9)	a-mbaːɲ	'oyster'	MM340
o-cok	xa-cok	a-ɲɟok	'neck'	MM340
o-tengaːdo	xa-tengaːdo	a-ndengaːdo	'hat'	MM340
o-qir	xa-qir		'whip'	DIC106
o-caːj	xa-caːj		'bridle'	DIC20
o-paŋ	xa-paŋ		'energetic dance'	DIC99
o-kafal	xa-kafal		'tsetse fly'	DIC64
o-qol	xa-qol		'field; farm'	DIC107

I analyze the lack of voicing mutation in partially mutating stems as the result of a structural configuration that is independently predicted by ROTB: an initial C linked to two empty LAR nodes underlyingly. As evidenced by LAR overwriting in regular voicing mutation, the phonology of Seereer-Siin tolerates root nodes linked to two LAR nodes at the I-level but not at the P-level. However, Seereer-Siin has a general ban on • linked to more than two LAR nodes ($*\bullet_{3\text{LAR}}$). For that reason, an oversaturated • will never allow for association of an additional LAR node. This effect is shown in the tableau in (178).

[47] Contra Mc Laughlin (2000: 339), I do not consider nominal roots such as *guru* ∼ *guru* ∼ *foŋguru* '7∼9∼13:cola nut' to be partially mutating. Instead, I analyze these cases as entirely regular derivations of nominals with an underlying voiced initial stop to which voicing and continuancy mutation apply vacuously (see section 3.1.2.1).

(178) *Partially mutating stems: Unsuccessful voicing mutation*

PL	Input = a.	$*\bullet_{3\text{LAR}}$	$*\bullet_{2\text{LAR}}$	• ↑ LAR
	a. 		*!	*
☞	b. 			*
	c. 	*!		

Non-mutating stems There are also a number of stop-initial roots in Seereer-Siin that are not affected by voicing or nasal mutation in the respective morphological contexts and thus do not have any alternating forms. While non-mutating roots form only a small part of the lexicon, they are considerably more numerous than in Fula (Merrill 2014: 14). The tables in (179) and (180) show some relevant data (see also Merrill 2014).

(179) *Non-mutating verbal roots*

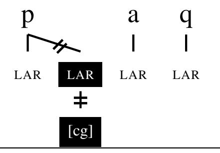
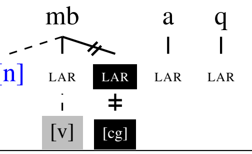
INFINITIVE	SINGULAR	PLURAL		
paf	pafa	pafa	'end up (doing sth.)'	MM341
paq	paq	paq	'be exhausted'	MM341
qec	qec	qec	'pull (as a string)'	MM341
taɓ	taɓ	taɓ	'be miserly'	MM341
ciʔ	ciʔ	ciʔ	'give'	DIC22
kaɓ̥	kaɓ̥	kaɓ̥	'burn (intrans.)'	DIC63
paːŋ	paːŋ	paːŋ	'finish'	DIC97
tuːɗ̥	tuːɗ̥	tuːɗ̥	'bend'	DIC130
kat	kat	kat	'trip (s.o.)'	DIC65

(180) *Non-mutating nominal roots*

A-GRADE	B-GRADE	C-GRADE		
mbaxana (CL.5)	xa-mbaxana (CL.11)	o-mbaxana (CL.12)	'hat'	MM339
	cit (CL.9)	cit (CL.6)	'gift'	DIC23
	pis (CL.9)	pis (CL.6)	'horse'	DIC102
	kom (CL.9)	kom (CL.6)	'day, date'	DIC68
	teːx (CL.9)	teːx (CL.6)	'medicine'	DIC126
	ceq (CL.9)	ceq (CL.6)	'necklace'	DIC22

The case of *mbaxana* is trivial if we assume an underlying initial /mb/ to which all three mutation processes apply vacuously. As far as /T/-initial nominal and verbal roots are concerned, I assume that the initial C is born with an additional LAR node, just like in partially mutating roots. What makes non-mutating roots different is that the additional LAR node is linked to a [cg] feature via an underlyingly invisible association line. This means that the • is linked to a [cg] node at the level of I-structure, making it an impossible target for a [n] node due to a high-ranked I-sensitive markedness constraint against co-occurrence of [cg] and [n], motivated on independent grounds for regular c-grade mutation in (144) above. In (181), the workings of the co-occurrence constraint is shown for the stem level phonology where the plural [n] is introduced; the relevant rankings remain the same on later strata.

(181) *Non-mutating stems: Unsuccessful nasal mutation*

WL	Input = a.	*[n]•[cg]	*[n]•¬[v]	• ↑ [n]	DEP [v]
☞ a.	[n] 			*	
b.	[n] 	*!			*

3.1.4 An alternative: BRCT

An obvious alternative to the analysis presented above is an account in terms of base-reduplicant faithfulness in BRCT. Under such an account, mutation overapplication would follow from a high-ranked IDENT constraint indexed to the RED morpheme. An analysis along these lines is presented in Mc Laughlin (2000). Mc Laughlin assumes that mutation is triggered by affixation of the floating features [+voice] for the a-grade, [-cont] for the b-grade, and [+nas] for the c-grade. Mutation is driven by MAX(subseg) "Every subsegment in the input has a correspondent in the output"; the details of segmental alternations and the immunity of certain segments follow from a set of markedness constraints similar to the one presented in section 3.1.3.1 above.

The invariable CVː-shape of the reduplicant derives from the interplay of general markedness and morpheme-specific templatic constraints in (182), i.e. the inbuilt faithfulness asymmetry in BRCT. Optimization proceeds monostratally: the verbal root, the RED morpheme, and the noun class marker are present and are evaluated in parallel. A high-ranked ALIGN-L ensures mutation always applies to the leftmost C (the onset of the reduplicant).

(182) a. RED = $\sigma_{\mu\mu}$
The reduplicant is a bimoraic syllable.

b. NOCODA
Syllables are open. (Mc Laughlin 2000: 355)

Optional overapplication of continuancy mutation as in the case of *otiːriw* ∼ *otiːtiw* 'weaver' follows from a ranking tie between the two identity constraints ID-IO(vce) and ID-BR(subseg).

As shown in the tableau in (183) below, local mutation incurs one violation of ID-IO (b.) and overapplication incurs one violation of ID-BR (c.). Since ID-IO and ID-BR are equally ranked and the violation profiles of the two candidates do not differ in any other respect, both candidates are optimal. Under Mc Laughlin's analysis, the empirical observation that a single affixed feature may appear in both base and reduplicant follows from two constraint ties between ID-BR and ID-IO.

(183) *Optional overapplication in BRCT* (fragment of Mc Laughlin 2000: 357)

o [-c] + RED + riw		MAX (subseg)	ID-BR (subseg)	ID-IO (vce)	ID-IO (cont)	ID-BR (F)
	a. oriiriw	*!				
☞	b. $ot_{[-c]}iit_{[-c]}iiw$			*	*	
☞	c. $ot_{[-c]}iiriw$		*			*

Overapplication is predicted in BRCT when BR-FAITH outranks IO-FAITH, and BRCT likewise predicts that a tie between these two constraints could potentially lead to more than one candidate being optimal, all else being equal. The major disadvantage of applying this reasoning to Seereer-Siin is that it crucially relies on the stipulation that the two competing candidates have perfectly identical violation profiles for the entire universe of constraints that are active in the grammar. This would necessarily presuppose that segmental and subsegmental markedness constraints such as */r/ or *[+cont]/C and OCP-like constraints against sequences of identical consonants cannot be ranked with respect to each other because the two candidates will always show divergent violation profiles for those types of constraints.

An even stronger case against Mc Laughlin's approach is that it needs to stipulate yet another morpheme-specific constraint in order to account for the exceptional devoicing pattern. The indexed constraint in (184) ensures the initial consonant of noun stems in the b-grade is voiceless and is fatally violated by suboptimal candidates such as **obi:bind* (input: /o/ [-c] + RED + /bind/).

(184) VCE/C_{Cl-b} (Mc Laughlin 2000: 350)
The initial consonant of noun stems in classes that condition the b-grade (Classes 3a, 4, 9, 11 and 15) is voiceless.

Mc Laughlin argues that this constraint is independently motivated by the behavior of the rhotic consonant in b-grade mutation. In cases such as *otew* 'woman:SG' ∼ *rew* 'woman:PL' ∼ *ondew* 'woman:DIM', the voiced a-grade segment /r/ has a voiceless partner /t/ in the b-grade. If /r/ is assumed to be the underlying segment[48], devoicing in the b-grade (r → t, *r → d) remains mysterious without the constraint in (184). If we consider /r̥/ the underlying consonant, as I have argued above, this constraint is no longer necessary. Furthermore, VCE/C_{Cl-b} is, as admitted by Mc Laughlin herself, too powerful: it falsely predicts *w* → **p*

[48] Mc Laughlin (2000) is rather vague when it comes to underlying representations. Mc Laughlin (1994) claims that b-grade forms are identical to their underlying forms for roots that display a voiced stop in their a-grade, and that a-grade forms are identical to their underlying forms if they begin in a continuant. Such an account falls short of partially mutating roots.

instead of $w \rightarrow b$ in the same environment, an unwanted side effect that requires the addition of yet another, more specific version of the same constraint.

My analysis presented in the previous section provides a unified account of exceptional devoicing and optional overapplication of continuancy mutation. I have argued against an alternative account that prescribes two unrelated morpheme-specific treatments for two processes which under my analysis follow from the same basic principles, viz. the interaction of defective material and a stratal organization of grammar.

3.2 Domain sensitivity in Meskwaki Fox

3.2.1 The problem

Fox makes extensive use of vowel alternations in various morphological and phonological contexts. When a vowel mutation process targets a vowel in a reduplicated string, it is blind to reduplication in some cases while it applies to both base and reduplicant in other cases. An example of the former is *Initial Change* (IC), a mutation process that is triggered by certain suffixes such as the participle marker *-aːʧihi* and that affects the vowel in the leftmost stem syllable ((185)-b). When such a suffix attaches to a reduplicated stem, IC again applies only to the first vowel in the reduplicant but not to any other vowel, not even the base vowel ((185)-c).

(185) a. **a**mw- ‘to eat’ (Dahlstrom 1997: 222)
b. **eː**mw-aːʧihi ‘the ones whom they eat’
c. **eː**mwa-h-**a**mw-aːʧihi ‘the ones whom they (repeatedly) eat’

Another pervasive vowel alternation pattern in Fox is a *raising* process that changes /e/ to /i/ in word-initial position ((186)-b). In reduplicated forms, word-initial raising overapplies and seems to be backcopied onto the base ((186)-c). Adding a prefix such as the agreement marker *net-* to a reduplicated stem bleeds word-initial raising, but curiously, raising is still observed in the base vowel ((186)-d). This is unexpected because neither the root nor the reduplicant seem to be in the context that triggers /e/-raising, i.e. in word-initial position.

(186) a. **e**naːpi- ‘to look’
b. **i**naːpi-wa ‘he looks’
c. **i**na-h-**i**naːpi-wa ‘he looks (repeatedly)’
d. net-**e**na-h-**i**naːpi ‘I look (repeatedly)’ (Dahlstrom 1997: 216)

The intricate behavior of /e/-raising and the fact that some vowel alternations overapply while others do not seems to provide a strong argument for theories in which constraints are indexed to individual morphemes. In this vein, Burkhardt (2001) argues that in order to account for the Fox data, it is necessary to invoke the full range of conceivable faithfulness relations in BRCT, viz. base-reduplicant, input-reduplicant, and output-output faithfulness, the latter two being controversial even among proponents of standard BRCT (McCarthy and Prince 1995, Hale et al. 1998, Strujke 2002). It is the goal of this chapter to show that both Initial Change and raising follow from affixation of defective segmental and prosodic material on different strata. It will be argued that all differences in their behavior under reduplication are derivable via general phonological constraints, thereby eradicating the need for morphological indexation with respect to both vowel mutation and reduplication. The core assumptions of my analysis are independently motivated by other processes in Fox that have been largely neglected in previous analyses.

3.2.2 Phonological background

Fox is a small family within the Eastern Great Planes Algonquian branch of Algonquian comprising the Meskwaki (Mesquakie) and Kickapoo languages, with the former being subdivided into the Meskwakie and Sac (Sauk) dialects (Hammarström et al. 2017). Meskwaki is spoken by approximately 200 speakers in Iowa and Sac by about 50 speakers in central Oklahoma and a few people on the Kansas-Nebraska border (Golla 2007: 77). As the term *Meskwaki(e)* may be ambiguous between a language and a particular dialect and "differences [between Meskwakie and Sac] are more social than linguistic" (ibid.), I will be using the term "Fox" as a cover term to refer to both Meskwakie and Sac (Sauk) throughout this chapter.

The data discussed here comes from a broad array of descriptive sources spanning almost an entire century: the descriptive grammar in Jones (1911), the grammatical notes in Bloomfield (1925, 1927) and Voorhis (1971), the phonological observations in Goddard (1991), the discussion of reduplication in Dahlstrom (1997), the critical edition of Bloomfield's dictionary in Goddard (1994), and the Sauk dictionary in Whittaker (2005), abbreviated here as J, B, BB, V, G, D, GG, and W, respectively.

Segment inventory Fox has a rather small consonant inventory consisting of stops, fricatives[49], nasals, glides, and one affricate (187). A notable property of Fox consonantism is the absence of laterals and rhotics. Fox distinguishes five primary places of articulation: bilabial, coronal anterior, coronal posterior, velar, and glottal.

(187) *Fox consonant inventory* (D209)

p	t		k	k^w	
		tʃ			
	s	ʃ			h
m	n				
w		j			

The labialized velar /k^w/ stands out as the only segment with a secondary place of articulation. I follow the monosegmental analysis of /k^w/ in Dahlstrom (1997), although in older works, occurrences of [kw] were commonly treated as bisegmental consonant-glide clusters (but note that Voorhis (1982) also assumes a phoneme /k^w/ for the closely related Kickapoo).

Fox has an asymmetrical four-vowel system with a gap in height opposition for the back rounded vowels (188). Quantity is phonemic, and all vowels can be short or long. Jones (1911: 741) describes the language as one "[giving] an impression of indolence. The lips are listless and passive [...] words often begin with some show of effort, then decrease in force, and finally die away in a lifeless breath". Jones might be referring to the devoicing of word-final vowels (cf. Goddard 1991) that is also attested in other Algonquian languages such as Cheyenne (Leman and Rhodes 1978) and Blackfoot (Frantz 2009).

[49] /s/ and /ʃ/ are in free variation before /k/ (Voorhis 1971).

(188) *Fox vowel inventory* (D209)

i, iː		
e, eː		o, oː
	a, aː	

The available sources vary to some extent in their transcription conventions. The table in (189) provides an overview of notational differences for the consulted sources. Note that Jones (1911) uses a narrow phonetic transcription with a variety of different symbols and diacritics which will not be reproduced here; the reader is referred to Jones (1911: 742–747) for an overview.

(189) *Notational differences in the transcription of Fox*

Bloomfield (1925, 1927)	Voorhis (1971)	Goddard (1991, 1994)	Dahlstrom (1997)	Whittaker (2005)	IPA (used here)
ī	i:	i·	i·	î	iː
ä	e:	e·	e·	ê	eː
u	o	o	o	o	o
ō	o:	o·	o·	ô	oː
ā	a:	a·	a·	â	aː
s	s	s	s	th	s
c	š	š	š	sh	ʃ
tc	c	č	č	ch	ʧ
y	y	y	y	y	j
g, k	k	k	k	k	k
kw	kw	kw	k^w	kw	k^w

Differences in the vowel symbols are purely notational, as all sources recognize four short and four long vowels. The choice to transcribe /s/ as <th> in Whittaker (2005) is motivated by the fact that this sound has an interdental pronunciation variant that is frequently heard especially among younger speakers (cf. Voorhis 1971). The treatment of /k^w/ was addressed above. Bloomfield (1925, 1927) differentiate between a voiced velar <g> and a voiceless <k>, "writing k only in word-initial [sic!], after personal prefixes, and after the regular types of reduplication; elsewhere g is used, including the initial of dependent nouns and of postpositive particles in the phrase" (B219). In doing so, Bloomfield follows the prevalent conventions at that time, but he essentially does not consider these two sounds separate phonemes, as he admits "[t]heory would demand a single symbol throughout" (ibid.).

The syllable Syllable structure in Fox follows a (C)CV(C) template and is fairly restricted (Goddard 1991, Dahlstrom 1997). Word-initially, syllables may start in a vowel, lacking an onset C. Complex onsets always have a glide as C_2. Only /ʃ/ and /h/ are allowed in the coda.

Stress Word stress in Fox is rather mysterious. Most of the available sources do not mention any word-level prominence or accentuation (Bloomfield 1925, 1927, Goddard 1994, Dahlstrom 1997, Whittaker 2005).[50] I therefore remain oblivious as to the status of word stress in Fox and implement my analysis in section 3.2.4 without making reference to foot structure.

General phonological processes I will now briefly discuss three phonological processes in Fox that will become relevant for the implementation of my analysis of reduplication later on: palatalization, word-final shortening, and hiatus resolution.

Palatalization changes a /t/ into the affricate /ʧ/ before long or short /i(ː)/ (190). Palatalization is a classic derived environment effect, as it applies only across morpheme boundaries but not within morphemes (191). The process of palatalization receives a natural explanation if /i/ and /t/ share a common feature and their adjacency triggers insertion of a different feature to obey an OCP constraint. I argue that both /i/ and /t/ are coronal and that the more posterior frication part in the affricate /ʧ/ is dorsal.

(190) *Palatalization before /i/*

/pjeːt-/	'hither'			
pjeːt-oseːwa	'he comes walking'	pjeːʧ-iseːwa	'he speeds hither'	B224
pjeːt-enamwa	'hand over'	pjeːʧ-i	'hither'	B224, W108
/-t-/	'3.AN.CONJ'			
pjeːjaː-t-a	'he who comes'	eːh-pjaː-ʧ-i	'he came'	B224
pjaː-t-e	'if he comes'	pjeːjaː-ʧ-iki	'they who come'	B224
/meht-/	'bare'			
meht-asenwi	'exposed to the wind'	mehʧ-iːki	'on the bare ground'	B224
/piːt-/	'inside'			
piːt-aːsenwi	'it falls inside'	piːʧ-iseːwa	'he flies in'	B225
/keht-/	'big'			
keht-esiwa	'old person'	kehʧ-i	'big, greatly'	B225

(191)
a. *-etiː-* 'reciprocal'
b. *-etisu-* 'reflexive'
c. *-tijeː-* 'rump'
d. *ʃamahtiːha* 'soldier'
e. *aʃaːtiːhi* 'arrowhead'
f. *nekoti* 'one' (B225)

The next operation that I will discuss briefly is the process of word-final shortening: underlyingly long vowels become short when they appear in word-final position (192). Word-final shortening is a general process affecting all four vowels across all word classes.[51] As will

[50] The few sources that do discuss this issue are often inconclusive and contradictory. Jones (1911: 747) notes that stress in bi- and trisyllabic words usually falls on the initial syllable, while primary stress falls on either the first or the second syllable in longer words, which also have secondary stress on the penultimate. Goddard (1991), on the other hand, states that in the "normal intonation [. . .] the primary stress and highest pitch fall on the second or the fourth syllable from the end of the word", whereas in the "interrogative intonation [. . .] stress falls on the third syllable from the end" (p.160). Voorhis (1967, 1971) discuss intonation contours in Kickapoo and Fox but make no clear distinction between phrase-level and word-level prominence.

[51] Voorhis (1971: 63) notes that in a few words, a word-final long vowel does occur. The two examples he gives are *eːheː* 'yes' and *waː* '(question particle)'. Occurrences of final long vowels might in these particles be due to a special prosody associated with the particular pragmatic context in which they are used. Moreover,

be seen in section 3.2.3.1, shortening applies to final vowels in all phonological words even when the end of a phonological word does not coincide with the end of a grammatical word.

(192) *Word-final shortening of long vowels*

/kepjaː/ 'come'	kepj**aː**-pwa 'you (pl.) are coming'	kepj**a** 'you (sg.) are coming'	W10
/igeː/ 'dwell'	aʃ-ig**eː**-wa 'he builds a house'	pit-ig**e** 'indoors, inside'	B226, B231

The final type of processes that will be discussed here are strategies for hiatus resolution. Fox has a general ban on bivocalic clusters across morpheme boundaries within a word and across word boundaries. Fox makes use of two insertion processes to resolve hiatus: /j/-epenthesis and /h-epenthesis/.[52]

The process of /j/-epenthesis inserts /j/ to resolve hiatus between a vowel-initial verb stem and a vowel-final directional preverbal element (193) and between a vowel-initial base and a monosyllabic reduplicant (194) (see also (198)).

(193) a. *aʃeː-j-aːmoː-wa*
backwards-*j*-flee-3SG
'he flees back' (B230)

b. *agoːsiː-j-oːteː-wa*
climb-*j*-crawl-3SG
'he crawls up' (B230)

c. *agwaː-j-aːʃoːwiː-wa*
out.from.water-*j*-ford-3SG
'he comes to land after fording' (B231)

(194) a. *aː-j-aːʧimo-wa*
RED-*j*-tell.story-3SG
'he tells a story' (D213)

b. *aː-j-aːʃoːkaːseː-wa*
RED-*j*-stumble-3SG
'he stumbles (D213)

The process of /h/-epenthesis inserts /h/ to resolve hiatus between two members of a compound (195), between a temporal proclitic and a verb stem (196), and between a vowel-initial base and a bisyllabic reduplicant (197) (see also (199)). This suggests that /h/-epenthesis operates across phonological word boundaries and /j/-epenthesis applies within the phonological word domain. Data for /h/-epenthesis in the latter two contexts ((196)–(197)) are robust (Jones 1911, Dahlstrom 1997). As regards the first context (195), Voorhis (1971) raises doubts about the validity of Bloomfield's notes, stating that "[/h/-epenthesis] does not occur between a final and an initial vowel in normal speech" (V63). Voorhis hypothesizes that occurrences of such /h/ "may be due to errors in reading or to spelling pronunciation"

Whittaker (2005: 15) notes that the vowels in *eːheː* are nasalized in Sauk, which points at a lexical idiosyncracy outside the scope of productive phonological processes.

[52]In certain contexts, hiatus may also be resolved by deletion (B230f).

(V64). However, Voorhis admits that "in reading from standard orthography, where [...] word boundary is often unmarked, [the sound /h/] has been heard between vowels in different words" (V64). The data in (195) should thus be taken with a grain of salt, which, however, does not devalidate the generalization about the phonological word domain on the basis of (196) and (197).

(195) a. *peʃekesiwi-h-owiwina*
deer-*h*-horn
'Deer-Horn (as woman's name)' (B220)

b. *mahkateːwi-h-anagweːwa*
black-*h*-rainbow
'Black Rainbow (as man's name)' (B220)

(196) a. *eː=h-onaːpeːmi-tʃi*
AOR=*h*-take.a.husband-PTCP
'when she took a husband' (J750)

b. *eː=h-api-h-api-tʃi*
AOR-*h*-RED-*h*-sit-PTCP
'he sat there a long while' (J815)

(197) a. *ata-h-atameː-wa*
RED-*h*-smoke-3SG
'he smokes' (D215)

b. *opi-h-opiteːheː-wa*
RED-*h*-happy-3SG
'he feels happy' (D215)

The observation that Fox has two epenthetic consonants for repairing hiatus at its disposal might seem puzzling at first. However, the choice of the epenthetic sound is not arbitrary as there is a crucial generalziation about the environments in which each of them occur: the one feature that is shared by all contexts for /h/-insertion is that it involves hiatus across phonological word boundaries. /j/-epenthesis, on the other hand, is confined to VV sequences within phonological words.

3.2.3 The relevant data

3.2.3.1 The four processes in isolation

In the following, I will describe the four relevant reduplicative and segmental processes and the way they interact with each other. The reduplication processes include monosyllabic and bisyllabic reduplication while the segmental alternations under discussion here are Initial Change and raising. The identifiers [1] – [4] will be used in the remainder of this section to make reference to these processes.

Fox has two productive processes of verbal reduplication[53], referred to as *monosyllabic* and *bisyllabic* in Dahlstrom (1997). The former indicates continuative or habitual aspect

[53] To a lesser extent, reduplication is also found with adverbs, numerals, quantifiers, and particles. I will focus on verbal reduplication because it is by far the most frequent and the best described type of reduplication.

whereas the latter expresses an iterative or distributive meaning. The aspectual distinctions are rather subtle, however, as Dahlstrom (1997: 206) notes:

> The same real-world situation may often be described either by a monosyllabic reduplication form or by a bisyllabic reduplication form, depending on how the speaker chooses to view the event. For example, consider the two reduplicated forms of nakiskaw-e·wa 'he meets him/them': na·-nakiskaw-e·wa and naki-nakiskaw-e·wa. In a situation such as a family reunion, the speaker might emphasize the distributed or iterative nature of the event, meeting one person after another, and choose the bisyllabic reduplicated form. Alternatively, the speaker might choose to view the family reunion as an event extending over an interval of time and use the monosyllabic reduplicated form to indicate that people were continually meeting one another throughout that interval.

Paying tribute to the complicated functional side of reduplication, and in order to avoid confusion with other aspectual affixes, I will adopt Dahlstrom's labels and refer to the two reduplication patterns as σ REDUP and σσ REDUP, respectively.

1 Monosyllabic reduplication The table in (198) gives some examples of monosyllabic reduplication.[54] Monosyllabic reduplication involves an intricate pattern of fixed segmentism: it copies the first base CV string and replaces the vowel in the reduplicant by a long /aː/ ((198)-a). If the first vowel is /e/ or /eː/, the vowel is lengthened but its quality remains unaffected ((198)-b). In addition, an epenthetic /j/ is inserted between reduplicant and base when the base is V-initial ((198)-c). The lack of verb roots beginning in /e(ː)/ or /i(ː)/ that permit regular σ REDUP is entirely accidental.

(198) *Monosyllabic reduplication*

a.	ʧiːtapi-wa	ʧaː-ʧiːtapi-wa	'he sits up'	D211
	nowiː-wa	naː-nowiː-wa	'he goes out'	D211
	moːhkiːhtaw-eːwa	maː-moːhkiːhtaw-eːwa	'he attacks him'	D211
	pakam-eːwa	paː-pakam-eːwa	'he hits him'	D211
	waːwaneːnet-amwa	waː-waːwaneːnet-amwa	'he is ignorant of it'	D211
b.	keteminaw-eːwa	keː-keteminaw-eːwa	'he blesses him'	D211
	neʃkim-eːwa	neː-neʃkim-eːwa	'he scolds him'	D211
	meːmenat-amwa	meː-meːmenat-amwa	'he vomits'	D211
	seːkih-eːwa	seː-seːkih-eːwa	'he frightens him'	D211
c.	aːʧimo-wa	aː-j-aːʧimo-wa	'he tells a story'	D213, V65
	aːʃoːkaːseː-wa	aː-j-aːʃoːkaːseː-wa	'he stumbles'	D213
	ahk^{w}i	aː-j-ahk^{w}i	'so far'	D213
	ahkowe	aː-j-ahkowe	'last, afterward'	V65

[54] Dahlstrom (1997: 211–214) notes that monosyllabic reduplication is somewhat less productive than bisyllabic reduplication, with a number of verbs showing irregular reduplicants or not allowing this type of reduplication at all. On these grounds, there is reason to doubt the systematicity of several segmental alternations such as glide non-copying, /k∼k^{w}/ alternations, and multiple /w/-epenthesis (D212f), all of which will not be discussed further here.

2 Biyllabic reduplication The second reduplication pattern involves copying the initial two syllables of a verbal base ((199)-a). The second syllable in the reduplicant must end in a short vowel, i.e. coda consonants of the second base syllable do not appear in the reduplicant ((199)-b), and a long vowel in the second base syllable corresponds to a short V in the reduplicant ((199)-c). When the base is V-initial, an epenthetic /h/ is inserted between base and reduplicant ((199)-d).

(199) *Bisyllabic reduplication*

a.	kanawi-wa	kana-kanawi-wa	'he speaks'	D215
	menah-eːwa	mena-menah-eːwa	'he makes him drink'	D215
	peʃekeːnem-eːwa	peʃe-peʃekeːnem-eːwa	'he considers him cute'	D215
	ʃekit-amwa	ʃeki-ʃekit-amwa	'he urinates on it'	D215
	wanim-eːwa	wani-wanim-eːwa	'he deceives him'	D215
	kiːhpoʧeː-wa	kiːhpo-kiːhpoʧeː-wa	'he eats his fill'	D217
b.	kaːʃkehtaw-eːwa	kaːʃke-kaːʃkehtaw-eːwa	'he hears him'	D217
	kok^{w}aːʃkeː-wa	kok^{w}a-kok^{w}aːʃkeː-wa	'he is jerked'	D218
	nenehkeːnem-eːwa	nene-nenehkeːnem-eːwa	'he thinks about him'	D218
	nakiʃkaw-eːwa	naki-nakiʃkaw-eːwa	'he meets him'	D218
	aneʃkenataw-eːwa	ane-h-aneʃkenataw-eːwa	'he fills a pipe for him'	D218
c.	nowiː-wa	nowi-nowiː-wa	'he goes out'	D206
	nepeː-wa	nepe-nepeː-wa	'he sleeps'	D206
	miːn-eːwa	miːne-miːn-eːwa	'he gives it to him'	D208
	aːmiː-wa	aːmi-h-aːmiː-wa	'he moves camp'	D218
	ʧiːpiːk^{w}eː-wa	ʧiːpi-ʧiːpiːk^{w}eː-wa	'he winks'	D218
	majoː-wa	majo-majoː-wa	'he cries'	D218
d.	atameː-wa	ata-h-atameː-wa	'he smokes'	D215
	aːʧimo-wa	aːʧi-h-aːʧimo-wa	'he tells a story'	D215
	eːnikoweː-wa	eːni-h-eːnikoweː-wa	'he talks funny'	D215
	iːtepihː-wa	iːte-h-iːtepihː-wa	'he goes there'	D215
	opiteːheː-wa	opi-h-opiteːheː-wa	'he feels happy'	D215

The base for σσ REDUP is the verb stem containing the root and inflectional suffixes. This becomes evident in examples such as *miːn-eːwa* → *miːne-miːn-eːwa* 'he gives it to him' ((199)-b). The agreement suffix *-eːwa* '3SG.A>3.O' attaches to the verb root *miːn-* 'to give' to form the verb stem that is then subject to reduplication of the initial two syllables, including the original suffix-initial vowel. The morphological structure of the reduplicated form is thus [miːne-[miːn-eːwa]], and the copy operation is blind to the internal morphological structure of the verbal stem.

3 Initial Change The first vowel of a verb form undergoes mutation when the stem is combined with certain suffixes, a process commonly referred to as *Initial Change* (IC) in the Algonquian literature.. IC turns short /i/, /e/, and /a/ into long /eː/, while short /o/ transforms into the sequence /weː/. Long vowels are not affected and do not undergo qualitative or quantitative modifications. Initial Change must not be confused with the process of /e/-raising, which is a purely phonological process that applies independently of other morphological processes (see discussion below). Splitting of /o/ is a vestige of Proto-Algonquian **we* > *o* in Fox (D221). The table in (200) summarizes the vocalic alternations of IC.

(200) *Initial Change: Segmental alternations*

		BASIC		IC
a.	MUTATION	i	→	eː
		e	→	eː
		a	→	eː
		o	→	we
b.	NO MUTATION	iː	=	iː
		eː	=	eː
		aː	=	aː
		oː	=	oː

The examples in (201) illustrate the effect of IC on short vowels and the immunity of long vowels. They also demonstrate the wide range of IC-triggering suffixes, most notably participle markers such as *-aːta*. Other suffixes inducing IC are the iterative marker *-ini* and the prioritive marker *-e*/*-waːkwe* (GG188).

(201) *Initial Change: Examples*

i → eː	/winimV/ 'forsake'	[55]	weːnim-aːta 'the one whom he had forsaken'	J829
e → eː	/pemiseː/ 'fly'	pemiseː-wa 'he flies past'	peːmis-aːʧi 'when he flew past'	BB194
a → eː	/maki/ 'be big'	makekin-wa[56] 'he is big'	meːkekin-eka 'he who is big, a/the big one'	BB194
o → weː	/nowiː/ 'go out'	nowiː-wa[57] 'he goes out'	nweːwiː-jaːnini 'whenever I go out'	BB194
Vː = Vː	/kiːʃiki/ 'grow up'	kiːʃiki-wa 'he grows up'	kiːʃiki-ta 'he who is grown up'	BB194

4 Raising Fox has a ban on word-initial /e/ that is regularly repaired by raising to /i/ ((202)-a). The notion of "word" refers to the prosodic word, as evidenced by the fact that preverbs and tense clitics, which are outside the phonological word domain, are invisible to

[55] Lexical roots with short /i/ in the first syllable are extremely rare, and examples nigh impossible to find.

[56] Glossing is somewhat problematic with this form. W63 gives *maki-* as 'big, large' and *makekinwa* = 'be big, large'. GG87 has *maki-* 'big, much'. GG61 further lists *inekinwa* 'he is so big'. The form at hand may well be the result of compounding of the latter with *maki*, possibly lexicalised and with loss of phonological material.

[57] The corresponding form in Sauk, *noːwiːwa*, has a long first vowel (W175).

raising ((202)-b)[58]. Epenthetic /h/ used to resolve hiatus is part of the ω domain but seems to be invisible for raising ((202)-b). Another important characteristic of raisingis that it only affects short /e/ but not long /eː/ ((202)-c), i.e. long vowels display the same immunity to segmental modification as in the context of IC.

(202) *Word-initial raising*

a.	/enaːpi/	'look'	[$_\omega$ inaːpi-wa]	'he looks'	D216
	/eʃawi/	'do'	[$_\omega$ iʃawi-wa]	'he does'	D216
	/eʃiʃo/	'be named'	[$_\omega$ iʃiʃo-wa]	'he is named'	D216
	/enoweː/	'say'	[$_\omega$ inoweː-wa]	'he says'	D216
b.	/enaːpi/	'look'	[$_\omega$ ne-koʧi] [$_\omega$ inaːpi]	'I try to look'	D216
	/eʃawi/	'do'	wiː=[$_\omega$ h-iʃawi-wa]	'he will do so'	B231
	/eʃawi/	'do'	eː=[$_\omega$ h-iʃawi-ʧi]	'he fared so'	B231
c.	/eːʃkami/	'gradually'	[$_\omega$ eːʃkamesi-wa]	'he gets more and more sick'	GG44
	/eːheːwa/	'swan'	[$_\omega$ eːheːweke:-wa]	'he dances the swan dance'	GG44

Summary The table in (203) summarizes the formal properties of the four reduplication and vowel alternation processes as well as the choice of epenthetic consonants in hiatus contexts.

(203) *Reduplication, vowel changes, and hiatus resolution in Fox*

	Process	Description	Hiatus
1	σ redup	CVː-sized copy, V(ː) → /aː/, /e(ː)/ → /eː/	j
2	σσ redup	2σ-sized copy, coda del. and V short. in 2nd syl	h
3	IC	V → /eː/, /o/ → /weː/, Vː unaffected	
4	Raising	/e/ → /i/ in ω-initial position	

3.2.3.2 The four processes in interaction

I will now discuss the intricate ways in which the four processes outlined above interact with each other. I will also sketch my analysis, which crucially relies on a stratal organization of grammar including the stem, the word, and the postlexical levels.

12 Monosyllabic and bisyllabic reduplication The two reduplication processes in Fox can to iteratively to express a combination of continuative and iterative aspect.[59] In such a case, monosyllabic reduplication applies first, creating a Caː-copy of the initial root syllable. Then, bisyllabic reduplication copies the initial two syllables of the resulting stem. The bisyllabic reduplicant thus copies portions from the original verb root and the monosyllabic reduplicant. This is illustrated by the verb form *waː-wi-waː-wiːtamaw-eːwa* 'he keeps telling him over and over' in (204).

[58] See the discussion of /h/-epenthesis in section 3.2.2 above for further evidence that these tense markers are indeed proclitics and not prefixes.

[59] Fox is a language that allows multiple reduplication, as opposed to several other North American languages such as Ahousaht and Kyuquot (Wakashan) which have more than one active reduplication pattern but in which no more than one reduplication process can apply at the same time (Zimmermann 2017c).

(204) *Multiple reduplication* (D208)

wiːtamaw-eːwa	'he tells him'
waː-wiːtamaw-eːwa	'he is telling him'
waːwi-waː-wiːtamaw-eːwa	'he keeps telling him over and over'

This allows us to establish the following ordering relation for the two reduplication patterns:

(205) σ REDUP ≺ σσ REDUP

I analyze σ REDUP as a stem-level and σσ REDUP as a word-level process. σσ REDUP is closer to the root than other word-level affixes, as seen in (206), where the word-level inflectional prefix *ne(t)-* '1SG' is located to the left of the bisyllabic reduplicant and not in between the two reduplicants.

(206)
a. *miːneː-wa* 'he gives it to him'
b. *miːne-miːneː-wa* 'he gives it to him'
c. *ne-miːna-miːnaː-wa* 'I give it to him'
*(*nemi-ne-miːnaː-wa)* (D208)

13 Monosyllabic reduplication and IC When both monosyllabic reduplication and Initial Change apply to the same verb stem, two possible interactions are conceivable: if IC applies before copying, we would expect the mutated /eː/ (given that the original vowel was short and IC did indeed apply) to appear in both base and reduplicant. If IC applies after copying has taken place, we would expect to see V mutation in the reduplicant, possibly overwriting the fixed segment of the reduplication process, but not in the base. As (207) shows, the latter is what we find in Fox. Monosyllabic reduplication on the verb /ketaːʃkaː-/ 'fly out' is exceptionally formed by prefixing /ke-/ (lacking the expected lengthening in the reduplicant), lengthening of the base vowel, and insertion of a glide /j/ in the base. The reduplicated verb form then acts as a single stem upon suffixation of the third person plural participle marker *-ʧiki*. Initial change regularly affects the first stem vowel, i.e. the vowel in the reduplicant, turning it into /eː/.

(207)
a. /ketaːʃkaː-/ 'fly out'
b. /ke-kjeːtaːʃkaː-/ 'keep flying out'
c. *keː-kjeːtaːʃkaː-ʧiki* 'the ones who keep flying out' (D222)

1 and 3 cannot be located on the same stratum because the IC trigger is an infix, and infixes cannot anchor at a position that is absent in the input. Moreover, both 1 and 3 each involve a floating μ, one of which is repaired by integration into existing structure and the other by copying. Therefore, the two processes must belong to different strata, viz. 1 on the stem and 3 on the word level. On the stem level, defective μ's are repaired by associating them to the structure present in the input, while on the word level, reduplication is the optimal repair strategy. Note that the order of IC and σ RED is only revealed in irregular forms as the one in (207) as σ RED normally creates a Vː and the presence of long vowels, which categorically resist IC, would blur the effect of IC.

14 **Monosyllabic reduplication and e-raising** To my knowledge, the only piece of data that sheds light on the interaction between σ REDUP and raising is the example in (208). The /e/-initial verb root /eʃawi-/ 'to do' undergoes regular raising in the unreduplicated form *iʃawi-wa* 'he does'. The reduplicated form *aː-j-eʃawi-wa* displays the vowel /aː/ in the reduplicant, which is the type of fixed segmentism that is found with /i/-initial stems. Stems with a mid vowel /e(ː)/ in the first syllable, however, are lengthened to /eː/.

(208) a. /eʃawi-/ 'to do'
b. *iʃawi-wa* 'he does'
c. *aː-j-eʃawi-wa* 'he does' (D213)

At first glance, the presence of /aː/ seems to suggest that raising must apply first, creating /i/, which then licenses mutation to /aː/. However, what I will argue for instead is that raising is a word-level process and has to apply *after* stem-level σ REDUP. The excitatory relation between raising and /Caː/-reduplication still holds, albeit not as a feeding relation: The reason for the emergence of /aː/ is that the floating feature responsible for vowel mutation in the reduplicant is introduced on the stem level and stays dormant until the word level, where it comes into effect to satisfy the constraint that normally triggers raising in the absence of such a feature.

23 **Bisyllabic reduplication and IC** Initial Change applies to the leftmost syllable of a reduplicated stem and is not backcopied to the base (209). The example of *eːti-h-itiː-jek^{w}e* illustrates the independence of IC and raising: Initial Change, triggered by the participle marker *-jek^{w}e*, affects the vowel in the reduplicant (inducing lengthening) while raising affects the ω-initial base vowel.

(209) *Local application of Initial Change*

/amw/ 'eat'	eːmwa-h-amw-aːʧihi 'the ones whom they (repeatedly) eat'	D222
/aʃam/ 'feed'	eːʃa-h-aʃam-aːʧi 'that which he (repeatedly) feeds him'	D222
/tak^{w}ahoːtaw/ 'set trap for'	teːk^{w}a-tak^{w}ahoːtaw-akiki 'the ones I (repeatedly) set traps for'	D222
/kanawi/ 'speak'	keːna-kanawi-ta 'the one who gives speeches'	D222
/etiː/ 'say to each other'	eːti-h-itiː-jek^{w}e 'that which you (pl.) say (repeatedly) to each other'	D222

24 **Bisyllabic reduplication and raising** In word forms that have undergone σσ REDUP, word-initial /e/ is changed to /i/ in both base and reduplicant (210). If the reduplicant is preceded by a prefix, raising does not apply to the vowel in the reduplicant but it still applies to the base-initial vowel. Raising thus seemingly applies at the wrong position (word-medially) even when the reduplicant does not provide a context for its application. As mentioned previously, epenthetic laryngeals are invisible to raising.

(210) *Overapplication and wrong-side application of raising*

/enaːpi/ 'to look'	ina-h-inaːpi-wa 'he looks'	net-ena-h-inaːpi 'I look'	D216
/eʃawi/ 'to do'	iʃa-h-iʃawi-wa 'he does'	net-eʃa-h-iʃawi 'I do'	D216
/enoweː/ 'to say'	ino-h-inoweː-wa 'he says'	net-eno-h-inoweː 'I say'	D216

34 IC and raising The interaction between IC and raising was shown under 23 above, repeated here as (211). In a reduplicated form such as *eːti-h-itiː-jek*^{w}*e*, the word-initial vowel is affected by Initial Change (lengthening of /e/ to /eː/) but not by raising (**iti-h-itiː-jek*^{w}*e*). It is not unexpected to find IC taking precedence over raising if raising is understood as a repair-driven process brought about by the ban on word-initial /e/. Regular application of IC changes /e/ to /eː/, thereby satisfying that constraint, without the need for further repairs.

(211) *Initial Change takes precedence over raising*

/etiː/ 'say to each other'	eːti-h-itiː-jek^{w}e 'that which you (pl.) say (repeatedly) to each other'	D222

Summary The table in (212) summarizes the interactions between 1 σ REDUP, 2 σσ REDUP, 3 Initial Change, and 4 raising.

(212) *Interaction of processes*

	1	2	3
2	12 [σσ-[σ-√]]: 1 ≺ 2		
3	13 Local application	23 Local application	
4	14 Excitatory	24 "Backcopying" overapplication	34 IC ✓, Rais. ✗

3.2.4 A phonological solution

3.2.4.1 Preliminaries

The tables in (213) and (214) present the featural decomposition of Fox vowels and consonants.

(213) *Featural representations of Fox vowels*

	LAB	COR	DOR	PHAR
o	√			
i		√		
e			√	
a				√

This decomposition captures two generalizations about Fox vocalism. First, it provides a straightforward answer to the question why word-initial /e/ is repaired by raising, i.e. delinking of the DOR place feature and insertion of an epenthetic COR feature, resulting in the vowel /i/. COR insertion is optimal because it is the least marked feature according to the place markedness hierarchy (Avery and Rice 1989; Prince and Smolensky 2004; Kang 2000; Lombardi 2002; Hirayama 2005; de Lacy 2006). Raising is thus an epiphenomenon of featural markedness and not an independent process. Second, /o/ in some cases predictably alternates with /we/, and this splitting into a labial approximant and a front vowel receives a straightforward explanation if both /o/ and /w/ are specified for LAB.

(214) *Featural representation of Fox consonants*

	[son]	[nas]	[cont]	LAB	COR	DOR	LAR
p	–		–	√			
t	–		–		√		
k	–		–			√	
kʷ	–		–	√		√	
ʧ	–		–		√	√	
s	–		+		√		
ʃ	–		+			√	
h	–		+				√
m	+	√	–	√			
n	+	√	–		√		
w	+		+	√			
j	+		+		√		

The consonant features are motivated as follows. /j/ and /h/ are two common epenthetic consonants, reflected in their unmarked featural make-up. Representing /s/ as coronal and /ʃ/ as dorsal eradicates the need for an additional anteriority tier. It also allows us to capture palatalization (/t/ → /ʧ/ before /i/) as a P-structure OCP effect enforcing epenthesis of DOR. The representation of /w/ as LAB was motivated in the preceding paragraph.

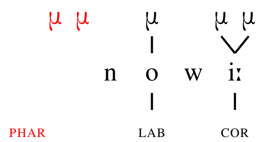
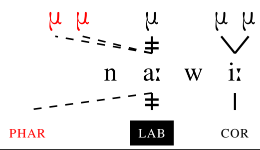
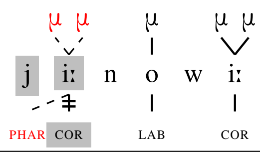
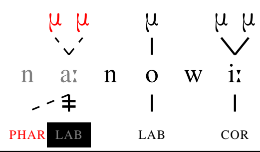
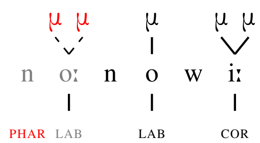
3.2.4.2 The four processes in isolation

1 Monosyllabic reduplication is triggered by two defective moras and a floating PHAR feature (215). The former trigger copying of the initial base (C)V and create a long vowel in the reduplicant. The latter associates to the copied structure, overwriting the features of the copied vowel (with the exception of /e/, see below).

(215) [CONT] ↔ µµ / PHAR (STEM LEVEL)

Monosyllabic reduplication is a stem-level process. The tableau in (216) shows how the floating material is handled by the stem-level phonology. The example word form is *naː-nowiː-wa* (RED-go.out-3SG) 'he goes out'.[60] Candidate b. links the floating moras and the segmental features with the input structure, satisfying µ→S and PHAR→• but fatally violating *MIX, which militates against root nodes that are associated to two (or more) moras via different types of association lines. Segmental epenthesis is eliminated as a repair for the defective moras because DEP(•) ≫ INT(S) (c.). The winning candidate d. creates a copy of the first two input segments, and links the two floating moras to the copied V. PHAR overwrites the copied LAB place feature. The copied structure is linearized adjacent to its base is due to high-ranked LOC_{C} (see section 2.2.3.1). Recall that fixed segmentism is obligatory for bases with /i/, /o/, and /a/. Candidate e., which displays reduplication but no mutation, is suboptimal compared to the winner because it fatally violates PHAR→•. Note that the floating PHAR cannot affect base material due to a high-ranked NCC and a constraint against PHAR features in consonants (not shown in the tableau).

(216) *Monosyllabic reduplication with fixed segmentism*

SL	Input = a.	Loc_{c}	µ ↓ S	MAX • DOR	*MIX µ •	DEP •	• ↑ PHAR	INT S
a.			*!*				*	
b.					*!			
c.						*!*		
☞ d.								**
e.							*!	**

The tableau in (217) demonstrates how fixed segmentism is suppressed when the first base syllable contains an /e(ː)/, taking the example of (the relevant parts of) the verb form *keː-keteminaw-eːwa* 'he blesses him'. Candidate b. exhibits reduplication and overwriting mutation in the same way as candidate d. in the previous tableau. Unlike that candidate, however,

[60]The inflectional marker *-wa* is a word-level suffix, which is why it is absent from stem-level evaluations.

candidate b. fatally violates a specific MAX constraint that protects association lines between a • and a DOR node. For that reason, candidate c., which repairs the defective moras by copying but leaves the PHAR floating, is optimal, despite its violation of PHAR→•. In other words, it is better not to integrate the floating PHAR than to contaminate a line between a • and a DOR node.

(217) *Lack of fixed segmentism with dorsal vowels*

SL	Input = a.	μ ↓ S	MAX•DOR	*MIX μ •	DEP •	• ↑ PHAR	INT S
	a. k e t e	*!*				*	
	b. k aː k e t e		*!				**
☞	c. k eː k e t e					*	**

Another peculiarity of σ REDUP is /j/-epenthesis occurring with V-initial bases, as in the case of *aːʧimo-wa* ∼ *aː-j-aːʧimo-wa* 'he tells a story'. /j/-epenthesis follows from a combination of *VV (a formalization of the observation that hiatus is strictly avoided, see Orie and Pulleyblank 1998) and the peak hierarchy for intervocalic consonants (218). The hierarchy favors intervocalic glides over less sonorous sounds. Major class and manner features of underlying intervocalic consonants are protected by faithfulness. The effect of the peak hierarchy can be observed in derived environments, however.

(218) *Peak hierarchy for intervocalic consonants* (Uffmann 2007, Staroverov 2016)

$$*V_{LAR}V \gg *V_{[-son]}V \gg *V_{[nas]}V \gg *V_{[+lat]}V \gg *V_{R}V \gg *V_{[+appr]}V$$

The tableau in (219) shows why /j/-epenthesis is rendered the optimal repair of VV sequences by the stem level phonology. Candidate b. executes monosyllabic reduplication and (vacuous) fixed segmentism without any further repair, incurring a fatal violation of *VV. Candidate c. inserts an epenthetic /h/, fatally violating $*V_{[-son]}V$. The winning candidate d. insertes an epenthetic /j/, violating low-ranked $*V_{[+appr]}V$. Candidate e. repairs hiatus by copying an extra segment from the base, which is suboptimal compared to the winner because of the additional violation of $*V_{[-son]}V$. Monosyllabic reduplication in Fox is thus truely minimal: it only copies as much structure as needed to accommodate the floating moras, but never more, not even as a means to resolve phonotactically illicit structures. Note that insertion of an unintegrated empty • does not help satisfy *VV because that constraint checks P-structure. Spreading from non-epenthetic features would incur violations of the respective versions of *MIX.

Monosyllabic reduplication is a stem-level process. All other processes apply at the word or the phrase levels, where different repair strategies for defective material are employed and where constraints on line protection are ranked differently.

(219) */j/-epenthesis with V-initial bases*

SL	Input = a.	*VV	μ ↓ S	MAX• DOR	$*V_{[-son]}V$	DEP •	• ↑ PHAR	INT S
	a. aː ʧ i m o		*!*		**		*	
	b. aː aː ʧ i m o	*!			***			*
	c. aː h aː ʧ i m o				***!	*		*
☞	d. aː j aː ʧ i m o				**	*		*
	e. aː ʧ aː ʧ i m o				***!			**

2 My analysis of bisyllabic reduplication adopts the basic idea of Dahlstrom (1997) that the reduplicant constitutes a minimal prosodic word (see Irie 2001 and Inkelas and Zoll 2005 for similar arguments). Consequently, I argue that the σσ REDUP morpheme contains a prosodically defective ω node (220). All segmental modifications (shortening, coda deletion) as well as the curious ways bisyllabic reduplication interacts with other processes are direct consequences of a ω node heading the copied structure. Affixation of the ω node, coupled with the word minimality constraint in (221) and structural markedness constraints militating against integration of ω into the input structure and syllable epenthesis, triggers copying of two adjacent σ nodes from the input alongside all structure dominated by these nodes.

(220) [DISTR] ↔ ω (WORD LEVEL)

(221) $\omega_{\boxed{2\sigma}}$ Assign one * for each ω linked to less than two σ of the same color.

σσ REDUP is a word-level process, which is why it obeys a different phonological grammar than monosyllabic reduplication. The tableau in (222) illustrates the mechanics of bisyllabic reduplication, taking the example of *kana-kanawi-wa* 'he speaks'. Note that the word-level suffix *-wa* '3SG' is also included in the representations because σσ REDUP is located at the word level. Candidates b. – e. illustrate different strategies to satisfy ω→σ, the constraint demanding ω nodes to be linked to a syllable node. Candidate b. repairs the subminimal ω node by double σ epenthesis, fatally violating DEP(σ). Candidate c. overwrites the prosodic structure of the stem, which incurs fatal violations of the NCC and the respective MAXLINE constraint. Candidates d. and e. resolve ω→σ by copying material from the input structure, which is preferred over σ epenthesis because DEP(σ) ≫ INT(σ). Candidate d. violates the minimality constraint in (221) because the ω node is linked to only one σ node. For that reason, bisyllabic copying in candidate e. is rendered optimal.

(222) *Bisyllabic reduplication*

WL		Input = a.	ω ↓ σ	ω [2σ]	ω ↑ σ	$*\times\overset{\omega}{\underset{\sigma}{\mid}}$	DEP σ	MAX $\overset{\omega}{\underset{\sigma}{\mid}}$	INT σ
	a.	ω [ω σ σ σ σ] k a n a w i w a	*!	*	*				
	b.	ω σ σ [ω σ σ σ σ] k a n a w i w a					*!*		
	c.	ω [ω σ σ σ σ] k a n a w i w a				*!		**	
	d.	ω σ k a [ω σ σ σ σ] k a n a w i w a		*!					*
☞	e.	ω σ σ k a n a [ω σ σ σ σ] k a n a w i w a							**

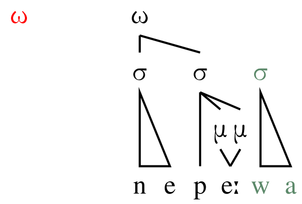
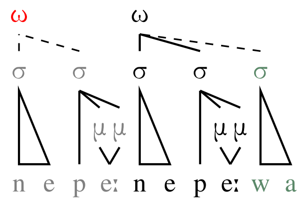
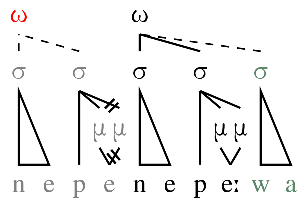
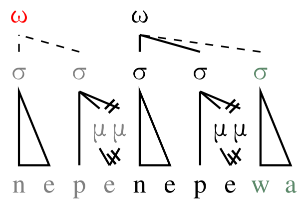
The fact that the reduplicant is headed by a separate ω node has obvious consequences for phonological processes that operate within the ω domain. All ω-sensitive processes can apply independently from each other, regardless of whether the structure belongs to a base or a reduplicant. This concerns raising (see below) but also the well-formedness constraint in (223), which states that a phonological word in Fox must end in a short V.

(223) $\overset{\mu}{\underset{V}{\mid}})_{\omega}$

Assign one * for each segment S such that:
(i) S is aligned with the right edge of a prosodic word,
(ii) at least one of (iii) and (iv) holds:
(iii) S is linked to more than one μ via phonetically visible lines,
(iv) S is a consonant.

The tableau in (224) illustrates how said constraint enforces word-final shortening in the reduplicant of *nepeː-wa* ∼ *nepe-nepeː-wa* 'he sleeps'. Candidate b. fatally violates the well-formedness constraint in (223) whereas candidate c. conforms to it by marking the lines between the V and one of its μ nodes as invisible. The presence of the word-level suffix *-wa* '3SG' and its integration into the ω domain blocks overapplication of shortening in the base (candidate d.). By the same token, the well-formedness constraint is also responsible for deletion of the coda C in the reduplicant (but not the base) of *naki-nakiʃkaw-eːwa* 'he meets him'. The phonological independence of base and reduplicant will also be relevant for the discussion of 24 below.

(224) *Word-final adjustments*

WL		Input = a.	ω ↓ σ	ω[2σ]	ω ↑ σ	μ¦V)ω	INT σ	MAX|
	a.		*!	*	*			
	b.					*!	**	
☞	c.						**	**
	d.						**	***!*

When a stem containing a monosyllabic verb root is targeted for bisyllabic reduplication, the minimality constraint compels copying of not only the root but also of affixal material. An example of a morphological complex base is *min-eːwa* ∼ *mine-min-eːwa* 'he gives it to him', where the initial V of the inflectional suffix *-eːwa* '3SG.A>3O' is copied in addition to the root material. In my version of ESC, this is possible because the copy mechanism is color-blind and the copied structure has a uniform color that does not reflect the internal morphological structure of the base. As shown in (225), a candidate that copies material across morpheme boundaries (c.) is better suited to satisfy the minimality requirement than one that does not (b.).[61] Note that word-final shortening applies in each ω domain as before.

[61] I assume that both base and reduplicant independently undergo re-syllabification at a later stage.

(225) *Copying of material with heterogeneous morphological affiliation*

WL	Input = a.	ω ↓ σ	ω[2σ]	ω ↑ σ	μ/V)$_{\omega}$	INT σ	MAXl
	a. m i n eː w a	*!	**	**			
	b. m i n m i n eː w a		*!			*	
☞	c. m i n e m i n eː w a					**	

When a bisyllabic copy of a V-initial stem is created, the resulting hiatus is resolved by /h/-epenthesis between the (phonetically) final reduplicant V and the initial base V. Recall that on the stem level, /j/ is the preferred epenthetic consonant to repair hiatus. On later strata, the relevant markedness constraints of the peak hierarchy are ranked too low to have an effect. Instead, the constraint $*V)(_{[+m]}V$ (226) is ranked high. This constraint demands that VV sequences across two ω domains are separated by a laryngeal segment and is based on Staroverov's LAR-EDGE "Assign a violation mark for any vocalic segment αwhich has modal voicing and occurs at an edge E (R or L) of a prosodic constituent C" (Staroverov 2014: 216). It is grounded in the observation that laryngeal epenthesis is most commonly found at prosodic edges cross-linguistically (Żygis 2010).

(226) $*V)(_{[+m]}V$ Assign one * for each pair of vowels V_1 and V_2 such that:
(i) V_1 is at the right edge of ω_1 and V_2 is in the initial σ under ω_2,
(ii) $\omega_1 \prec \omega_2$,
(iii) V_1 and V_2 are not separated by non-modal voicing.

It is important to note that /h/-epenthesis takes place at the postlexical level, after the completion of all word-level computations, for reasons that will be discussed under 24 below. The tableau in (227) illustrates the effect of (226), using the example of *aːʧimo-wa* ∼ *aːʧi-h-aːʧimo-wa* 'he tells a story'. This evaluation takes place after regular copying and line insertion have applied, which is why the original stem, the copied material, and the suffix have the same color. The fully faithful candidate a. fatally violates *VV and $*V)(_{[+m]}V$. Candidate b. and c. both satisfy *VV by segmental epenthesis. Candidate b. is more harmonic than candidate c. because it inserts a (non-modal) laryngeal fricative between the two vowels. Deletion (candidate d.) is not an optimal repair strategy due to high-ranked MAXl.

(227) *Hiatus resolution by /h/-epenthesis at PL*

PL	Input = a.	*VV	*V)$_{([+m]}$V	MAX^{σ}_{S}	DEP •
a.	(ω (σ aː)(σ ʧ i)) (ω (σ aː)(σ ʧ i)(σ m o)(σ w a))	*!	*		
☞ b.	(ω (σ aː)(σ ʧ i)) h (ω (σ aː)(σ ʧ i)(σ m o)(σ w a))				*
c.	(ω (σ aː)(σ ʧ i)) j (ω (σ aː)(σ ʧ i)(σ m o)(σ w a))		*!		*
d.	(ω (σ aː)(σ ʧ i)) (ω (σ ǂ aː)(σ ʧ i)(σ m o)(σ w a))			*!	

3 The vowel mutation process that accompanies certain suffixes such as the changed conjunct participle markers has four properties that a formal analysis needs to capture: (i) it changes the *quality* of a vowel to /e/; (ii) it changes the *quantity* of a vowel from short to long; (iii) it induces *splitting* of /o/ to /weː/; (iv) it never affects non-derived *long* vowels.

I analyze suffixes triggering IC as circumfixes that consist of two components: a suffixal part containing healthy segments, and an infixal part containing a floating µ and a floating DOR feature that is inserted to the right of the first vowel. The infixal part is aligned to the leftmost vowel in the word domain. Initial syllable vowels are pivotal positions and therefore qualify as anchor points for infixes. In (228), a representative lexical entry for a trigger suffix, the iterative marker -*ini*, is given.

(228) [ITER] ↔ /ini/ ALIGN(/ini/, L, $S_{\text{LAST-STEM}}$, R) (WORD LEVEL) ,
$\underset{\text{DOR}}{\mu}$ ALIGN($\underset{\text{DOR}}{\mu}$, L, $V_{\text{1ST-WORD}}$, R) (WORD LEVEL) .

The crucial evidence for the word level affiliation of triggering suffixes comes from the interaction of IC and σσ REDUP: bisyllabic reduplication may copy segments from the suffix if the stem is subminimal, which means that the suffixal part needs to be present at the point where σσ REDUP takes place. The motivation for an infixal analysis of µ and DOR comes from glide creation. The specifications in (228) correctly predict that the labial part in the mutation product /weː/ precedes the dorsal vocalic part (229). /o/ → /weː/ mutation follows from insertion of a root node to the right of the underlying V1 and from assigning V1 the role of an onset C (229-b). Left-anchoring of V1 would predict glide creation at the wrong side (229-a).

(229) a. *Wrong side glide creation* b. *The o/we alternation*

The immunity of underlyingly long vowels to IC is due to the constraint in (230) (see the discussion of raising under [4] for further evidence for this constraint). By analogy, floating features cannot associate to a consonantal root node due to the constraint in (231).

(230) Id V:
Assign one * for each vowel V such that:
(i) V is linked to two μ under the same σ in M,
(ii) at least one of (iii) and (iv) holds:
(iii) there is some feature F that is phonetically linked to V in M but not in P,
(iv) there is some feature F that is linked to V in P but not in M.

(231) Id C
Assign one * for each consonant C such that:
(i) at least one of (ii) and (iii) holds:
(ii) there is some feature F that is phonetically linked to C in M but not in P,
(iii) there is some feature F that is linked to C in P but not in M.

The tableau in (232) shows how IC affects the quality and quantity of the vowel in the initial syllable (*makekin-wa* 'he is big' ∼ *meːkekin-eka* 'he who is big, a/the big one'). The constraints μ→σ and DOR→• demand that the defective nodes be properly integrated. Candidate b. satisfies both these constraints by inserting lines between the floaters and the V, effectively inducing mutation and lengthening of /a/ to /eː/. Candidate c. integrates the floating μ but leaves DOR floating, incurring a fatal violation of DOR→•. Candidate d. accommodates the DOR under a consonantal root node, causing (vacuous) C mutation but fatally violating Id(C).

Long Vs categorically resist IC, cf. *kiːʃiki-wa* 'grow up' ∼ *kiːʃiki-ta* 'he who is grown up'. The tableau in (233) demonstrates why mutation fails to apply in such forms. Candidate b., which would be optimal if the first stem V was short, fatally violates $*S^{3\rho}$ because the vowel is linked to three prosodic nodes (three moras) in I. This candidate also violates Id(V:) because it tampers with the featural configuration of an underlyingly long vowel. Candidate c. only links the DOR and leaves the mora floating, satisfying $*S^{3\rho}$ but not Id(V:). Candidates d. and e. do the opposite, incurring fatal violations of $*S^{3\rho}$ (note that this constraint is also responsible for the absence of super-long Vs in Fox). For this reason, the fully faithful candidate a. is selected as optimal and IC fails to apply.

(232) *IC: Overwriting of short /V/*

WL	Input = a.	ID V:	MAX$^{\bullet}_{\text{LAB}}$	ID C	μ ↓ S	• ↑ DOR	DEP$^{\mu}_{\text{S}}$	MAX$^{\bullet}_{\text{DOR}}$	MAX$^{\bullet}_{\text{PHAR}}$
	a. m a k (μ μ; LAB PHAR DOR DOR)				*!	*			
☞	b. m eː k (μ μ; LAB ~~PHAR~~ DOR DOR)						*		*
	c. m aː k (μ μ; LAB PHAR DOR DOR)					*!	*		
	d. m aː k (μ μ; LAB PHAR DOR ~~DOR~~)			*!			*	*	

(233) *IC: No overwriting of /Vː/*

WL	Input = a.	$*S^{3\mu}$	ID V:	MAX$^{\bullet}_{\text{LAB}}$	μ ↓ S	• ↑ DOR	DEP$^{\mu}_{\text{S}}$	MAX$^{\bullet}_{\text{COR}}$
☞	a. k iː ʃ (μ μ μ; DOR COR DOR DOR)				*	*		
	b. k eː ʃ (μ μ μ; DOR ~~COR~~ DOR DOR)	*!	*				*	*
	c. k eː ʃ (μ μ μ; DOR ~~COR~~ DOR DOR)		*!					*
	d. k iː ʃ (μ μ μ; DOR COR DOR DOR)	*!				*	*	
	e. k iːː ʃ (μ μ μ; DOR COR DOR DOR)	*!				*	*	

The fact that /o/ does not alternate with /eː/ but with /weː/ derives from a high-ranked constraint protecting the association line between a V and a LAB feature. The pressure to associate the floating DOR can only be satisfied by inserting a • which acts as a host for the floating feature, resulting in a sequence of a semivowel and a vowel. (236) shows how splitting is chosen as optimal when a floating DOR is combined with an underlying labial vowel. Candidate b. realizes only the μ, which violates COR→•. Candidate c. links both floating elements to the V, but in doing so, it fatally violates MAX(•–LAB). When a labial vowel is exposed to a floating DOR, this high-ranked line protection gives rise to a complex repair strategy: the optimal candidate d. (cf. (229-b) above) inserts a root node to the right of the first stem V and the floating DOR associates to that root node, yielding the vowel /e/. The mora linked to the underlying V disassociates and re-associates under the • to avoid a violation of *VV. The underlying vocalic • re-associates directly under the σ node to avoid a violation of the constraint in (234), which militates against root nodes that are not dominated by at least one prosodic node in P. Since the segment is syllabified into an onset position and no longer projects a mora, it is now interpreted as a glide /w/ instead of a labial vowel. A less complex repair strategy is shown in candidate e., which only inserts a new root node to which the floating COR and the defective mora associate. However, this leads to a violation of *VV, a high-ranked constraint not only at the phrase level (cf. 1 above) but also at the word level.[62]

(234) ρ ↑ •
Assign * for each root node R such that
R is not associated to at least one prosodic node (μ, σ)
via a phonetically visible line.

4 My account of raising follows the general idea of Burkhardt (2001) who attributes the change from /e/ to /i/ in word-initial position to a positional markedness constraint *#e "No word-initial /e/".[63] The constraint in (235) is a slightly modified version of Burkhardt's constraint. It militates against a dorsal feature under a segment projecting a single mora at the left edge of a prosodic word.[64]

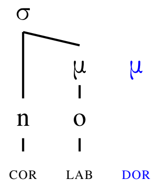
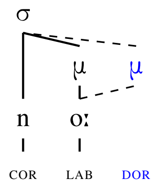
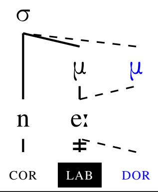
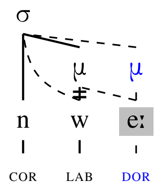
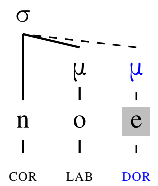
(235) 
Assign * for each triple of nodes (F, R, M) such that:
(i) F is a DOR node, R is a root node, and M is a mora;
(ii) F, R, and M are linked via phonetically visible lines;
(iii) R is aligned to the left edge of a prosodic word;
(iv) R is not linked to any other mora.

[62] The reason why this rescue strategy is not possible with long vowels is that it would violate the I-structure constraint $*S^{3\rho}$, which is sensitive to all kinds of prosodic nodes (μ, σ, ...). Assuming that onsets in Fox are never moraic, the underlying long vowel would need to mark the lines to both its moras as invisible and add a new line to σ, resulting in a configuration with three phonological lines linked to a single S. The prediction here is that there may be morphological lengthening but no shortening at the word level in Fox.

[63] A crucial difference to Burkhardt's analysis is that I analyze the emergence of /i/ as the effect of featural epenthesis. On Burkhardt's account, the constraint *#e is coupled to a phonological rule [e] → [i] / # __. Re-introducing rules into a constraint-based framework is not the rationale of the present analysis.

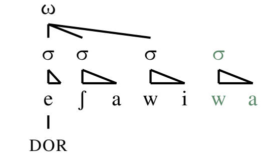
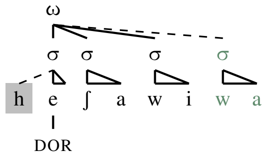
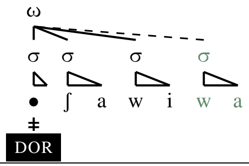
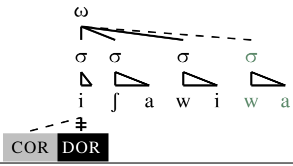
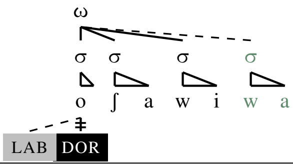
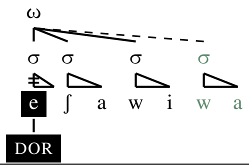
[64] It is not possible to define the constraint in (235) without making reference to length because a more general definition would wrongly predict raising to block IC with /e/-initial stems while in fact the opposite is true, see 34 in section 3.2.4.3.

(236) *IC: Preservation of* LAB

WL	Input = a.	*VV	MAX •|LAB	μ ↓ S	• ↑ DOR	DEP •	DEP μ|S	MAX •|COR
	a. 			*!	*			
	b. 				*!		*	
	c. 		*!				*	
☞	d. 					*		
	e. 	*!				*		

In the tableau in (237), several competing repairs for the violation of (235) are shown, using the example of *iʃawi-wa*. Insertion of an epenthetic h to the left of V1 is eliminated because it violates high-ranked DEP(●) (b.). Candidate c. marks the line between the initial ● and its place feature as invisible, incurring a violation of ●→PL, a constraint militating against unspecified root nodes. The optimal candidate d. is the same as c. with one crucial difference: it inserts a COR feature which associates to the initial root node, thus satisfying ●→PL. Candidate e. illustrates the same repair strategy with an epenthetic LAB feature. This strategy is not optimal because DEP(LAB) outranks DEP(COR); for the same reason, lowering is also ruled out (DEP(PHAR) ≫ DEP(COR), not shown). Candidate f. involves deletion without compensation similar to c. but with a higher line being marked as invisible. This candidate is ruled out by MAXLINE. Another conceivable repair would involve lengthening of the initial V, which is ruled out because DEP(μ) is undominated at WL. The failure of raising to apply to long vowels follows from the fact that the constraint that drives raising only militates against short word-initial dorsal vowels. For that reason, the fully faithful /eː/-initial candidate in (238), which only violates low-ranked ONS, is selected as optimal.

(237) *Raising as featural epenthesis*

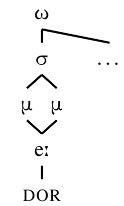
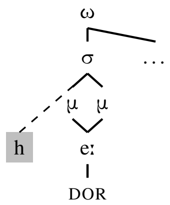
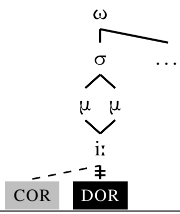
WL	Input = a.	DEP •	DEP LAB	MAX μ S	• ↓ PL	*ω(μ • DOR	ω ↑ σ	DEP COR	MAX • DOR
	a. 					*!	*		
	b. 	*!							
	c. 				*!				*
☞	d. 							*	*
	e. 		*!						*
	f. 			*!					

The table in (239) provides a summary of the four processes discussed in this section, the defective structures triggering the prosodic and segmental alternations, phonotactically driven epenthetic material, and the strata on which the relevant operations are performed.

3.2.4.3 The four processes in interaction

12 Multiple reduplication in Fox provides a solid argument for cyclic effect as predicted by SOT. Monosyllabic reduplication copies the initial two syllables of the stem, including the reduplicant created by the former reduplication process (240).

(238) *No raising of long vowels*

WL	Input = a.	ID V:	DEP •	MAX$^{\mu}_{S}$	• ↓ PL	*$_{\omega}$(μ • DOR	DEP COR	MAX •$_{DOR}$	ONS
☞	a. 								*
	b. 		*!						
	c. 	*!					*	*	*

(239) *Reduplication and mutation in Fox: Exponents and epenthetic material*

		EXPONENTS	INSERTED
1	σ REDUP	μμ PHAR (SL)	j (SL)
2	σσ REDUP	ω (WL)	h (PL)
3	Initial Change	various segmental strings (WL), μ DOR (WL)	• (WL)
4	Raising		

(240) *Multiple reduplication* (= (204))

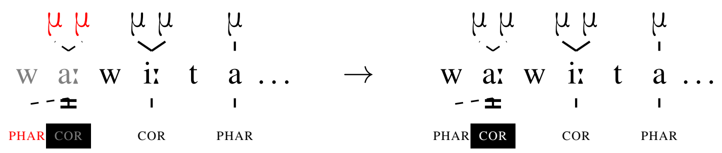
wi:tamaw-e:wa	'he tells him'
wa:-wi:tamaw-e:wa	'he is telling him'
wa:wi-wa:-wi:tamaw-e:wa	'he keeps telling him over and over'

The fact that copied material from σ REDUP is accessible to σσ REDUP follows from their non-identical stratal specifications: σ REDUP is a stem-level process whereas σσ REDUP is located at the word level. The following tableaux show the relevant evaluation steps for the derivation of the verb form *wa:wi-wa:-wi:tamaw-e:wa*, from stem level (241) to interstratal FR (242) to word level (243).

(241) *Stem level: Monosyllabic reduplication*

SL	Input = a.	μ↓S	*MIX	•↑PHAR	INT S	MAX•COR
	a. w iː t a …	*!*		*		
☞	b. w aː w iː t a …				**	*

(242) *Full Rebirthing*



(243) *Word level: Bisyllabic reduplication*

WL	Input = a.	ω↓σ	ω[2σ]	ω↑σ	*×(ω|σ)	DEP σ	μ|V)ω	INT σ
	a. w aː w iː t a m eː w a	*!	*	**				
☞	b. w aː w i w aː w iː t a m eː w a							**

Note that the fact that the second word-level base vowel is long (waːw**iː**…) while the second word-level reduplicant vowel is short (waːw**i**-…) naturally falls out as an effect of ω node affixation: Since the latter is at the right edge of a ω domain, it undergoes regular word-final shortening.

13 As was mentioned in the previous section, the interaction between monosyllabic reduplication and Initial Change provides support for the disparate stratal affiliation of the two processes as they involve different repair strategies for defective moras. On the stem level, unassociated μ nodes trigger reduplication, whereas on the word level, they cause lengthening of the first stem vowel.

(244) a. /ketaːʃkaː-/ 'fly out'
b. /ke-kjeːtaːʃkaː-/ 'keep flying out'
c. *keː-kjeːtaːʃkaː-ʧiki* 'the ones who keep flying out' (= (207))

The verb root /keta:ʃka:-/ in (244) has an irregular continuative form /ke-kje:ta:ʃka:-/ which has to be assumed to be listed in the lexicon. It might therefore not be particularly well-suited to prove that IC applies irrespective of the morphological make-up of a word form. However, the fact that IC fails to apply even when a stem has undergone regular monosyllabic reduplication, obeying the general immunity of long Vː's, is a strong point for treating both processes as proper phonological operations located at different strata. Morphology-centered theoretical devices such as REALIZEMORPHEME (Akinlabi 1996, Kurisu 2001, van Oostendorp 2005a) or ∃-FAITH (Strujke 2002) would make the problematic prediction that IC could affect the base vowel instead in order to avoid zero exponence in such cases. A high-ranked BR-FAITH could then enforce overapplication, which is in no way supported by the Fox data and would be an excessive overgeneration.

14 The fact that σ REDUP fixed segmentism is successfully instantiated with word-initial /e/ (245) gives rise to an intricate ordering paradox. It seems that raising must apply first, changing /e/ into /i/, after which σ REDUP mutates /i/ into /aː/. This would, however, wrongly predict that the base vowel should be a raised /i/ while it is in fact /e/. Also, what I have argued for so far is that σ REDUP is a stem-level process that precedes word-level raising. Such an ordering, however, does not straightforwardly generate the correct output form, either (246).

(245)

a.	/eʃawi-/	'to do'	
b.	*iʃawi-wa*	'he does'	
c.	*aː-j-eʃawi-wa*	'he does'	
			(=(208))

(246) *An apparent ordering paradox*

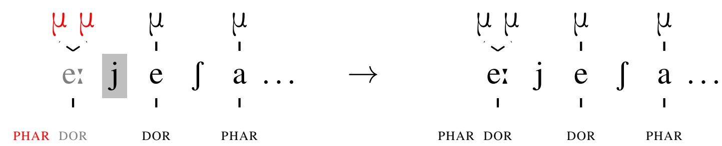
	/eʃawi-/		/eʃawi-/
1	eː-j-eʃawi-wa	4	iʃawi-wa
4	*eː-j-eʃawi-wa	1	*aː-j-iʃawi-wa
	⇒ *actual ordering, correct base V, incorrect redup. V*		⇒ *incorrect ordering, incorrect base V, correct redup. V*

The solution I propose follows the same logic as my analysis of voicing mutation in Seereer-Siin in section 3.1. The PHAR feature from the reduplication morpheme cannot trigger V mutation on the stem level due to immunity of /V(ː)/ and remains floating. Following the basic principles of LR, the floating feature is shipped onto the word stratum as it is. Unlike Seereer-Siin, where a [v] feature stays dormant on the stem and word levels, PHAR in Fox awakens on the word level and blocks DOR insertion. The complete derivation is given in the tableaux and figures in (247) – (249).

(247) *Stem level: Non-integration of* PHAR

SL	Input = a.	μ ↓ S	MAX• DOR	*MIX μ •	• ↑ PHAR	INT S	DEP •
a.	μ μ (PHAR) e ʃ a … (μ–e–DOR, μ–a–PHAR)	*!*			*		
☞ b.	μμ–eː j e ʃ a … (PHAR DOR, DOR, PHAR)				*	*	*
c.	μμ–aː j e ʃ a … (PHAR DOR, DOR, PHAR)		*!			*	*

(248) *Full Rebirthing*



(249) *Word level: Integration of* PHAR

WL	Input = a.	DEP •	• ↑ PHAR	ID V:	*ω(μ • DOR)	DEP COR	MAX• DOR	ALT
a.	μμ–eː j e ʃ a … (PHAR DOR, DOR, PHAR)		*!					
☞ b.	μμ–aː j e ʃ a … (PHAR DOR, DOR, PHAR)			*			*	*
c.	μμ–iː j e ʃ a … (PHAR DOR COR, DOR, PHAR)		*!	*		*	*	

The winning candidate b. violates ID(Vː), which normally protects long vowels against featural overwriting in IC. However, from the interaction of raising with σ REDUP it becomes clear that PHAR→● must outrank ID(Vː): PHAR→● ≫ ID(Vː). Instances in which a floating PHAR is present are thus the only situations where the vowel identity constraint is overridden on the word level. The winning candidate also violates ALTERNATION and the respective version of MAXLINE, which is compatible with my analysis of IC. A direct comparison of the stem and the word strata reveals that the stem level phonology ranks MAXLINE ≫ PHAR→● whereas the word level phonology has the opposite ranking: PHAR→● ≫ MAX-LINE. Note that DEP(●) is ranked high enough to prevent insertion of a rescuer root node for the PHAR feature but still low enough to enable splitting of /o/ → /weː/ at WL.

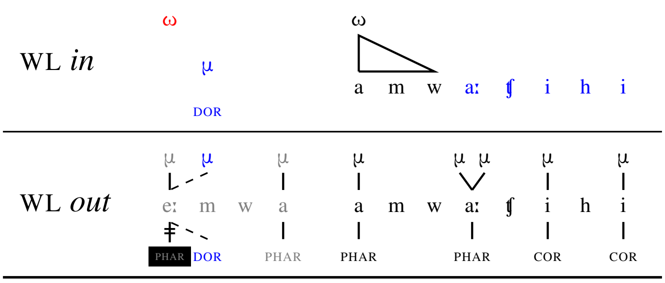
23 Initial Change applies locally to the leftmost syllable of a reduplicated word form (250). The fact that IC does not overapply follows from the assumption of input-driven copying and the absence of BR-FAITH constraints in ESC. σσ REDUP may copy parts of the IC-triggering morpheme to satisfy the word minimality constraint when it is affixed to a monosyllabic verb stem. This is possible because σσ REDUP and trigger suffixes are both introduced at the WL.

(250) *No overapplication with Initial Change* (full table under (209))

/amw/ 'eat'	eːmwa-h-amw-aːʧihi 'the ones whom they (repeatedly) eat'	D222
/kanawi/ 'speak'	keːna-kanawi-ta 'the ones who gives speeches'	D222
/etiː/ 'say to each other'	eːti-h-itiː-jekʷe 'that which you (pl.) say (repeatedly) to each other'	D222

Taking the example of *eːmwa-h-amw-aːʧihi*, the table in (251) shows the input and the optimal output for a verbal complex in which both σσ REDUP and IC have applied. The suffixal part of the participle marker combines with the verb stem and the defective ω node induces copying of two (heteromorphemic) syllables, as discussed under 2 above. Sine the infixal part has to be aligned to the left of the word domain, it ends up adjacent to the leftmost copied vowel, lawfully applying the segmental and quantitative alternations discussed under 3 above. The epenthetic glottal is introduced only at the phrase level (cf. 4).

(251) *No overapplication of IC to reduplicated verb forms*



Verb forms such as *eːti-h-itiː-jekʷe*, which exhibits Initial Change in the reduplicant V and raising in the base V, pose a serious challenge to BRCT. Neither the vowel in the base nor the vowel in the reduplicant is faithful to the input vowel, and neither are the two vowels are not faithful to each other (see 34 below for a discussion of why raising is absent in the first V). Under a purely phonological account, however, the observation that base and copied segments can be affected by phonological processes independently of each other follows naturally from the assumption that there are no faithfulness relations holding between copied and base material.

24 The interaction between σσ REDUP and raising is presented as a key argument for BRCT enriched by input-reduplicant and output-output faithfulness in Burkhardt (2001). The relevant data are repeated for convenience in (252) below. Of particular interest are the apparent backcopying overapplication in ((252)-c) and the lack of overapplication (faithfulness to the input) in ((252)-d). In Burkhardt's analysis, backcopying follows from high-ranked BR-FAITH, the standard device for deriving overapplication (253). The exceptional application of raising in the base in d. is attributed to the interaction of two constraints: IR-Faith, ruling out candidates with /i/ in the reduplicant, and OO-FAITH , favoring a candidate with /i/ in the base (254). The reason why IR-FAITH does not suppress raising in (253) is that it is ranked below *#e.

(252) (= (186))

a.	/ena:pi-/	'to look'
b.	**i**na:pi-wa	'he looks'
c.	**i**na-h-**i**na:pi-wa	'he looks repeatedly'
d.	net-**e**na-h-**i**na:pi	'I look repeatedly'

(253) *BR-Faith drives backcopying overapplication* (Burkhardt 2001: 40)

		RED + ena:pi + wa	*#e	FAITH(BR)	FAITH(IO)
	a.	**e**nah**e**na:piwa	*!		
	b.	**e**nah**i**na:piwa	*!	*	*
	c.	**i**nah**e**na:piwa		*!	*
☞	d.	**i**nah**i**na:piwa			**

(254) *IR-Faith and OO-Faith drive exceptional raising but block overapplication* (Burkhardt 2001: 42)

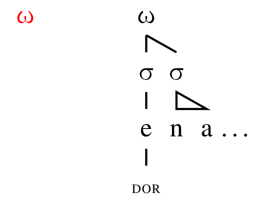
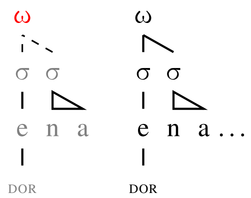
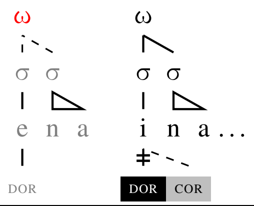
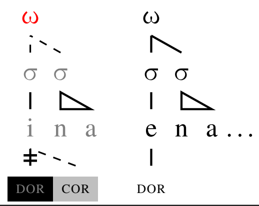
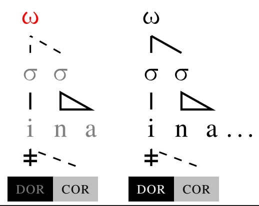
		net + RED + ena:pi	FAITH(IR)	FAITH(OO) [inahina:piwa]	FAITH(BR)	FAITH(IB)
	a.	net**e**nah**e**na:pi		**!		
☞	b.	net**e**nah**i**na:pi		*	*	*
	c.	net**i**nah**e**na:pi	*!	*	*	
	d.	net**i**nah**i**na:pi	*!			*

As stated under 4 above, the apparent case of backcopying overapplication in ((252)-c) receives a natural explanation under the assumption that copying is triggered by a ω node which imposes the same phonotactic restrictions on the reduplicant as the input ω node does on the base. This is illustrated in the tableau in (255), where candidate e. is optimal because it raises both ω-initial Vs, compared to candidates b. – d., which apply raising once or not at all, thus incurring fatal violations of $*_{\omega}($e. The tableau in (256) shows why the "exceptional" raising in ((252)-d) is in fact entirely regular: raising regularly applies in ω-initial position in the base, but, owing to integration of the word-level prefix *ne(t)-*[65] into the left periphery of the ω node, the reduplicant V is no longer in a word-initial position and hence not subject to the constraint triggering raising. Therefore, that constraint is satisfied by both c. and e.,

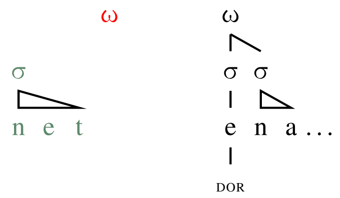
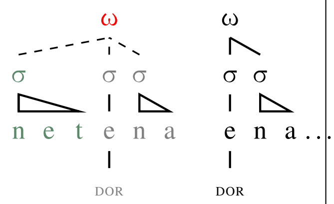
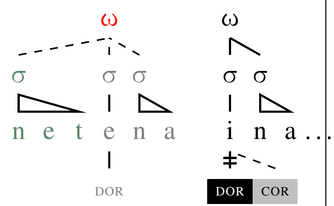
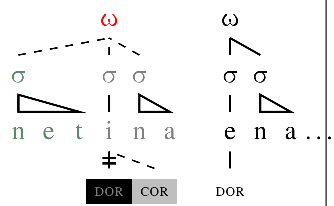
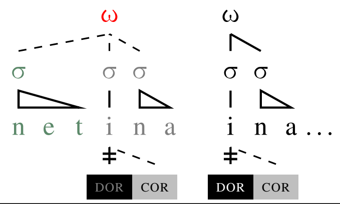
[65] This affix has a V-final allomorph before C-initial stems and vice versa. This allomorphy is sometimes analyzed as /t/-epenthesis (B231, GG190ff).

and c. wins because it is overall more faithful. Note that the prefix σ has to associate to the reduplicative ω in order to avoid a violation of σ→ω. Linking to the prefix σ and copying of only a single stem σ would not be sufficient to satisfy the minimality constraint as its definition in (221) requires linking to two nodes of the same color.

(255) *Raising applies under each ω node if applicable*

WL	Input = a.	$\omega_{\boxed{2\sigma}}$	$*(\mu\ \text{DOR})_\omega$	ω ↑ σ	$\text{MAX}^{\bullet}_{\text{DOR}}$	DEP COR	INT σ
	a. 	*!	*				
	b. 		*!*				**
	c. 		*!		*	*	**
	d. 		*!		*	*	**
☞	e. 				**	**	**

(256) *Raising applies under each ω node if applicable*

WL	Input = a.	$\omega_{\boxed{2\sigma}}$	$*_{\omega}($ μ • DOR $)$	ω ↑ σ	MAX • DOR	DEP COR	INT σ
	a. 	*!	*				
	b. 		*!				**
☞	c. 				*	*	**
	d. 		*!		*	*	**
	e. 				*!*	**	**

As discussed earlier, I analyze /h/-epenthesis as a postlexical process that takes place after reduplication and raising. The interaction of σσ REDUP and raising adds a crucial piece of evidence for this assumption: if /h/-insertion were to take place in parallel with raising on the word stratum it would bleed raising in the same way as *ne(t)-* prefixation because onset creation would destroy the context for the application of raising (onset creation is driven by high-ranked •→ρ at the word level). /h/-insertion must therefore apply after raising, from which it follows that the two processes stand in a counterbleeding relation. Epenthetic intervocalic /h/ never appears in the reduplicant for the exact same reason, but even if both processes did apply in parallel, M-structure copying would still predict /h/-insertion to overapply locally.

As an interim summary, Fox raising overapplication does not offer empirical support for BRCT with paradigmatic OO-FAITH (Benua 2000, Ussishkin 2000) or IR-FAITH as argued for in (Burkhardt 2001). This result aligns well with the general criticism of the many serious theoretical drawbacks of OO-FAITH such as the lack of a clearly defined search procedure for the privileged base form (Hale et al. 1998, Trommer 2013). In contrast, deriving the raising patterns from independently motivated representational assumptions and general phonological processes in the language offers a more parsimonious account.

34 In an environment where both IC and raising are expected to apply, only the effect of IC is observed on the surface (257). This is the expected behavior if both processes apply at the word stratum: Any candidate which applies IC will always harmonically bound one that applies raising because by changing the segmental and/or moraic composition of /e/, a candidate will automatically satisfy the constraint against a pronounced word-initial short /e/.

(257) *Initial Change takes precedence over raising* (= (211))

/eti:/	e:ti-h-iti:-jek^{w}e	D222
'say to each other'	'that which you (pl.) say (repeatedly) to each other'	

Curiously, IC would also be the predicted to win against raising if the order of the two processes were different: If IC ≺ raising, IC would bleed raising by destroying the context in which the latter applies (lengthening of /e/ to /e:/). If IC and raising were to be evaluated serially, with raising applying before IC, /e/ would be first raised to /i/ and then mutated to /e:/, giving an unlikely Duke-of-York derivation that would renders the application of raising opaque.

3.3 Interim summary

Both ICM overapplication in Seereer-Siin and raising overapplication in Fox meet the descriptive criteria for backcopying: a well-motivated change in the reduplicant is also enforced upon the base where its motivation is not immediately obvious. The existence of backcopying has been the subject of a long-standing debate (McCarthy and Prince 1995, Raimy 2000a, Inkelas and Zoll 2005, Nevins 2005, Inkelas 2008, Zimmermann and Trommer 2011, Inkelas 2014). What I have argued for in this chapter is that what looks like backcopying overapplication can in fact be analyzed as emerging from the interplay of non-segmental affixation and constraints against unassociated nodes. In Seereer-Siin, base-directed overapplication is accidental: several high-ranked constraints usually prevent an underlying [+c] obstruent from hooking onto a [-c] node, but in the presence of a copied [+c] node, greediness may cause multiple linking of a [-c] node if the NCC is sufficiently low-ranked. In Fox, ω affixation creates the illusion of backcopying because the same regular processes apply under the base ω and the affix ω nodes. Iterative application of raising is the expected outcome.

The consequence of this is that while cases of overapplication that could be described as morphological backcopying are an empirical reality, there is no need to invoke morpheme-specific constraints or cophonologies. Affixation of defective phonological material triggering copying and subsegmental changes in the phonology is entirely sufficient to account for the overapplication patterns in Seereer-Siin and Fox. This is a surprising result because one would expect that cases of overapplication are best handled by a theory that straightforwardly predicts them rather than one that does away with the RED morpheme.

Chapter 4

Underapplication

In this chapter, I present two case studies of mutation underapplication. The mutation patterns in the two case studies both involve raising of a low vowel to a mid or high front vowel before certain trigger suffixes that is blocked in the context of reduplication. In the case of Lakota, stems can be lexically specified for either undergoing or resisting vowel mutation. A certain subset of reduplicated undergoer stems also resist mutation in what seems to be a case of *morphological overwriting* of lexical properties by a reduplicative construction. In the case of Kulina, copied trigger suffixes fail to induce mutation on their own bases. Copying in Kulina seems to go hand in hand with *loss of morphological information*, viz. the property of being a mutation trigger.

I will argue that underapplication in Lakota and Kulina is not morphologically conditioned but entirely phonological in nature. In both cases, the failure of mutation to apply in the context of reduplication follows from independently motivated assumptions about the mechanics of mutation in the respective languages. In Lakota, copying of underspecified vowels creates too many potential targets for mutation, which renders non-realization of the floating feature and insertion of a rescuer feature optimal. In Kulina, a reduplicated trigger suffix fails to apply mutation because the copied string only contains features associated to segmental root nodes but not the floating features that trigger mutation. In both cases, reduplication creates a context where the ratio of mutation triggers and targets is different than the one in non-reduplicated contexts, which allows to capture the underapplication patterns in more general phonological terms.

4.1 No multiple linking in Lakota

This section explores the case of vowel mutation underapplication in Lakota. I argue that failure of vowel mutation in reduplicated words results from a conspiracy of underspecification and general restrictions on multiple feature association and does not require any morpheme-specific rules or constraints as claimed by Shaw (1980) and Saba Kirchner (2009). I will show that my underspecification account of mutation correctly predicts exceptional interaction of mutated stems with palatalization, and it also provides an explanation for a paradigm uniformity effect in mutated aspirated stems. I will argue against Albright (2015) that base-identity relations in Lakota follow from full rebirthing of association lines, making trans-derivational faithfulness constraints obsolete.

4.1.1 Introduction

4.1.1.1 Mutation underapplication in Lakota

Lakota has a process of vowel mutation that raises stem-final low vowels (/a/ and /ã/) to /e/ before certain suffixes. There are four classes of morphemes in Lakota: morphemes that undergo mutation, morphemes that do not undergo mutation, suffixes that trigger mutation, and suffixes that do not trigger mutation. Mutation applies only if the stem belongs to the class of mutation undergoers and the following suffix belongs to the class of mutation triggers. As shown in (258), all other combinations do not result in mutation.[66]

(258) *Vowel mutation applies only in the context of a trigger and an undergoer*

	STEM	NON-TRIGGER -*pi* 'PL'	TRIGGER -*ʃni* 'NEG'		
NON-UNDERGOER	nija	nija-pi	nija-ʃni	'breathe'	S144
	lowã	lowã-pi	lowã-ʃni	'sing'	S147
UNDERGOER	$\text{ap}^{\text{h}}\text{a}$	$\text{ap}^{\text{h}}\text{a-pi}$	$\textbf{ap}^{\textbf{h}}\textbf{e-ʃni}$	'strike'	S149
	pehã	pehã-pi	**pehe-ʃni**	'fold'	NLD476

Lakota also has a process of reduplication by which the final stem syllable is copied. As shown in (259), vowel raising is exceptionally blocked from applying in both the base and the reduplicant when a reduplicated undergoer stem is followed by a trigger suffix.

(259) *Mutation underapplication in reduplicated stems*

	STEM	REDUP.	REDUP. + TRIGGER -*ʃni* 'NEG'		
UNDERGOER	$\text{ap}^{\text{h}}\text{a}$	$\text{ap}^{\text{h}}\text{a-p}^{\text{h}}\text{a}$	$\textbf{ap}^{\textbf{h}}\textbf{a-p}^{\textbf{h}}\textbf{a-ʃni}$	'strike'	NLD58
	pehã	pehã-hã	**pehã-hã-ʃni**	'fold'	NLD476

[66] My main sources of data for Lakota are Shaw (1980) and the New Lakota Dictionary (Ullrich 2011), which I abbreviate as S and NLD, respectively.

4.1.1.2 An argument for cophonologies?

Mutation underapplication in Lakota presents a serious challenge to standard BRCT because the basic mutation pattern in unreduplicated forms suggests that the constraint responsible for mutation must outrank IO-FAITH (260). Under such a ranking, applying mutation will always harmonically bound underapplication, even when the standard mechanism for enforcing identity between base and reduplicant, BR-FAITH, is high-ranked (261). Saba Kirchner (2009) offers a careful discussion of the underapplication facts and concludes that they elude an explanation in BRCT unless some additional theoretical machinery is employed. Kirchner proposes an account in terms of morphological colors that crucially relies on a constraint that requires epenthetic material to have the same color as other material in the output (MAX-PM, Walker and Feng 2004). Assigning inserted material the same color as material in the input contravenes the principle of Consistency of Exponence and is not possible in ESC.

(260) *Mutation in BRCT*

		ap^{h}a + [-l]	MAXFLOAT	IO-IDENT
	a.	ap^{h}a	*!	
☞	b.	ap^{h}e$_{[-l]}$		*

(261) *Mutation and reduplication in BRCT*

		ap^{h}a + RED + [-l]	BR-IDENT	MAXFLOAT	IO-IDENT
☹	a.	ap^{h}ap^{h}a		*!	
☛	b.	ap^{h}e$_{[-l]}$p^{h}e$_{[-l]}$			*
	c.	ap^{h}ap^{h}e$_{[-l]}$	*!		*

A potential solution to the dilemma presented in (261) could be to exploit the fact that the input and the output in (261) are inevitably different by virtue of reduplication. If mutation in simple forms is triggered by a constraint that simply requires non-identity between input and output, as in Kurisu's version of REALIZE-MORPHEME (Kurisu 2001), underapplication in reduplication is optimal because it satisfies RM as well as IO-FAITH and BR-FAITH.[67]

If environments favoring and blocking mutation in simple forms are defined in terms of lexical classes, mutation underapplication is readily describable in declarative frameworks such as Sign-Based Morphology (Orgun 1996, Inkelas and Zoll 2005) or Sign-Based Construction Grammar (Croft 2001, Sag et al. 2012). Declarative approaches could distinguish two reduplicative constructions. In the first construction, the two daughters are C-final roots and the whole construction inherits the mutation behavior (e.g. the feature [±ABLAUT]) from its daughters. The second construction contains two V-final roots and imposes its own cophonology which crucially turns the whole construction into [-ABLAUT]. Underapplication would thus simply follow from the presence of construction-specific features. The remainder of this section will be dedicated to showing that underapplication in Lakota follows from phonological constraints on node linking and insertion and not from cophonologies.

[67] It is, however, questionable if transderivational anti-faithfulness constraints (Alderete 2001) are also capable of deriving the desired effect.

4.1.2 General information

4.1.2.1 Lakota and Dakotan

Lakota belongs to the Dakotan subgroup of the Mississippi Valley branch of the Siouan language family and is spoken by about 2,000 people. There is a certain amount of disagreement on the exact denotations of the terms *Lakota* and *Dakota(n)* in the literature, as the latter is variably used to refer to a group of languages, an individual language, or a particular dialect. The table in (262) provides an overview of how these labels are used by different sources.[68] Marked in boldface are the names for the languoid under discussion here.

(262) *The Dakotan languoids in the Mississippi Valley branch of Siouan*

SOURCE	LANGUAGE(S)	DIALECTS
Shaw (1980)	Dakota	Assiniboine (= Nakota) Santee (= Dakota) Stoney (= Nakota) **Teton (= Lakota)** Yankton (= Nakota)[69]
Campbell (1997)	Dakota	Assiniboin Santee Stoney **Teton** Yankton
NLD (Ullrich 2011)	**Lakota + Dakota** Nakoda	Eastern Dakota (= Santee-Sisseton) Western Dakota (= Yankton-Yanktonai) **Lakota (= Thíťuŋwaŋ = Teton)** Assiniboine Stoney
Ethnologue 20 (Simons and Fennig 2017)	Assiniboine Dakota (= Sioux) **Lakota (= Teton)** Stoney (= Nakoda)	 Dakota (= Santee) Nakota (= Yankton) Brulé Northern Southern
Glottolog 3.1 (Hammarström et al. 2017)	Assiniboine Dakota **Lakota** Stoney	 Santee-Sisseton Yankton-Yanktonai Brulé Alexis-Paul Stoney Morley Stoney

[68] The NLD often vacillates between the labels *language* and *dialect* when referring to Lakota, despite stating that Lakota and Dakota "can be classified as dialects because they are mutually intelligible to a large extent" (NLD2). Furthermore, the NLD does not have a single term to refer to the unity of Eastern Dakota, Western Dakota, and Lakota, which is why I put 'Lakota + Dakota' in the LANGUAGE column in the table in (262).

4.1.2.2 Phonological background

The vowel phoneme inventory of Lakota comprises five oral and three nasal vowels (263), a property shared with all other varieties of Dakotan and many members of the Siouan family.

(263) *Lakota vowel inventory*

i ĩ		u ũ
e		o
	a ã	

The table in (264) presents the consonant inventory of Lakota. It comprises between 22 and 24 obstruents, two nasals,[70] and three glides. Notable features of the consonant system are a three-way distinction between plain, aspirated and ejective plosives, the presence of glottalized fricatives, and the absence of rhotics. The varieties of Dakotan show some diversity in their consonant inventories, with Stoney being the most divergent from Lakota.

(264) *Lakota consonant inventory* (after S16)

p p’	t t’	ʧ ʧ’	k k’	(ʔ)
pʰ (b)	tʰ	ʧʰ	kʰ	
	s s’	ʃ ʃ’	x x’	h
	z	ʒ	ɣ	
	l			
m	n			
w		j		

The plosive /b/ has only a marginal status as a phoneme because most occurrences of [b] are regular allophones of /p/ before /l/ or are the result of an independent voicing process. Only a small number of native words attest /b/ before a vowel or in word-initial position (S17). The phonemic status of the glottal stop is disputable because it is never contrastive word-initially and is automatically epenthesized between two adjacent vowels (NLD749). The velar fricative series consisting of /x/, /x’/ and /ɣ/ is phonetically more accurately described as uvular (NLD748; Ingham 2001: 2).

Lakota lacks phonemic length and tone. However, Lakota has distinctive word stress that is of particular relevance for the distinction between underlyingly C- and V-final roots. Minimal pairs include *léna* ‘right here’ vs. *lená* ‘these’ and *ówãʒila* ‘together’ vs. *owã́ʒila* ‘at ease, quietly’ (NLD750). The preferred syllable structure in Lakota is ((C)C)V. Onset clusters of as many as two consonants are acceptable, while codas are heavily dispreferred.[71] Nonetheless, there is a considerable number of lexical items that attest a word-final consonant (mostly, but not only, /l/ or /ʃ/) (265). C-final words may be adverbs, personal pronouns,

[69] Note the classification of Yankton as Nakota in Shaw (1980) alongside Stoney and Assiniboine. The geographic location of Yankton in the center of the Dakota-Lakota dialect continuum and the large number of regular sound correspondences with Santee-Sisseton suggest that Yankton/Yanktonai belongs to the Dakota dialect group instead (NLD4).

[70] See Scarborough et al. (2015) for an overview of nasal coarticulation and spreading in Lakota.

[71] In CVCCV sequences, the default syllabification is CV.CCV. However, Mirzayan (2010: 39) notes that “the morphological makeup of the word sometimes, but not always, clarifies the syllabification. The pattern seems to be such that the syllabification respects the morpheme boundaries.”

conjuctions, and interjections. There is a general ban on clusters of more than two consonants for all parts of speech in Lakota. Longer clusters that result from affixation or compounding are repaired by deleting the first consonant (S67).[72]

(265) *C-final simple words*

hél	'there'	NLD158	*p^{h}oskil*	'hugging'	NLD485
ũkíʃ	'we'	NLD572	*naĩ́ʃ*	'or'	NLD380
ʧ^{h}ĩtók	'of course!'	NLD97	*ipáwex*	'incorrectly'	NLD228
sã́p	'more, beyond'	NLD494	*gmús*	'closed'	NLD141

The table in (266) offers an overview of the notational differences between the transcription used here and in some of the consulted sources. The transcription in the NLD follows the conventions of the contemporary practical orthography used by the Lakota community. Only the NLD systematically distinguishes between glottal and velar friction noise in aspirated consonants, marked as <Ch> and <Cȟ>, respectively (see section 4.1.6.2 for discussion). The capital lettes <A> and <Ã> indicate low vowels that undergo mutation (see section 4.1.3.1).

(266) *Notational differences in the transcription of Lakota*

Boas and Deloria (1941)	Shaw (1980)	Ullrich (2011)	IPA (used here)
ą	ą	aŋ	ã
į	į	iŋ	ĩ
ų	ų	uŋ	ũ
	A	A	A
	Ą	Aŋ	Ã
c	č	č	ʧ
ġ	ɣ	ǧ	ɣ
ḣ	x	ȟ	x
ṡ	š	š	ʃ
y	y	y	j
ż	ž	ž	ʒ
’	ʔ	’	ʔ
C’	C^{ʔ}	C’	C’
C‘	C^{h}	Ch, Cȟ	C^{h}

4.1.3 Data

4.1.3.1 Mutation

Several suffixes in Lakota affect the quality of an immediately preceding vowel. These vowel mutation processes are commonly referred to as *ablaut* in the literature (Shaw 1980, 1985, Albright 2002, Kim 2002, Saba Kirchner 2009, Mirzayan 2010, Ullrich 2011). The conditions under which vowel mutation applies in Lakota, however, share few properties with the classical ablaut patterns in Indo-European languages for which this term was coined and has

[72] See Kellogg (1991) for an account in terms of extraprosodicity and Kyle (1994) for critical discussion.

been used in this sense since at least the 19th century (Grimm 1819). Vowel alternations in Lakota bear a stronger resemblance to German umlaut (Wiese 1996, Trommer 2016a) than, for instance, Modern English ablaut, because it is better described in terms of morpheme combinations than in terms of morphological paradigms. In order to avoid confusion, I will refer to the process in question by the neutral term *vowel mutation* in the following.

Vowel mutation process in Lakota raises stem-final low vowels to /e/ before certain suffixes when the low vowel belongs to a morpheme that is lexically specified to be a mutation undergoer. In line with Shaw (1980) and the NLD, I indicate vowels eligible for mutation by capital letters (/A/, /Ã/). Vowel mutation only affects stem-final vowels and never applies to vowels that are not adjacent to the trigger suffix. Some relevant examples showing morpheme combinations which favor and block mutation are given in (267) – (269).

(267) *Undergoer stems before the trigger suffix -ʃni* ‘NEG’*: Mutation*

a. *ap^{h}éʃni*
ap^{h}A -ʃni
strike -NEG
‘he did not strike it’ (S129)

b. *ejéʃni*
ejA -ʃni
say -NEG
‘he did not say’ (S251)

(268) *Non-undergoer stems before the trigger suffix -ʃni* ‘NEG’*: No mutation*

a. *nijáʃni*
nija -ʃni
breathe -NEG
‘he is not breathing’ (S144)

b. *ptux’áʃni*
ptux’a -ʃni
crumble.down -NEG
‘it did not crumble down’ (S145)

(269) *Undergoer stems before the non-trigger suffix -pi* ‘PL’*: No mutation*

a. *jaksápi*
jaksA -pi
bite.off -PL
‘they bit off’ (NLD699)

b. *blogjã́kapi*
blogjãkA -pi
be.sedentary -PL (NLD74)
‘they lived in a permanent village’

The tables in (270) and (271) give some examples of the four different mutation classes. There are no segmental, semantic, or syntactic features shared by all members of any class, which means that there has to be some lexical specification that distinguishes one class from the other. I argue that the behavior of all four classes can be derived by assuming differences in their underlying phonological representations, in particular the presence of floating material.

(270) *Triggers and non-triggers of vowel mutation* (Shaw 1980: 129–135)

TRIGGER		NON-TRIGGER	
-ʃni	‘NEG’	-pi	‘PL’
-la	‘DIM’	-ʃna	‘HAB’
-ja	‘ADV’	-ʃk^{h}a	‘QUOT’
-Ø	‘TERM’	-ʧ^{h}ãke	‘because’
-s’e	‘as if’	-eʃ	‘in spite of’
-k’ũ	‘the aforesaid’	-jũk^{h}ã	‘and then’
…		…	

(271) *Mutation undergoers and non-undergoers* (Shaw 1980: 144–155)

UNDERGOER		NON-UNDERGOER	
ejA	'to say'	nija	'to breathe'
eptʃA	'to think'	jawa	'to count'
mimA	'to be round'	gleʃka	'to be spotted'
...		...	
jatkÃ	'to drink'	lowã	'to sing'
hĩxtÃ[73]	'to be porous'	ijũktʃã	'to think about'
slohÃ	'to crawl'	ʃpã	'to cook'
...		...	
ũp-A	'to lay'	top-a	'to be four'
juz-A	'to take hold of'	tʃaɣ-a	'to freeze'
aʃ'ak-A	'to be furry'	ajut-a	'to look at'
...		...	

The zero suffix, tentatively glossed as 'TERM' in (270), deserves special attention. This suffix always appears on verbs in sentence-final position and reveals its presence solely by inducing mutation (272).[74] In its distribution and its function as a mutation trigger, the suffix is equivalent to Shaw's "sentence terminal marker" -*ʔ*; here, I follow the NLD in assuming that TERM is in fact devoid of segmental content (NLD754). For the sake of simplicity, I will use the TERM suffix to illustrate the behavior of triggering suffixes in all tableaux in this section.

(272) *Mutation in sentence-final position*

a. *júte*
jutA -Ø
eat -TERM
'she ate it' (NLD754)

b. *ʃṹkakĩ sápe*
ʃũk-a -kĩ sap-A -Ø
dog-FV -DEF black-FV -TERM
'the dog was black' (NLD754)

c. *ʃṹka wã sápatʃʰa wãbláke*
ʃũka wã sap-A -tʃʰa wãblákA -Ø
dog INDEF black-FV -REL see:1SG>3 -TERM
'I saw a black dog' (NLD754)

[73] This verb is listed as a non-undergoer in the NLD (NLD163).
[74] Shaw (1980: 136–141) notes that final undergoer vowels in derived nouns and dependent verb stems also mutate to /e/, which could be analyzed as involving the TERM suffix or some other suffix with identical phonological content.

Apart from mutation to /e/, which is triggered by a large number of suffixes, there is also a less frequent mutation pattern that changes low vowels to /ĩ/.[75] Triggers of this process are the future tense marker *-ktA* and the additive marker *-na* as well as derivatives of the latter such as *-naíʃ* 'or' and *-nakũ* 'too'. /ĩ/-mutation applies in the exact same conditions as /e/-mutation, i.e. mutation is only observed with undergoer stems (273). Note that *-ktA* may act as a trigger and an undergoer at the same time ((273)-b).

(273) *Vowel mutation to /ĩ/*

a. *jatkĩ́kta*
jatkÃ -ktA
drink -FUT
'he will drink it' (S142)

b. *sápĩktĩna*
sap-A -ktA -na
black-FV -FUT -ADD
'it will be black and ...' (S142)

4.1.3.2 Reduplication

Verbal reduplication in Lakota marks plurality of an inanimate subject[76], iterative and distributive aspect, and intensification. In certain contexts, reduplication may also be used to express attenuation, to form deverbal adverbs, and to mark subject agreement with possessed body parts in the plural (NLD806f).[77] Examples of the main functions of reduplication in Lakota are given in (274) – (276).

(274) *Plurality of an inanimate subject*

a. *tʃ^{h}ã́-kĩ hã́ska-ska*
tree-DEF tall-RED
'the trees are tall'

b. *míla-kĩ p^{h}e-p^{h}é*
knife-DEF sharp-RED
'the knives are sharp' (S319)

(275) *Iterative and distributive aspect*

a. *t^{h}a-ʃṹke-kĩ p^{h}úx-p^{h}uɣ-e*
3.POSS-horse-DEF snort-RED-FV
'his horse snorted repeatedly'

b. *wa-ksá-ksa*
with.knife-cut-RED
'he cut it up (in several places)' (NLD806)

[75] Shaw (1980: 142) reports a third mutation pattern by which /A/ and /Ã/ are raised to /i/ before the polite request particle *jé*, e.g. *ap^{h}í jé* 'please hit it' < *ap^{h}A* 'strike' + *je* 'IMP'. This pattern is no longer attested in contemporary Lakota. Instead, *jé* is now a trigger of /ĩ/-mutation (NLD707.755).

[76] Plurality of an animate subject is not marked by reduplication but by the suffix *-pi*. Plural non-human animate subjects can be marked by a combination of reduplication and *-pi* (S319f).

[77] Reduplication is also attested with other parts of speech such as adverbs, as in *líg-lila* very-RED 'an awful lot', and even with some suffixes, as in *nijá-ʃni-ʃni* breathe-NEG-RED 'all out of breath' (S324f). Since those instances of reduplication are infrequent and rather lexicalized, they will not be considered here. Reduplication is also observed as a strategy to create semantically not fully transparent agent nouns, e.g. *wawĩ́jãjãka* 'a man who runs after women, a womanizer' < *wĩ́jã* 'woman' (NLD807).

(276) *Intensification*

a. *líla ową̃́jak-waʃte-ʃte-pi*
very look.at-good-RED-PL
'they were very good to look at'

b. *dená maʃté-ʃte*
PROX:PL sunny-RED
'these (days) are so sunny' (Santee, Sioux Valley) (S323)

The reduplicant is always a full copy of the final root syllable. Lakota combines two typologically unusual traits: it has productive partial reduplication without having total reduplication (see discussion in Rubino 2013 and Stolz et al. 2011, 2015), and it has full syllable copying that does not obey a fixed segmental template (see section 2.2.3 for discussion).[78] When reduplication creates an illicit consonant cluster, the final base consonant is subject to the same segmental changes that also apply to resolve clusters outside of reduplication (277).

(277) *Cluster simplification and modification processes*

DELETION	/blez/	ble-blez-A	'to be sane'	S332
	/ʃũk/	ʃũ-blok-a	'horse + male' = 'stallion'	S333
LENITION	/kʰat/	kʰal-kʰat-A	'to be hot'	S334
	/kʰat/	kʰal-ja	'hot + ADV'	S336
ASSIMILATION	/kaɣ/	kax-kaɣ-A	'to make'	S334
	/kaɣ/	kax-ʃi	'make + command' = 'she told him to make it'	NLD755

4.1.3.3 Underapplication

The interaction between mutation and reduplication in Lakota is highly intriguing because reduplicated V-final undergoer stems are never affected by mutation while reduplicated C-final stems behave exactly like their non-reduplicated counterparts (for more discussion on the distinction between C-final and V-final stems, see section 4.1.4). The immunity of reduplicated V-final stems is illustrated by the data in (278). The examples in (279) show that reduplicated C-final stems inherit the property of being an undergoer or a non-undergoer from the base stem.

(278) *Mutation underapplication in reduplicated V-final stems*

STEM	BEFORE TRIGGER			
apʰA	apʰe	apʰa-pʰa	'strike'	S351, NLD58
hãskA	hãske	hãska-ska	'to be tall'	S350f
kʃÃ	kʃe	kʃã-kʃã	'to be bent'[79]	S351
pehÃ	pehe	pehã-hã	'fold'	NLD476

[78]The crucial evidence for full syllable copying is the observation that both complex onset clusters (cf. (274-a), (275-b) and (276)) and consonants (cf. (277)) are copied even if this creates a phonotactically ill-formed sequence requiring subsequent repair.

[79]This verb is listed as a non-undergoer (*kʃã*) in the NLD. Shaw (1980) omits the nasalization of the final V.

(279) *Transparent mutation in reduplicated C-final stems*

STEM	BEFORE TRIGGER			
blez-A	blez-e	ble-blez-e	'to be sane'	S351f
ʃap-A	ʃap-e	ʃap-ʃap-e	'to be dirty'	S352
ptetʃ-A	ptetʃ-e	pte-ptetʃ-e	'to be short'	S352
tʃãɣ-a	tʃãɣ-a	tʃãx-tʃãɣ-a	'to be gristly'	NLD75
blixetʃ-a	blixetʃ-a	blixel-xetʃ-a	'to be energetic'	NLD73
ajut-a	ajut-a	ajul-jut-a	'to look at'	NLD71

The differences between C- and V-final roots with respect to mutation in reduplication are summarized in (280).

(280) *Mutation and reduplication*

ROOT TYPE	MUTATION IN SIMPLE FORMS?	MUTATION IN REDUPLICATION?	EXAMPLES
V-final	✓	✘	*ap^{h}A, hãskA, ...*
V-final	✘	✘	*nija, jawa, ...*
C-final	✓	✓	*blez-A, ʃap-A, ...*
C-final	✘	✘	*tʃãɣ-a, blixetʃ-a, ...*

4.1.4 Preliminaries to my analysis

4.1.4.1 Root shape and stem formation

I follow Shaw (1980) in assuming there are underlyingly C-final and V-final roots in Lakota. C-final and V-final roots behave differently in a number of contexts, and it is important to distinguish them in order to correctly predict the shape of reduplicated stems. The shape of the root is not immediately visible from the simple stem form because many underlyingly C-final roots are augmented by a low final vowel at the stem level. Consider the C-final roots in (281). The simple (unaffixed) stem forms all show a final unstressed /a/ or /A/.[80] Final syllable reduplication applies to the final root syllable, ignoring the final stem vowel. The final vowel is absent when the root appears as the first member of a lexical compound. Underlyingly C-final stems may be mutation undergoers (e.g. *psítʃA*) or non-undergoers (e.g. *tʃã́ɣa*), the former being more frequent than the latter.

(281) *C-final stems*

ROOT	STEM	REDUPLICATED/COMPOUND		
/ɣop/	ɣópA	ɣópɣopA	'to snore'	S117, NLD143
/psitʃ/	psítʃA	psípsitʃA	'to jump'	S117, NLD487
/tʃãɣ/	tʃã́ɣa	tʃãxtʃã́ɣa	'to be porous'	NLD75
/ʃũk/	ʃṹka	ʃũk-mánitu (dog-wilderness 'wolf')	'dog'	S119, NLD516

[80] Stress in reduplicated forms depends on whether the root belongs to the class of active or stative verbs: active verbs show initial stress while stative verbs stress the second stem syllable (S51ff).

Compare these data with those of V-final roots in (282). V-final roots show a strikingly different behavior from C-final roots: any vowel can appear in stem-final position, and the final vowel is usually stressed. Reduplication copies the final open root syllable including the final vowel. In lexical compounds, the final vowel is retained. Underlyingly V-final stems may be non-undergoers or undergoers but are never affected by mutation in reduplicated forms.

(282) *V-final stems*

ROOT	STEM	REDUPLICATED/COMPOUND		
/gmigmA/	gmigmÁ	gmigmá-gma	'to be spherical'	S120, NLD141
/kala/	kalá	kalá-la	'to scatter, pour'	S118, NLD284
/waʃte/	waʃté	waʃté-ʃte	'to be good'	NLD627
/pʰeʒi/	pʰeʒí	pʰeʒí-xota	'grass'	S119, NLD1068
		(grass-gray 'sage')		

The table in (283) summarizes the criteria that allow to distinguish between C-final and V-final stems.[81]

(283) *Diagnostics for inferring root shape from stem properties*

	C-final	V-final
FINAL STEM VOWEL	/a/, /A/	any /V/
STRESS	never on final V	may be on final V
REDUPLICATION	final V ignored	final V copied
COMPOUNDS	final V absent	final V present

Augmentation of C-final roots might be regarded as a markedness-driven repair to avoid word-final closed syllables at the stem level. There are two major problems with this point of view. First, it is not obvious why insertion should be more harmonic than deletion, given that consonant clusters that exceed the maximum number of two consonants are regularly simplified by deletion of the coda C (see (277)). Second, recall from section 4.1.2.2 that there are a number of lexical items that do end in a closed syllable. Assuming that these words are also underlyingly C-final, it would be a mystery why they should resist vowel insertion when they are processed by the stem-level phonology unless one stipulates that they are subject to a different cophonology.

Instead, I assume that stem-final augmentation is the result of affixing a verb (*v*) morpheme to C-final stems. Note that the crucial difference between the non-augmented words in (265) and the augmented stems in (281) is that the former belong to closed word classes while the latter are verbs and nouns.[82] The *v* morpheme (284) contains a • and selects only for C-final stems, a case of phonologically conditioned allomorphy (Nevins 2011, Trommer and Gleim 2017).

[81] Shaw (1980) discusses a fifth context in which C- and V-final stems can be distinguished: in NV object incorporation constructions, underyling final vowels surface faithfully but augmentation vowels do not.

[82] Nouns such as *ʃũka* in (281) suggest that there is also a noun morpheme that with identical phonological content.

(284) [*v*] ↔ • / C)$_{\text{STEM}}$ (STEM LEVEL)

The reason why this root node is never copied is that the stem level is a cyclic domain and the reduplicative morpheme is concatenated before *v* (see next section). The empty • is not inherently specified for being an undergoer or a non-undergoer; instead, mutation behavior depends entirely on the phonological properties of the root, as will be discussed in section 4.1.5.1.

4.1.4.2 Stratification

Following Shaw's (1980) intuition that some affixes are separated from the stem by a "morpheme boundary" while other affixes instantiate an "enclitic boundary", I distinguish between stem-level and word-level affixes. Stem-level affixes in Lakota include agreement, instrumental, and locative prefixes as well as a small number of suffixes. Stem-level suffixes are morphemes that trigger reduplication, such as the iterative morpheme, as well as the *v* morpheme.[83] All word-level affixes are suffixes covering a wide range of grammatical and lexical functions. A subset of word-level suffixes trigger vowel mutation.[84]

The table in (285) gives an overview of some of the grammatical processes that are relevant in the present discussion. A different stratal affiliation of reduplication and mutation is crucial for understanding the way these two processes interact. Ordering mutation before reduplication would erroneously predict mutation overapplication: $\sqrt{ap^hA}$ → [$_{\text{SL}}$ *ap^{h}e*] → *[$_{\text{WL}}$ *ap^{h}ep^{h}e*] 'strike'. If mutation and reduplication were both to apply on the word stratum, they would be evaluated in parallel and it would not be immediately obvious why the defective μ from the reduplicative affix would choose to copy material from the verb root but not from the suffix. Furthermore, data such as (276-a), where the reduplicative suffix is closer to the root than word-level suffixes, support the view that reduplication applies before all word-level processes.

(285) *Stratal phonology of Lakota*

	STEM *cyclic*	WORD *non-cyclic*	PHRASE *non-cyclic*
MORPHEMES	all prefixes some suffixes, including reduplication and *v*	– most suffixes	
PROCESSES	palatalization stress assignment	vowel mutation	aspiration quality

[83] Saba Kirchner (2009) argues that reduplication cannot be a stem-level process because no V is inserted after the base coda C. Kirchner's argument only holds if (i) augmentation is analyzed as epenthesis and (ii) the constraint that triggers epenthesis is blind to any prosodic structure beyond the σ level. Since I do not assume (i), my analysis evades Kirchner's criticism.

[84] For now, I set aside the question of the trigger *-ja* 'ADV', which is analyzed as a stem-level suffix in Shaw (1980).

Stress is assigned at the stem level, as evidenced by the fact that all stem-level affixes, including the reduplicant, are visible to default postinitial stress assignment (286).[85] Word-level affixes are invisible to stress assignment. I deduce the fact that the augment vowel is never stressed to its prosodic deficiency (the lack of μ and higher prosodic structure associated to it) which I assume is only repaired at the word level.

(286)

a. *tʃʰi-kté*
1SG>2SG-kill
'I kill you' (S31)

b. *ma-já-kte*
1SG-2SG-kill
'you kill me' (S31)

c. *witʃʰá-ja-kte*
3PL-2SG-kill
'you kill them' (S31)

d. *pus-púz-a*
dry-RED-FV
'be dry' (S51)

e. *pʰe-pʰé*
sharp-RED
'be sharp' (S328)

f. *gmigmá-gma*
spherical-RED
'be spherical' (S329)

Prefixes are introduced and evaluated before suffixes on the stem stratum. The corresponding morphological structure of complex verbal stems in Lakota is shown in (287). This structure correctly predicts that the augmentation V is not copied in reduplication. I also explains why palatalization induced by a prefix containing /i/ (see section 4.1.6.1 for discussion) overapplies in reduplicated stems (288), an argument for sequential ordering already noted by Wilbur (1973b). The overapplication data make a strong case for recursiveness inside the stem-level domain.[86]

(287) $[\,[\,[\,[\,\ldots[\,\text{PRFX}_2\ [\text{PRFX}_1\ \sqrt{v}]\,]\,]\,\ldots]\ \text{REDUP}\,]\ v\,]_{\text{STEM}}$

(288) *Overapplication of palatalization in reduplicated stems*

/kaɣ/ 'to make'	ki-ʧaɣ 'to make for sb.'	wiʧʰa-ki-ʧax-ʧax ijeja 'he made it for them quickly'	S344f
/koz/ 'to wave'	ki-ʧoz 'to wave to sb.'	ki-**ʧ**os-**ʧ**oz-a 'he waved [his hand] to him'	S345

4.1.5 Analysis of mutation underapplication

4.1.5.1 Vowel mutation

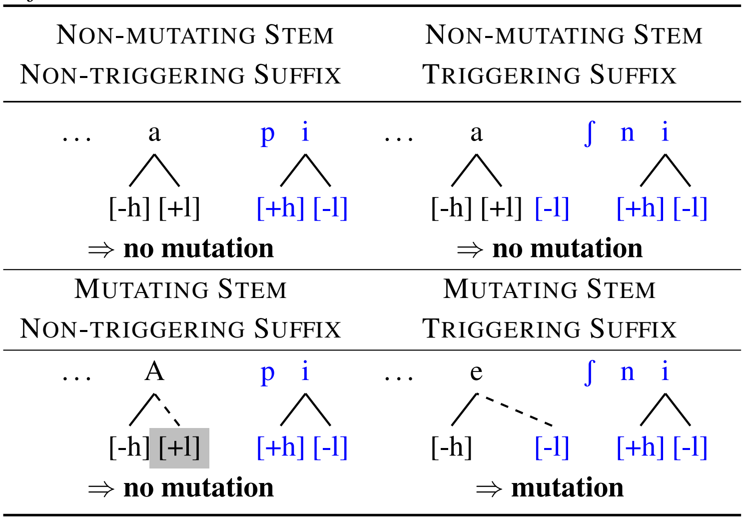
My analysis of vowel mutation in Lakota assumes that there are two phonological classes of lexical roots in Lakota: those that have a [+l] feature at their right edge and those in which [+l] is absent. Roots with a final non-low vowel belong to the latter class. Roots with a final low vowel may belong to either group, i.e. they can be fully specified with a [+l] feature or they can be underspecified and lack a [+l] feature. In C-final roots, the [+l]/Ø dichotomy manifests itself in that some C-final roots have a floating [+l] feature at their right edge while others lack a floating [+l].

[85] The default stress pattern may be overridden by lexical and morphological stress; see (Shaw 1980: 51–55) for discussion.

[86] Although his rule-based account would in principle be equally well-suited to derive the overapplication data as an ordering effect, Marantz (1982) argues they should be treated as listed allomorphs.

Mutation to /e/ is triggered by a floating [-l] feature at the left edge of triggering suffixes. The figure in (289) illustrates the behavior of V-final stems upon suffixation of the non-trigger suffix *-pi* ‘PL’ and the trigger suffix *-ʃni* ‘NEG’.

(289) *V-final stems, word level*



The immunity of fully specified vowels in Lakota follows from simple faithfulness constraints on association lines. Consider the tableau in (290). Due to a high-ranked $*\bullet_{2[l]}$, overwriting (b.) and oversaturation (c.) of a • with [l] features is impossible. The fully faithful candidate a., which does not realize the [-l], is the winner. Note that the primary driving force of vowel mutation is not [-l]→• but •→[l], the constraint requiring vowels to be fully specified.[87]

(290) *V-final non-undergoers*

WL	Input = a.	DEP [-l]	$*\bullet_{2[l]}$	• ↓ [l]	$*[\text{-l}]^{2\bullet}$	DEP [+l]	DEP •|[-l]	• ↑ [-l]
☞	a. a | [+l] [-l]							*
	b. e ǂ [+l] [-l]		*!				*	
	c. æ | [+l] [-l]		*!				*	

[87]In the following, I will not concern myself with [±h] features because they are not relevant to the mutation process under discussion here. I assume that the stem level phonology requires vowels to be specified for height and that insertion of [-h] is the optimal repair strategy because of a high-ranked *•[h]• and because DEP([+h]) ≫ DEP([-h]).

(291) *V-final undergoers*

WL	Input = a.	DEP [-l]	$*\bullet_{2[l]}$	$\bullet \downarrow$ [l]	$*[-l]^{2\bullet}$	DEP [+l]	DEP $\overset{\bullet}{\mid}_{[-l]}$	$\bullet \uparrow$ [-l]
	a. A [-l]			*!				*
	b. a ¦ [+l] [-l]					*!		*
☞	c. e ╲ [-l]						*	
	d. e ¦ [-l] [-l]	*!						*!

In (291), the • underspecified for [±l] fatally violates •→[l] in candidate a. Candidates b. and d. are eliminated because they both incur fatal violations of DEP constraints. This leaves candidate c., which integrates the floating [-l], as the winner. ALT is undominated in Lakota on all strata, which is why candidates which violate this constraint are not shown. The same is true of *MIX, which is why underlyingly associated features can never spread to other root nodes.

C-final non-undergoers are equipped with a floating [+l] feature which associates to the • from *v* at the stem level. As shown in the tableau in (292), the stem-level phonology imposes a strong ban on unassociated [+l] features. For that reason, the [+l] immediately associates to the underspecified •. Since the relevant markedness constraint on multiple linking ($*\bullet_{2[l]}$) is also undominated at the stem level, the floating [+l] will never overwrite an underlyingly specified vowel.

(292) *C-final non-undergoers, stem level (last cycle)*

SL	Input = a.	$\bullet \uparrow$ [+l]	$*\bullet_{2[l]}$	DEP [l]	DEP $\overset{\bullet}{\mid}_{[+l]}$
	a. e C • ; e | [-l] ; [+l]	*!			
	b. a C • ; a ǂ [-l], a ╌ [+l]		*!		*
☞	c. e C a ; e | [-l] ; a ¦ [+l]				*

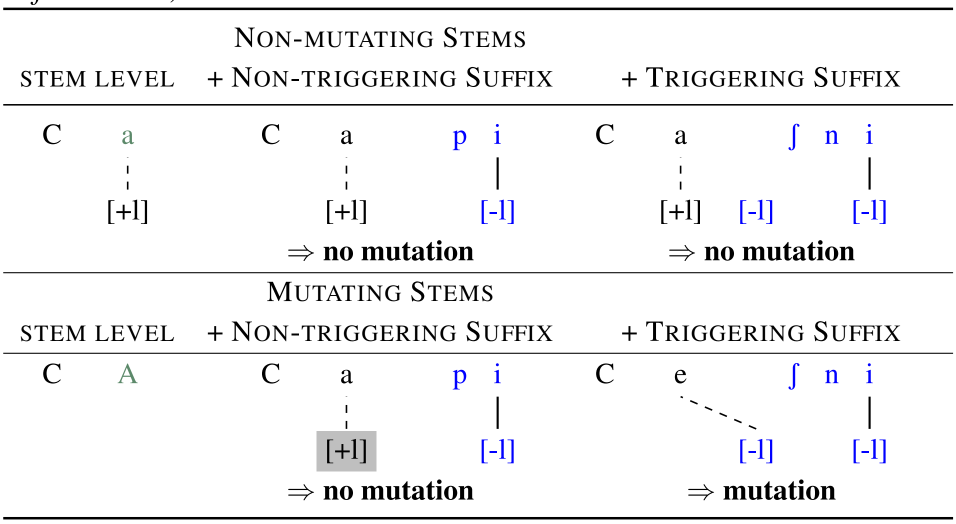
On the word level, C-final non-undergoer stems behave the same as V-final non-undergoers. The floating [-l] from the trigger suffix cannot be associated to the final vowel because that vowel is already specified for [+l] (293). C-final undergoers lack the floating [+l] of non-undergoers, which is why they are treated analogously to V-final undergoers and the [-l] can link to the underspecified root node.

(293) *C-final non-undergoers, word level*

WL Input = a.	DEP [-l]	*$\bullet_{2[l]}$	$\bullet$ ↓ [l]	*[-l]$^{2\bullet}$	DEP [+l]	DEP $\bullet$ ¦ [-l]	$\bullet$ ↑ [-l]
☞ a. C a ¦ [+l] [-l]							*
b. C e [+l] [-l]		*!				*	

The figures in (294) summarize the behavior of C-final roots at SL and WL.

(294) *C-final stems, stem and word levels*



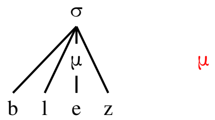
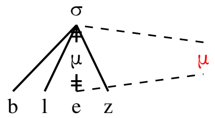
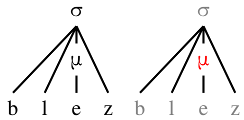
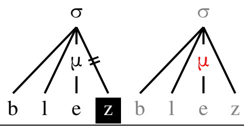
4.1.5.2 Reduplication

Reduplication in Lakota involves copying the final syllable of a verb root. I analyze affixes that trigger reduplication such as the iterative morpheme as containing a prosodically defective μ, as shown in (295).

(295) [ITER, ...] ↔ μ (STEM LEVEL)

The defective μ is repaired by copying of the rightmost stem σ, with subsequent segmental modifications of the base syllable when applicable. Reduplication is a stem-level process, and since stress assignment proceeds cyclically at the stem level, the copied syllable is visible to stress assignment. The tableau in (296) illustrates why full syllable reduplication is optimal upon μ-affixation. Phonotactically-driven modifications in the base are not back-copied to the reduplicant because the copy mechanism can only select M-structure strings for copying.

(296) μ *affixation triggers full syllable copying:* ble-blez-A *'to be sane'*

SL	Input = a.	*CCC	σ ↑ μ	μ ↓ S	DEP σ|μ	DEP μ|S	DEP μ	MAX σ|S	INT σ
a.			*!	*					
b.					*!	*			
c.		*!							*
☞ d.								*	*

4.1.5.3 Underapplication

As mentioned earlier, vowels in a reduplicated V-final root never undergo mutation even when their base belongs to the class of undergoer roots. The crucial question is then why a copied underspecified V prefers to be filled with an epenthetic feature rather than the floating feature feature from the trigger suffix. I argue that mutation underapplication in Lakota is an instantiation of the *Too Many Targets Problem* (297). This problem arises when constraints against multiple linking conspire with constraints against line insertion, rendering featural epenthesis optimal.

(297) *The Too Many Targets Problem*
Let F be a feature that triggers a segmental alternation A and let T be a potential target for A. When there is an equal number of T's and F's, application of A is optimal. When there are more T's than F's, not applying A is optimal.

At first glance, mutation underapplication could be interpreted as an identity effect between base and reduplicant, as predicted by BRCT. What I argue here is that mechanisms at work do not involve faithfulness constraints over a base and a RED morpheme. Instead, underapplication follows from the interplay of general phonological constraints.

The tableau in (299) shows how the underapplication pattern is derived. The word-level phonology of Lakota has a general ban on [-l] features associated to more than one •, as formalized in (298-a). Reduplicated undergoer stems have two vowels underspecified for [l] which could potentially serve as targets for a floating [-l]. Due to this constraint, [-l] cannot associate to both Vs at the same time (candidate b.). The obvious alternative is local mutation of the final V and default insertion of [+l] to fill the base V, as shown in candidate c. (recall that •→[l] is undominated at WL). This violates both DEP([+l]) and DEP(•–[-l]). Recall from section 4.1.5.1 that DEP([-l]) is undominated at the word level, and so it is never the case that two underspecified root nodes are accidentally filled with two distinct [-l] features, one belonging to a trigger suffix and the other one being epenthetic.

(298) a. *[-l]$^{2\bullet}$
Assign * for each [-l] feature associated to more than one root node.
b. *[+l]$^{2\bullet}$
Assign * for each [+l] feature associated to more than one root node.

There is, however, one candidate which satisfies the constraint against line insertion and which does not incur violations of any higher-ranked constraints: candidate d. leaves the [-l] floating and fills the two underspecified Vs with a single inserted [+l] node. This is possible because the constraint against multiple linking of [+l] in (298-b) and [-l]→• are ranked rather low. Applying local mutation *and* inserting a [+l] is thus suboptimal with respect to simply inserting a [+l] that hooks to more than one root node. The fact that one target is in a base and the other target is in a reduplicant is irrelevant because reduplication takes place at the stem level and FULL REBIRTHING merges root and copy colors at the interface.

(299) *Reduplicated V-final undergoers resist mutation*

WL	Input = a.	DEP [-l]	*$\bullet_{2[l]}$	• ↓ [l]	*[-l]$^{2\bullet}$	DEP [+l]	DEP •|[-l]	• ↑ [-l]	*[+l]$^{2\bullet}$
	a. a pʰ A pʰ A; [-l]			*!*				*	
	b. a pʰ e pʰ e; [-l] linked to both e				*!		**		
	c. a pʰ a pʰ e; [+l] linked to first a, [-l] linked to e					*	*!		
☞	d. a pʰ a pʰ a; [+l] linked to both a, [-l] floating					*		*	*

C-final stems are characterized by the presence of a final vowel augment. This vowel is not present at the time of reduplication and therefore not part of the copied string. When an underlyingly C-final root is reduplicated, the final root syllable is copied and the • from *v* is inserted to the right of the reduplicant. C-final non-undergoer roots have a floating [+l] that docks onto the underspecified • on the stem level, blocking association of [-l] at the word level. This is possible because the NCC for lines between • and [+l] nodes is outranked by [+l]→• at the stem level, as shown in (300) using the example of *ʧã̃x-ʧã̃ɣ-a* 'to be gristly'. The tableau in (301) shows that at the word level, C-final non-undergoers are treated the same as V-final non-undergoers.

(300) *Immunization of C-final roots*

SL	Input = a./a'.	$*\bullet_{2[l]}$	σ ↑ μ	μ ↓ S	• ↑ [+l]	$*\times\bullet_{[l]}$	INT σ
	a. μ μ / tʃ ã ɣ / [+l][+l]		*!	*	*		
☞	b. μ μ / tʃ ã x tʃ ã ɣ / [+l][+l] [+l]				*		*
	a'. μ μ / tʃ ã x tʃ ã ɣ • / [+l][+l] [+l]				*!		*
☞	b'. μ μ / tʃ ã x tʃ ã ɣ a / [+l][+l] [+l]					*	*

(301) *Reduplicated C-final non-undergoers resist mutation*

WL	Input = a.	DEP [-l]	$*\bullet_{2[l]}$	• ↓ [l]	$*[\text{-l}]^{2\bullet}$	DEP [+l]	DEP $\bullet_{[\text{-l}]}$	• ↑ [-l]
☞	a. tʃ ã x tʃ ã ɣ a / [+l][+l] [+l] [-l]							*
	b. tʃ ã x tʃ ã ɣ a / [+l][+l] [+l] [-l]		*!				*	

The crucial difference between C-final and V-final reduplicated undergoer stems is that the latter have too many potential mutation targets while the former has only a single one. Non-exceptional application of mutation in reduplicated C-final undergoer stems thus follows the same logic as in non-reduplicated stems: the presence of an underspecified • and the availability of an unassociated [-l] feature. This is illustrated for *ʃap-ʃap-A* 'to be dirty' in (302).

(302) *Reduplicated C-final undergoers do not resist mutation*

WL	Input = a.	DEP [-l]	$*\bullet_{2[l]}$	• ↓ [l]	$*[\text{-l}]^{2\bullet}$	DEP [+l]	DEP $\bullet_{[\text{-l}]}$	• ↑ [-l]
	a. ʃ a p ʃ a p A / [+l] [+l] [-l]			*!				*
☞	b. ʃ a p ʃ a p e / [+l] [+l] [-l]						*	

There is one unresolved issue with the current analysis: when an affix that is both an undergoer and a trigger of mutation is concatenated with a V-final undergoer stem, it predicts insertion and multiple linking of [+l]. As shown by the data in (303), this prediction is wrong. Instead, mutation applies locally to the undergoer stem and the suffix vowel retains its undergoer status, i.e. it changes to /e/ when it is followed by a trigger suffix.

(303) a. *ijájejA*
ijajA -jA
leave -CAUS
'to send sb. away' (NLD803)

b. *jejÁ*
jA -jA
go -CAUS
'to send sb. there' (NLD803)

c. *k^higléjA*
k^higlA -jA
start.returning -CAUS
'to send sb. back there' (NLD803)

Why is local mutation optimal in *ijájejA* but not in *ap^háp^haʃni*? The crucial difference is that in the latter, a [+l] associates to two nodes of the same color while in the former, the same feature would have to link to two nodes of different color. This configuration is excluded by the constraint in (304), which penalizes multiple linking across morpheme boundaries.

(304) *□[+l]□ Assign * for each [+l] node associated to a node N_1 of color χ_1 and to a node N_2 of color χ_2 such that $\chi_1 \neq \chi_2$.

The violation profiles for the candidates in (305) are minimally different from those in (299) (note that candidate b. also violates ALTERNATION). The crucial point is that candidate d. is no longer optimal with respect to candidate c. because it incurs an additional violation of *□[+l]□. Hybrid suffixes prove the correctness of my analysis in terms of different stratal specificationss for reduplication and mutation and highlight the importance of color merging in inter-stratal FULL REBIRTHING.

The present analysis of underapplication as an instance of the *Too Many Targets Problem* crucially relies on the notion of a default feature, which is +l in Lakota. Without such a default feature, it would not be possible to analyze underapplication in the way presented in this section. Thus, in a hypothetical language Lakota' where the same mutation process does not only affect low but also non-low vowels (i.e. where we find *maske/maski-ʃni* next to *ap^ha/ap^he-ʃni*), any default feature would neutralize the height contrast between the final stem vowels. The empirical prediction that follows from this is that languages such as Lakota' do not exist, or if they do, there must be some independent process to which failure to apply mutation can be judiciously attributed.

Before concluding the discussion of mutation underapplication, I will briefly address the issue of putative mutation overapplication. Shaw (1980) notes that mutation overapplication is observed when the reduplicated string is an undergoer suffix. She cites forms such as *ʒa-hé-he-ja* (noise(?)-CONT-RED-ADV) ‘with repeated, confused sounds’ (S354), where the continuant aspect marker *-hã* is reduplicated and mutation applies in base and reduplicant.

(305) *V-final undergoer stem and hybrid suffix*

WL		Input = a.	*□[+l]□	• ↓ [l]	*[-l]²•	DEP [+l]	DEP • [-l]	• ↑ [-l]
	a.	i j a j A j A [-l] [+l] [-l]		*!*				*
	b.	i j a j e j e [-l] [+l] [-l]			*!		**	
☞	c.	i j a j e j a [-l] [+l] [-l] [+l]				*	*	
	d.	i j a j a j a [-l] [+l] [-l] [+l]	*!			*		*

Two comments are due. First, Shaw only gives a total of four examples, all of them taken from the potentially outdated descriptions in Boas and Deloria (1941). The process in question is not productive in contemporary Lakota (Adam Albright, p.c.). Moreover, the fact that the alleged CONT suffix *-he* may be better analyzed as belonging to the lexical root (*ʒahé-ja*, NLD740) gives solid grounds to refute the productivity of this process even in older stages of Lakota. Second, while cases of doubled affixes are attested in Lakota, most of them are restricted to adverbial constructions and often have idiosyncratic meanings, cf. *nijá-ʃni-ʃni* (breathe-NEG-RED) ‘all out of breath’ and *kaɣí-ʃni-ʃni* (obstruct-NEG-RED) ‘doing as one pleases’ (S325). This suggests that instead of grammatical affix doubling, what we are really dealing with here are pseudoreduplicated suffixes in highly lexicalized constructions. If this is true, this would counter Saba Kirchner’s (2009) argument that reduplication cannot be a stem level process because all productive reduplication in Lakota *do* take place at the stem level.

4.1.6 Further evidence

4.1.6.1 Palatalization

Palatalization changes a pre-vocalic velar stop (/k/, /k’/, /kʰ/)[88] into a postalveolar affricate (/ʧ/, /ʧ’/, /ʧʰ/) when it is preceded by /i/. Both lexical roots and affixes can trigger and undergo palatalization. Oral /i/ triggers palatalization but nasal /ĩ/ is not a trigger (Shaw 1980: 246). The data in (306) show some representative examples of palatalization. Palatalization is a strictly local process and cannot skip any segmental material ((306)-f). As shown in (307), underlying /e/ is not a trigger of palatalization.

[88] Velar fricatives do not undergo palatalization, cf. *kíʧixa* < kiʧi-xa ‘BEN-dig’ (NLD179).

(306)

a. *nitʃítʃaʃla*
ni- ki- kaʃla
2.O- BEN- cut.low
'he cut it low for you'

b. *tʃʰitʃʰí*
tʃʰi- kʰi
1>2- take.from
'I took it from you'

c. *nitʃʰé*
ni- kʰA
2.O- mean
'he is talking about you'

d. *nitʃ'ú*
ni- k'u
2.O- give
'he gave it to you'

e. *kʰitʃákse*
kʰi- kaksA
divide- cut.off
'he cut it in two'

f. *kʰiwákakse*
kʰi- wa- kaksA
divide- 1SG.A- cut.off
'I cut it in two' (NLD756)

(307) *No palatalization after underlying /e/* (Shaw 1980: 200)

'woman's elder sister'	'man's elder sister'	'the blood'	'it is rather tough'
tʃʰuwéku	*tʰãkéku*	*wékĩ*	*x'éka*
tʃʰuwe-ku	tʰãke-ku	we-kĩ	x'e-ka
woman's.elder.sister -3S.POSS	man's.elder.sister -3S.POSS	blood-DEF	rough-QUAL

Palatalization is triggered by markedness constraints penalizing occurrences of [k] after the front vowels /i/ (308-a) and /e/ (308-b). On the stem level, *ekV is outranked by all relevant faithfulness constraints, including DEP(●–COR), and therefore never shows any effect.

(308)

a. *ikV
Assign * for every pronounced [ikV] sequence. (McCarthy 2007: 25)

b. *ekV
Assign * for every pronounced [ekV] sequence.

(309) *Palatalization by underlying /i/*

SL		Input = a.	*ikV	● ↓ PL	MAX ●¦COR	*DOR²●	DEP ●¦COR	MAX ●¦DOR	*ekV
	a.	n i k' u (COR DOR)	*!						
☞	b.	n i tʃ' u (COR DOR)					*	*	
	c.	n ɯ k' u (COR DOR)			*!	*			
	d.	n i ʔ u (COR DOR)		*!				*	

The constraint *<u>ikV</u>, however, is ranked high enough to enforce spreading of the COR feature from the vowel to the consonant, as shown in the tableau in (309).

The way palatalization interacts with mutation offers support for an account in terms of floating features. While underlying /e/ is not a trigger of palatalization, derived /e/ patterns like underlying /i/ (see also Boas and Deloria 1941: 14). Note that in the examples in (310), the velar-initial suffixes act as both triggers and targets for segmental alternations.

(310)
a. *sápetʃĩ*
sap-A -kĩ
black-FV -DEF
'the black one' (S201)

b. *sápetʃa*
sap-A -ka
black-FV -QUAL
'kind of black' (S203)

c. *ijájetʃ'ũ*
ijajA -k'ũ
go- aforesaid
'the aforesaid has gone' (S202)

d. *ijájetʃ'eʃ*
ijajA -k'eʃ
go -CNTF.OPT
'if only he had gone' (S203)

In order to understand why derived /e/ compels palatalization while underlying /e/ does not, we need to spell out one detail of vowel mutation that has been neglected so far. In the preceding section, it was tacitly assumed that raising of a low vowel by associating a [-l] feature yields a front (coronal) vowel /e/ instead of a back (labial) vowel /o/. Granting that low vowels are not contrastively specified for place in Lakota, there has to be some constraint at work to ensure that a raised vowel will have a coronal place of articulation.

The tableau in (312) shows that the emergence of front /e/ is a standard markedness effect: insertion of COR is cheaper than insertion of LAB because DEP(LAB) outranks DEP(COR). This is in line with the Universal Place Hierarchy (311), according to which COR is less marked than other (oral) places or articulation (Avery and Rice 1989, Prince and Smolensky 2004, Kang 2000, Lombardi 2002, Hirayama 2005, de Lacy 2006).

(311) *Universal Place Hierarchy*
COR $\prec$ {DOR, LAB}

With this in mind, the unexpected potential of mutated /e/ to palatalize a following velar is readily derivable. The word level phonology demotes *<u>iKV</u> and *<u>eKV</u> so that they are outranked by DEP(●–COR). This has the effect that a colored COR can never spread and palatalization is normally absent. An epenthetic COR, however, may associate to a ● without violating DEP(●–COR) because association lines between an epenthetic and some other node may be added at no additional cost. Thus, a derived /e/ triggers palatalization by virtue of the fact that it involves insertion of a COR node on independent grounds.[89]

[89] The present analysis could potentially be extended to the demonstratives *hé* 'that near your', *lé* 'this near me', and *é* 'the aforementioned', which in pre-1950 Lakota also acted as exceptional triggers of palatalization (Shaw 1980: 199–201): if we assume that the vowels in these words are born without a place feature – a configuration independently predicted by ROTB – featural insertion will have the same catalyzing effect as in the case of mutated /e/. However, demonstratives no longer trigger palatalization in modern Lakota (NLD). Moreover, demonstratives could only affect a small number of words in what may well have been lexicalized collocations, which raises doubts concerning the productivity of this process.

(312) *Palatalization by derived /e/*

WL	Input = a.	DEP(•–COR)	• → [-l]	DEP LAB	DEP COR	*eKV	*iKV	MAX(•–DOR)
	a. j A k' u ([-l]; k'–DOR)		*!					
	b. j o k' u ([-l]; o–LAB, k'–DOR)			*!				
	c. j e k' u ([-l]; e–COR, k'–DOR)				*	*!		
☞	d. j e ʧ' u ([-l]; e–COR, ʧ'–DOR delinked)				*			*

Palatalization by derived /e/ used to be a productive process in pre-1950 Lakota but is no longer accepted by contemporary speakers (NLD756). This diachronic change can be easily explained in terms of constraint demotion: in modern Lakota, *eKV is ranked lower than MAX(•–DOR) protecting association lines between • and DOR nodes. This constraint was ranked too low to have any effect at the word level in older stages of Lakota (312).

4.1.6.2 Aspiration

An important consequence of cyclic domains is outward locality, as stated in the Russian Doll Theorem (313).

(313) *The Russian Doll Theorem* (Bermúdez-Otero 2011, 2018)
Let there be the nested cyclic domains $[_\gamma \ldots [_\beta \ldots [_\alpha \ldots] \ldots] \ldots]$. If a phonological process p is opaque in β because its domain is α, then p is opaque in γ.

A potential counterexample to the Russian Doll Theorem is the case of paradigm uniformity with respect to aspiration quality in Lakota (Albright 2015). In this section, I will carefully examine the data and offer a phonological account that combines the insights of my analysis of mutation with my theory of FULL REBIRTHING. FULL REBIRTHING opens a window to the past which allows the phrase-level phonology to access just the right amount of derivational information from previous strata.

As discussed in section 4.1.2 above, Lakota distinguishes voiceless plain, voiceless aspirated, and ejective plosives. The phonetic quality of aspiration is determined by the place of articulation in the plosive and by the quality of the following vowel (Mirzayan 2010, Ullrich

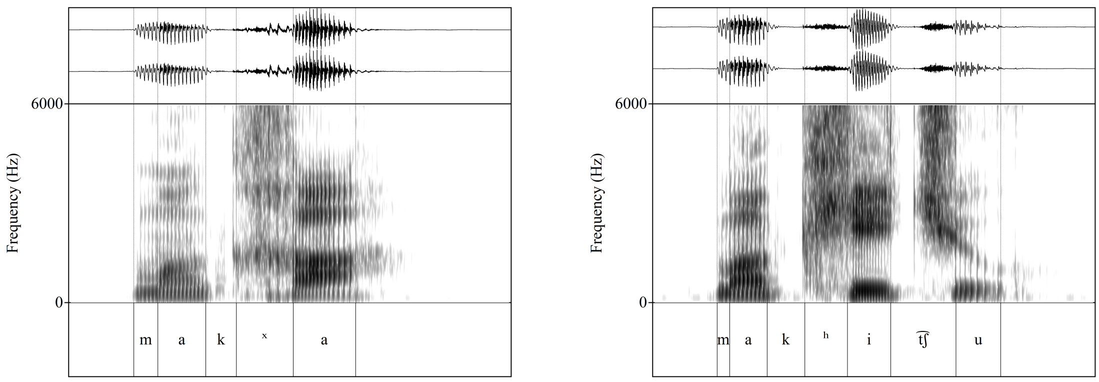
2011). As a rule of thumb, aspiration before high front vowels tends to contain lower-energy glottal friction while aspiration before back low vowels is more likely to contain portions of higher-energy velar friction. The tables in (314) show the distribution of glottal and velar aspiration depending on the combination of consonants and vowels.[90] Note that velar aspiration is strictly limited to aspirated plosives and is never observed with fricatives or affricates. For instance, when the initial velar plosive in *k^{x}A* 'to mean' undergoes palatalization following the second person prefix *ni-*, the result is *nitʃ^{h}é*, not **nitʃ^{x}é* (Ullrich 2011: 756).

(314) *Velar vs. glottal aspiration in Lakota* (Ullrich 2011, Albright 2015)

BILABIAL				ALVEOLAR				VELAR			
p^{h}i	p^{h}ĩ	p^{h}u		t^{h}i	t^{h}ĩ	t^{h}u		k^{h}i	k^{h}ĩ	k^{h}u	
p^{x}e		p^{x}o	p^{x}ũ	t^{h}e/t^{x}e		t^{x}o	t^{x}ũ	k^{h}e		k^{x}o	k^{x}ũ
		p^{x}a	p^{x}ã			t^{x}a	t^{x}ã			k^{x}a	k^{x}ã

The pictures in (315) illustrate the acoustic properties of the two aspiration types in Lakota. Recordings were taken from the New Lakota Dictionary software (Lakota Language Consortium 2014; male adult native speaker) and analyzed with Praat (Boersma and Weenink 2017). On the image to the left, velar aspiration in *mak^{x}á* 'earth' stretches from the burst of [k] to the onset of the stressed [a] over ca. 130 msec, which is only about 10 msec shorter than the duration of the [a]. A center of gravity at 897 Hz, local prominence peaks at 1.3 kHz and 3.5 kHz, and quasi-periodic peaks starting at about 70 msec into the aspiration phase suggest a uvular place of constriction.

(315) *"Velar" friction (left image) and "glottal" friction (right image)*



[90] A potential complication is presented by the case of [t^{h}e] vs. [t^{x}e], as aspiration quality is not predictable when an aspirated *t* is followed by the mid front vowel *e*. The choice between velar and glottal aspiration in these cases appears to be highly lexicalized. For example, *t^{h}exí* 'difficult, hard' is pronounced with glottal aspiration, while *t^{x}éhã* 'for a long time' displays velar aspiration (Ullrich 2011: 752). One possible way to make these facts consistent with the otherwise allophonic status of aspiration quality might be to reanalyze either velar or glottal aspiration following *t* as complex onsets, i.e. *t^{h}exí* as underlying /thexi/ or *t^{x}éhã* as underlying /txehã/. This would be consistent with the observation that VOT and vowel duration are nearly the same. For the time being, I follow Albright's judgment that aspiration quality is truly non-contrastive and set aside the puzzle posed by [t$^{h/x}$e] as a question for future research.

The right picture shows glottal aspiration before the high vowel [i] in *mak^{h}ítʃu* 'settle'. The duration of both the vowel and the VOT is ca. 100 msec. The spectrum is characterized by high-energy turbulent noise. Local spectral peaks at 2.9 kHz and 4.3 kHz and a center of gravity at 2.7 kHz suggest a constriction further in the front of the oral cavity than in the previous recording (see Paschen 2015), which is consistent with the auditory impression of palatal friction. This means that while one can maintain a broad two-categorical distinction between the velar/uvular and the glottal/palatal types of aspiration, there is a considerable amount of contextual variation in the phonetic details of these types. Therefore, "velar" and "glottal" should be understood as convenient labels rather than as accurate phonetic descriptions of aspiration quality in Lakota.

The examination of aspiration friction in *mak^{x}á* and *mak^{h}ítʃu* reveals that aspiration type is not a property linked to a lexical root but instead varies across derivatives according to the quality of the following vowel. The data in (316) show more examples of variation in aspiration quality in derivatives.

(316) *Predictable aspiration quality* (Ullrich 2011, Albright 2015)

/mak^{h}a/ 'earth'			[mak^{x}á] 'earth'
	+	/a-mani/ 'APPL-walk'	[mak^{x}ámani] 'to travel on foot'
	+	/e-glakĩjã/ '*e*-transversely'	[mak^{h}églakĩjã] 'across the world/a region (adv.)'
	+	/itʃu/ 'take'	[mak^{h}ítʃu] 'to settle, take up land'

Vowel mutation has an unexpected effect on aspiration quality. Undergoer vowels always entail velar aspiration, regardless of whether the phonetic quality of the vowel is [a] (non-mutation environment) or [e] (mutation environment); some representative examples are given in (317). This paradigm uniformity effect is surprising, given that for all cases we have seen so far, the surface shape of both the consonant (lack of velar aspiration in palatalization) and the vowel (no effect of base vowel in lexical derivation) were the sole predictors of aspiration type while properties of underlying representations or other forms within a paradigm showed no effect.

(317) *Paradigm uniformity in the context of mutation* (Albright 2015)

		'hit'	'try to do'	'tell the truth'
	-PROG	ap^{x}a-hã	ijut^{x}a-hã	witʃak^{x}a-hã
e-mutation	-NEG	ap^{x}e-ʃni	ijut^{x}e-ʃni	witʃak^{x}e-ʃni
e-mutation	-EMPH	ap^{x}e-xtʃa	ijut^{x}e-xtʃa	witʃak^{x}e-xtʃa
ĩ-mutation	-FUT	ap^{x}ĩ-kte	ijut^{x}ĩ-kte	witʃak^{x}ĩ-kte

Albright (2015) points out that stratal accounts are confronted with serious problems if they want to account for the fact that velar friction is preserved in mutated forms. What is at stake are two contradictory generalizations over evaluation domains: The data in (316) reveal that aspiration quality is computed at the phrase level regardless of whether or not it was already present in intermediate representations. The data in (317), on the other hand, suggest that aspiration quality is fixed at an early level and preserved throughout the course of a derivation. Albright argues that an analysis in terms of OO-Correspondence circumvents this conflict as it allows to enforce identity between a base and its inflected siblings within a paradigm.

Albright's criticism of derivational approaches to the Lakota data is valid under the assumption that mutated and non-mutated vowels are indistinguishable to the phrase-level phonology. This is true for the featural composition of the two types of mid vowels. It does, however, not apply to their derivational history: non-mutated /e/ is linked to a [-l] underlyingly whereas mutated /e/ starts out with no [-l] feature and is associated to a suffix [-l] via an epenthetic line at the word level. The principle of FULL REBIRTHING dictates that the epenthetic line is fully rebirthed (not changed into an underlying line) on subsequent strata. Vowel mutation thus leaves a representational footprint that sets it apart from non-mutated vowels and that allows to treat the two differently in outer evaluation domains.

The phrase-level phonology has high-ranked markedness constraints against velar aspiration preceding a high vowel and a number of segment-specific constraints that account for the basic facts in (314). This yields the non-exceptional combinations of aspiration and vowel quality in ((318)-abc). In addition, there is an undominated constraint against glottal friction preceding a vowel associated to a [-l] feature via an epenthetic line ((318)-d). This constraint is responsible for the occurrence of velar aspiration before mutated vowels but not before underlying mid vowels with the same featural make-up. Paradigm uniformity is thus an epiphenomenon that emerges from the interplay of phonotactic restrictions and a stratal organization of grammar with FULL REBIRTHING.

(318) FULL REBIRTHING *and aspiration types in mutated and non-mutated vowels*

	LEXICAL ENTRY	WL OUTPUT	PL OUTPUT	ASPIRATION TYPE
a.	a [-h] [+l]	a [-h] [+l]	a [-h] [+l]	**velar**
b.	e [-h] [-l]	e [-h] [-l]	e [-h] [-l]	**glottal**
c.	A [-h]	a [-h] [+l]	a [-h] [+l]	**velar**
d.	A [-h]	e [-h] [-l]	e [-h] [-l]	**velar**

The reason why the phrase-level phonology has access to derivational information from earlier levels is that FULL REBIRTHING does not phoneticize association lines. Under Trommer's REBIRTHING, the crucial distinction between underlying and epenthetic lines would be lost after the output of the word stratum has been shipped to the phrase stratum. A theory that preserves unpronounced nodes and all association lines throughout the course of a derivation can readily derive apparent anticyclic effects such as the case of paradigm uniformity in Lakota.

4.2 No copying of floating features in Kulina

The case of vowel mutation underapplication in Kulina adds further support to the research program of GNLA. In Kulina, a copy of a mutation-triggering suffix fails to trigger mutation on its base. I analyze this pattern as an instance of Lossy Copying (19). If mutation is triggered by floating features and reduplication is the result of minimal copying to repair defective prosodic nodes, floating features are not expected to be copied alongside segmental material, and the ability to trigger mutation is expected to be absent in the reduplicant. Underapplication thus follows directly from the assumption that non-concatenative morphology derives from non-segmental affixation.

4.2.1 Phonological Background

Kulina (self-denomination: Madihá) is an Arawan language with approximately 5,500 speakers in the states of Acre and Amazonas in Brazil and several hundred speakers in Peru. Data presented here are mainly based on Dienst (2014), which is a grammatical description of the Lower Alto variant of the Purus dialect as spoken in the village of Santa Júlia, Brazil. In addition, I have also consulted fieldnotes from Cindy and Jim Boyer (Wycliffe/SIL), who have been working with Purus speakers in the village of San Bernardo (Peru) for many years. The variety of Kulina spoken in San Bernardo is very similar to Lower Alto Purus described in Dienst (2014) as far as the relevant grammatical processes are concerned. A few times, I will also discuss data from the Juruá dialect in Brazil (Tiss 2004). Since Juruá and Purus exhibit some notable differences, the empirical observations and my analyses hold for the Purus but not necessarily for the Juruá variety of Kulina. In the following, I will abbreviate Dienst (2014), Boyer (p.c.), and Tiss (2004) as D, B, and T, respectively.

The sound inventory of Kulina is given in (319) and (320) below. The high vowels /i/ and /u/ can be realized as closed or partially opened ([i∼e], [u∼o]). /e/ is an open [ɛ]. Sibilants have affricated and non-affricated phonetic variants, with the affricated variants being widely used in Purus and the non-affricated variants being more common in Juruá (T22–25). Stops in the coronal series are dental while fricatives/affricates are alveolar. /w/ is pronounced [β̞] or [v] before /e/ and /i/ and [w̜] before /a/ (D24).

(319) *Kulina vowel inventory* (D19)

i		
e		o
	a	

(320) *Kulina consonant inventory* (based on D23)

p pʰ b	t tʰ d	k kʰ	
	s sʰ z		h
m	n		
	r		
w			

The table in (321) gives an overview of notational differences between the consulted sources. Only the SIL orthography, devised by “missionaries of the Summer Institute of Linguistics (SIL) working in Peru since 1954 [. . .] based on the orthography of Spanish” (D15), distinguishes <c(c)> before the non-front vowels /a/ and /o/ and <q(q)u> before the front vowels /i/ and /e/.

(321) *Notational differences in the transcription of Kulina*

SIL Peruvian Orthography	Tiss (2004)	Dienst (2014)	IPA as used here (and phonetic variants)
pp	ph	ph	p^h
tt	th	th	t^h
ds	z	z	z (∼ʣ)
s	s	s	s (∼ʦ)
ss	sh	sh	s^h (∼$ʦ^h$)
c, qu	k	k	k
cc, qqu	kh	kh	k^h
j	h	h	h
hu	w	w	w (∼w̜∼β̞)
h	(not written)	(not written)	(ʔ; not written)

Syllables in Kulina are (C)V. Onsetless syllables mostly occur morpheme-initially, and heterosyllabic vowel sequences are usually separated by a glottal stop [ʔ] in careful pronunciation. Kulina does not have lexical tone or distinctive length. Word stress is always final.

4.2.2 Data

4.2.2.1 Vowel mutation

Vowel mutation, also referred to as *ablaut* or *apophony* in the literature (Dienst 2014), is a process by which a low vowel /a/ changes to /e/ or /i/ before certain suffixes; a list of triggering suffixes is provided in (322). Vowels other than /a/ never undergo mutation. Whether the outcome of mutation is a mid vowel /e/ or a high vowel /i/ is lexically specified on the undergoing morphemes and not predictable from any surface phonological properties.[91] It is important to note that a trigger suffix will affect a preceding /a/ regardless of its morphological provenience, i.e. vowels in both lexical roots and affixes can undergo raising. The only exception to this are reduplicated forms, which will be addressed in more detail below.

[91] One generalization that can be made is that inflecting main verbs uniformly change /a/ to /e/. Dienst (2014: 38) postulates an additional rule by which any mutated /a/ is raised to /i/ when the preceding vowel in the verb stem is an /i/. There are a number of complications with this rule, one being that it only applies to inflecting main verbs (cf. his example (421), repeated here as (325), where no additional raising occurs on the verb root /k^ha/-), the other being that in Peruvian Purus, the quality of the vowel preceding a mutation target never affects the outcome of the mutation process (Boyer p.c.). Due to these uncertainties, I will not address this rule in my discussion of mutation.

(322) *Vowel mutation triggers*[92]

DIRECTIONAL		AKTIONSART/NEGATION	
-hiza	'across'	*-mani*	'again'
-k^{h}ima	'past'	*-hera*	inflectional negation
-ma	'(from) below or inside'	*-ra*	derivational negation
-moha	'across over'		
-mora	'ashore'		
-na	'out'		
-p^{h}a	'in(to) water'		
-p^{h}i	'through, across'		
-za	'in, into'		
-zana	'engulfing'		

(D38)

(323) *ok^{h}enana*
o- k^{h}a- na- na
1SG- move.SG- out- IFUT
'I am going to walk out (of the house)' (D38)

(324) *hikeherani*
hika- hera- ni
run.out- NEG.F- DECL.F
'there are lots' (D39)

(325) *ahi tik^{h}ezimahi*
ahi ti- k^{h}a- za- ma- hi
DEIC.F 2- move.SG- in- below- IMP.F
'come in!' (D187)

The examples in ((323)–(325)) show several mutation triggers and non-triggers in inflected verb forms. The two suffixes -*na* 'out' and -*na* 'IFUT' in (323) are homophonous on the surface but behave differently with respect to mutation, showing that mutation is not predictable from surface phonological properties. The verb form in (325) illustrates how concatenation of triggering suffixes creates transparent mutation chains: the directional suffix -*ma* 'below' triggers mutation on the preceding directional -*za* 'in', which in turn triggers mutation on the verbal root *k^{h}a* 'move.SG'.

(326) *Vowel mutation*

		FOLLOWED BY TRIGGER	FOLLOWED BY NON-TRIGGER
/a_1/	→	/e/	/a/
/a_2/	→	/i/	/a/

[92]Excluded from this list is the spurious suffix -*mina*, which Dienst lists as a trigger affix without providing a translation or giving any examples and which is not recognized by Purus speakers in San Bernardo (Boyer p.c.).

The table in (326) summarizes the mutation patterns in Kulina; vowels alternating with /e/ are tentatively labelled with a subscript 1 and vowels alternating with /i/ with a subscript 2. The situation in Kulina is in some sense a mirror image of that in Lakota, where /a/ can also mutate into one of the two vowels /e/ and /ĩ/ but where the choice of the outcome vowel depends on the triggering suffix rather than the undergoer.

4.2.2.2 Reduplication

Reduplication is a productive morphological process expressing a variety of meanings in Kulina. From a formal perspective, three types of reduplication can be distinguished: full reduplication, initial syllable reduplication, and final syllable reduplication, of which only the latter interacts with vowel mutation; for the sake of completeness, I will also give a brief description of the other processes. Full reduplication of a verb stem marks reciprocity with plural agents (327) and is also used in certain types of associative clauses (328). In reciprocals, the reduplicated verb is no longer able to take any inflectional affixes, which is why such verbs are always accompanied by the auxiliary verb *na-*. Note that reciprocity is additionally marked with a prefix *ka-* on the auxiliary, which is the general reciprocal marker that also appears in non-plural contexts. In associative constructions, the reduplicated verb form also appears without any inflectional markers but it may act as a host for the associative marker *=k^{h}a*.

(327) *Full reduplication: Plural reciprocity*

a. *bis^{h}i-bis^{h}i Ø-ka-na-i*
pinch-RED 3-REC-AUX-DECL.M
'They (more than two) pinched one another.' (D131)

b. *et^{h}e k^{h}a-k^{h}a Ø-ka-na-i*
dog bite-RED 3-REP-AUX-DECL.M
'The dogs (more than two) bit one another.' (D131)

(328) *Full reduplication: Associative constructions*

a. *ini-deni makaari kahi-kahi=k^{h}a ima*
grandmother-NSG squirrel marry-RED=ASS story
'the story about the ancestors who married squirrels' (D248)

b. *k^{h}orobo madiha hika-hika=kha*
golden.trahira people die.PL-RED=ASS
'[the story about] how the Khorobo Madiha died' (D249)

Initial syllable reduplication is used to derive instrument nouns from dynamic verbs, e.g. *be-beri* 'scissors' < *beri* 'cut with scissors', *zo-zodo* 'pen(cil)' < *zodo* 'write' etc. (D265f). When combined with the suffix *-de*, reduplication of an initial stem syllable can also be used to derive "agent nouns", cf. *ho-ho-de* 'wind' < *ho* 'blow (wind)', *ma-maiza-de* 'liar' < *maiza* 'lie' (D267).

Final syllable reduplication of bare roots expresses dual number of a direct object on dynamic verbs (329) and dual number of a subject on stative verbs (329).[93] Kulina also has

[93] Dienst (2014: 106) gives one example of a monosyllabic base which deviates from this pattern: in the case of *k^{h}a* 'bite dead', the final (and only) syllable is not duplicated; instead, the vowel is pronounced three times

two non-reduplicative markers for indicating object number: a prefix *ta-* 'PL.DO' for plural direct objects, and a less specific prefix *bak^{h}i-* 'NSG.O' for any number greater than one that can also cross-reference indirect objects (D104–107). Likewise, plurality of subjects is marked with a suffix *-k^{h}iri* on stative verbs; when an auxiliary is present, it usually marks several inflectional categories, including number.

(329) *Final syllable reduplication: Direct object duality with dynamic verbs*

a. *takara dama-ma o-na-na*
chicken grab-RED 1SG-AUX-IFUT
'I'm going to grab two chickens.' (D106)

b. *siba kororo ozip^{h}ana*[94]
siba koro-ro o-na-za-p^{h}a-na
stone throw-RED 1SG-AUX-in-water-IFUT
'I'm going to throw two stones into the water.' (D106)

(330) *Final syllable reduplication: Subject duality with stative verbs*

a. *bika-ka i-na-na*
good-RED 1NSG-AUX-IFUT
'The two of us are going to get well.' (D143)

b. *ia=pi i-pame-e dako-ko i-hira-ni*
1NSG=TOP.F 1NSG-two-F strong-RED 1NSG-AUX-DECL.F
'We two are strong.' (D150)

The cases discussed so far have all involved reduplication on verb stems consisting of nothing but the lexical root. However, reduplication may also apply to complex stems in which the copied material is not a lexical root, but a directional affix. In such cases, reduplication commonly indicates a continuous movement, as seen in (331)–(332).

(331) *hawi heziphapha*
hawi Ø-ha-za-p^{h}a-p^{h}a
move.PL 1NSG-AUX-in-water-RED
'while we were walking (a little way) down (the hill or towards the water)' (D293, B)

(332) *k^{h}ahonananana owa-za bak^{h}o nai*
k^{h}a-hona-na-na-na owa-za bak^{h}o Ø-na-i
move.SG-hither-RED-RED-RED 1SG-IO arrive 3-AUX-DECL.M
'he slowly came and arrived to me' (B)

Tiss (2004) reports that final syllable reduplication in conjunction with the centrifugal prefix *to-* 'CTF' indicates a new habitual action in the present tense in Juruá Kulina.[95] As (333) shows, the reduplicative suffix takes semantic scope over the whole stem although the copied

(*k^{h}a-a-a* 'bite dead two [children]'). Other examples of vowel triplication in monosyllabic roots are *to-o-o* 'shoot two' and *ti-i-i* 'cut two (with machete)'. This pattern is not productive and extends only to a very small number of lexical items (Boyer p.c.).

[94] The auxiliary *na-* is regularly omitted before certain suffixes, including the trigger *-za* .

[95] While Dienst (2014) discusses the same prefix (glossed as 'AWAY') in Purus Kulina, he also mentions a homophonous change-of-state prefix *to-* used in dynamic verbs derived from stative verbs. Since the verb form

segments belong solely to the plural marker -*mana*. Note that unlike Purus, the plural marker -*mana* triggers mutation in Juruá.

(333) *poadeni p^{h}owini tohipemanana nawi*
poa-deni p^{h}owini Ø-to-hipa-mana-na na-wi
3.M-PL frog 3-CTF-eat-PL-RED AUX-DECL.M
'they (now) regularly eat frog (but in the past, they never did)' (T154)

A similar construction is also attested in the Purus dialect, where initial syllable reduplication is used instead of the prefix *to*-. It is worth noting that while it is possible to have multiple instances of reduplication with directional affixes yielding an iconic interpretation (see examples (332), (336), and (337)), it is not possible to create a habitual reading of a continuous movement by circum-reduplication of a stem containing a reduplicated directional suffix because the continuous aspect marked by suffixal reduplication is semantically incompatible with the habitual aspect reading conveyed by prefixal reduplication:

(334) **ook^{h}ezip^{h}ap^{h}ap^{h}a nani*
o-o-k^{h}a-zi-p^{h}a-p^{h}a-p^{h}a na-ni
RED-1SG-move.SG-in-water-RED-RED AUX-DECL.F
Intended: 'I regularly walk a little way down towards the water.' (B)

4.2.2.3 Underapplication

When final syllable reduplication copies a directional affix that belongs to the class of mutation triggers, the copy does not trigger mutation on its base. An example of this pattern was presented in (331), repeated here as (335): the directional suffix -*p^{h}a* regularly triggers mutation on -*za*, but the reduplicated suffix -*p^{h}a* fails to trigger mutation on its base.[96] Other examples of reduplicated trigger suffixes are given in (336), where -*na* 'out' triggers mutation but its copy does not, and (337), where -*za* 'in(to)' triggers mutation but none of its copies do.

(335) *hawi hezip^{h}ap^{h}a* (= (331))
hawi Ø-ha-za-p^{h}a-p^{h}a
move.PL 1NSG-AUX-in-water-RED
'while we were walking (a little way) down (the hill or towards the water)' (D293, B)

in (333) also conveys the sense of a new situation replacing an old one, the *to*- at hand may be better analyzed as a change-of-state marker than a directional affix.

[96] Boyer (p.c.) point out that an alternative analysis of the sequence -*zi-p^{h}a* as a single morpheme denoting 'towards/into water; down hill' is also possible (see Agnew 1963 for a similar argument). However, since both -*za* and -*p^{h}a* are attested independently and the meaning of -*zip^{h}a* can be readily inferred from the meanings of -*za* and -*pha*, I follow the compositional analysis by Dienst (2014) and consider -*zi-p^{h}a* two suffixes instead of one. Note that question of morphological segmentation in the case of -*zi(-)p^{h}a* does not bear on my argument for a phonological account of the underapplication pattern because a hypothetical morpheme -*zip^{h}a* would also be a mutation trigger (cf. mutation on the auxiliary stem *ha* in (335)).

(336) *pasta miri onaza k^henanana hikahari*

pasta	miri	o-na-za	k^ha-na-na-na	hika-hari
toothpaste	squeeze	1SG-AUX-TC	move.SG-out-RED-RED	run.out-NAR.M

'I squeezed the toothpaste and it came out, out, out and finished.' (B)

(337) *madihapa kanowaza hai*[97] *tohezazazaza hika naza kanowa ihiharo*

madiha=pa	kanowa-za	hai	to-ha-za-za-za-za	Ø-hika	naza
people=TOP.M	canoe-IN	move.PL	3-AUX-in-RED-RED-RED	3-finish	then

kanowa	ihi-haro
canoe	full-NAR.F

'The people got into, into, into the canoe and when they finished, the canoe was full.' (B)

4.2.3 Analysis

4.2.3.1 Vowel mutation

I analyze mutation as a process triggered by a floating [-l] feature. Each trigger suffix listed in table (322) has a floating [-l] at its left edge, and segmentally identical morphemes such as *-na* 'out' and *-na* 'IFUT' differ in that one has a floating [-l] and the other does not. When a floating [-l] associates to a • of /a/, it overwrites the original [+l] feature, resulting in a structure where [-h] and [-l] are pronounced, yielding a mid vowel /e/.

The fact that some low stem vowels mutate to /i/ instead of /e/ can be explained by assuming that those vowels are underlyingly associated to [+h] instead of [-h]. I will use the symbol /æ/ for a vowel that is specified for [+l] and [+h]. This vowel is never pronounced [æ] but either /i/ (after undergoing mutation) or /a/ (in non-mutating contexts). When a floating [-l] associates to a • of /æ/, it overwrites the original [+l] feature, resulting in a structure where [+h] and [-l], i.e. a high vowel /i/, is pronounced. The idea of a segment whose underlying shape is never realized because the grammar dictates repairs in all possible contexts is similar to arguments made for the exceptional sonority status of the voiced bilabial continuant in Russian (Jakobson 1948, Lightner 1972, Halle 1973, Calabrese 1995) and vowel-zero alternations in Hungarian (Siptár and Törkenczy 2000), Sye (Crowley 1998; see chapter 5 for discussion), and Slavic (Lightner 1972; Kenstowicz and Rubach 1987; Scheer 2006; but see Gouskova 2012 for a different approach).

The table in (338) gives an overview of the featural decomposition of Kulina vowels. Specifying /o/ as LAB without any height features allows to capture the four-way contrast between /i/, /e/, /æ/ and /a/ using only two binary features. This decomposition also offers a natural explanation why /o/ is not a possible target for mutation.

[97] *hai* and *hawi* (cf. (335)) are dialectal variants. The former is used in the upper Purus region while the latter is more common downriver in Brazil.

(338) *Vowel features*

/i/		[-l]	[+h]	
/e/		[-l]	[-h]	
/o/				LAB
/a/	(= a_1)	[+l]	[-h]	
/æ/	(= a_2)	[+l]	[+h]	

In the tableau in (339), the basic workings of the mutation process are presented. The input candidate a. violates [-l]→●, the constraint demanding integration of the floating feature. Associating [-l] without delinking the underlying [+l] feature violates *$\underline{●_{2[l]}}$, a structural markedness constraints against pronouncing two [l] features under the same ● (c.). Automutation on the affix vowel is ruled out due to ALTERNATION (d.), leaving overwriting as the optimal output (b.). I assume that both mutation and reduplication are word-level processes and are therefore computed in parallel.

(339) *Mutation of /a/ (= /a_1/) to /e/*

WL		Input = a.	● ↑ [-l]	ALT	*$\underline{●_{2[l]}}$	MAXl	DEPl
	a.	kʰ a n a [-h] [+l] [-l] [+l] [-h]	*!				
☞	b.	kʰ e n a [-h] [+l] [-l] [+l] [-h]				*	*
	c.	kʰ V n a [-h] [+l] [-l] [+l] [-h]			*!		*
	d.	kʰ a n e [-h] [+l] [-l] [+l] [-h]		*!		*	*

Mutation on an underlying /æ/ proceeds analogously (341). Stems with an /æ/ additionally violate *$\underline{æ}$ (340), a constraint against pronouncing [+l] and [+h] under the same ●. As a structural markedness constraint, *$\underline{æ}$ takes up the idea that full positive specification is deprecated from SPE (Chomsky and Halle 1968; see also Lindau 1978). *$\underline{æ}$ is automatically satisfied by realizing the floating [-l]. Outside of mutation contexts, *$\underline{æ}$ triggers a change from /æ/ to /a/ and is the reason why /æ/ never surfaces as [æ]. As shown in the tableau in (342), /æ/ neutralizes with /a/ instead of /i/ because epenthesis of [-h] is optimal compared to insertion of [-l] because DEP([-l]) outranks DEP([-h]). Note that *$\underline{æ}$ must be inactive (ranked too low to ever have any effect) on the morpheme stratum.

(340) *$\underline{æ}$ Assign one * for each segmental root node associated to both [+l] and [+h] in P.

(341) *Mutation of /æ/ (= $/a_2/$) to /i/*

WL		Input = a.	• ↑ [-l]	ALT	$*\bullet_{2[l]}$	*æ	DEP [-l]	DEP [-h]	MAX|	DEP|
	a.	z æ m a [+h] [+l] [-l]	*!			*				
☞	b.	z i m a [+h] [+l] [-l]							*	*
	c.	z a m a [+h] [+l] [-l] [-h]	*!					*	*	

(342) *Neutralization of /æ/ an /a/ in the absence of a mutation trigger*

WL		Input = a.	• ↑ [-l]	ALT	$*\bullet_{2[l]}$	*æ	DEP [-l]	DEP [-h]	MAX|	DEP|
	a.	z æ [+h] [+l]				*!				
	b.	z i [+h] [+l] [-l]					*!		*	
☞	c.	z a [+h] [+l] [-h]						*	*	

4.2.3.2 Reduplication

I analyze final syllable reduplication as being triggered by a defective mora (343). Affixation of μ entails copying of the closest σ node due to high-ranked constraints ruling out other repairs such as lengthening or non-realization, much like in Lakota.[98]

(343) [CONT] ↔ μ

The tableau in (344) shows how the presence of a floating μ drives σ copying. Candidate a., which leaves the μ floating, fatally violates high-ranked ω→σ. Candidate b. violates high-ranked DEP(σ) militating against colorless σ nodes. Integrating the μ into a stem σ, be it by simple linking or by overwriting, is not optimal due to high-ranked $*\sigma_{2\mu}$, a constraint that is independently motivated by the strict C(V) syllable structure in Kulina (candidates c. and d.). Copying is then left as the most harmonic repair strategy (e.).

[98]Since syllables in Kulina are maximally CV, nothing crucially hinges on the assumption that copying is upwards and not downwards.

(344) *Final CV reduplication* (= (329-a))

WL		Input = a.	σ ↑ μ	$*\sigma_{2\mu}$	DEP σ	MAX$^{\sigma}_{\mu}$	INT σ
	a.	d a m a μ	*!				
	b.	d a m a σ μ			*!		
	c.	d a m a μ		*!			
	d.	d a m a μ		*!		*	
☞	e.	d a m a m a					*

In the case of multiple reduplication, several repetitions of the continuous morpheme are concatenated.[99] As in the previous examples, each of the defective moras induces a copy of the closest syllable in M-structure. The tableau in (345) illustrates this process using the example of *k^henanana* (< k^ha-na-na-na 'move.SG-out-RED-RED', cf. (336)). None of the copies in *k^henanana* trigger mutation on a preceding low vowel; the reasons for this will be discussed in the next section.

(345) *Multiple reduplication*

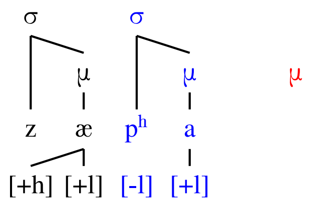
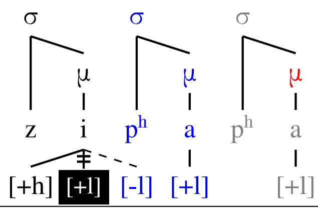
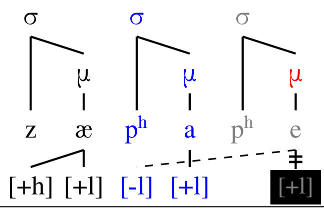
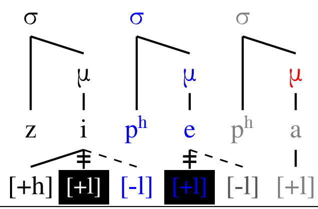
WL		Input = a.	σ ↑ μ	$*\sigma_{2\mu}$	DEP σ	MAX$^{\sigma}_{\mu}$	INT σ
	a.	k^h a n a μ μ [-h] [+l] [-l] [+l]	*!*				
☞	b.	k^h e n a n a n a [-h] [+l] [-l] [+l] [+l] [+l]					**

[99]Iconic multiple affixation of the same reduplicative affix is also reported for Tigre, where up to three instances of the same frequentive/attenuative morpheme can be stacked, each one intensifying the attenuative meaning (Rose 2003). In Mojeño Trinitario, single reduplicative affixes sometimes induce double copying: *-amo-momo-* (swell.up-RED) 'swollen up all over' (Rose 2014: 395).

4.2.3.3 Underapplication

The incapability of copied material to act as a mutation trigger follows from the hypothesis that reduplication is copying of phonological strings. Featural nodes that are not dominated by the copied string, in particular floating features that induce mutation, are not copied. The underapplication pattern in Kulina is therefore the natural consequence of copying in phonology: a copied trigger morpheme lacks the crucial floating feature and loses its status as a mutation trigger.

(346) *Copies are not possible triggers*

WL		Input = a.	● ↑ [-l]	INT [-l]	ALT	σ ↑ μ	DEP [-l]	*× ● [l]	INT σ
	a.		*!			*			
☞	b.								*
	c.							*!	*
	d.			*!					*

The tableau in (346) shows that local association of the floating [-l] to a preceding ● is optimal under reduplication (b.). The floating [-l] from the directional suffix *-na* is not present in the copied material (b. and c.). Local leftward mutation in candidate b. is the winner. Rightward mutation in candidate c. loses because it violates the NCC. Candidate d. copies both the σ and the floating [-l] feature from the directional suffix *-na*. Since the [-l] is not associated to the σ via a path of lines, copying of [-l] is not covered by pied-piping and incurs an additional violation of INTEGRITY, more specifically INT([-l]), which I assume is undominated in Kulina. Copying of σ and copying of [-l] instantiate separate copy operation, which is why the resulting structures are assigned different colors.

4.3 Interim summary

In this chapter, I have presented two case studies of mutation underapplication. Both Kulina and Lakota have a vowel mutation process that raises a low vowel to a non-low vowel. However, as summarized in (347), the environments in which mutation is observed, as well as the nature of underapplication, are almost exact mirror images of each other.

(347) *Underapplication in Lakota and Kulina*

	LAKOTA	KULINA
Are there immune low vowels?	Yes	No
Quality of mutated V determined by ...	Suffix	Stem
Reduplication copies ...	Final syllable	Final syllable
Underapplication is observed when ...	Undergoer is copied	Trigger is copied
Cause of underapplication:	TMTP	Lossy Copying

I have argued that despite these differences, both underapplication patterns are captured by an analysis that derives mutation and reduplication from non-segmental affixation. In the case of Lakota, *underspecification* is the key to understanding why only some stems are eligible for mutation. The failure of mutation in reduplicated stems results from TMTP, i.e. *excess supply of mutation targets*. Note that a TMTP account of underspecification is only applicable to cases where default feature insertion can be sensibly assumed, i.e. it is predicted that no underapplication of this kind is observed in languages without such default features. It is also worth noting that another prediction of BMR is borne out in Lakota, namely that bidirectional markedness constraints may enforce copying of a higher prosodic node, resulting in a typologically rare full syllable copying pattern.

In Kulina, some stem vowels have *illicit feature configurations* which explains why the outcome of mutation may be a high or a mid vowel. The fact that the copy of a trigger does no longer trigger mutation follows from an *undersupply of mutation triggers* due to Lossy Copying. BMR thus makes the interesting prediction that copies are in a morphological sense "imperfect": they lack unintegrated material present in the base. Lossy Copying stands in stark contrast to what seems to be the expected consequence of morphological doubling as advocated in MDT because there is no obvious reason why the morphological information of belonging to the class of mutation triggers should be absent from a (segmentally truncated) morphological clone.

The underlying rationale behind both TMTP and Lossy Copying is that reduplication may create a context in which a mutation trigger faces more potential targets than outside of reduplication. In Kulina, this leads to regular local mutation on the stem vowel preceding the base suffix but to lack of mutation elsewhere due to non-copying of floating features. In Lakota, the one floating [-l] finds itself in a quandary owing to the presence of two underspecified vowels; in the end, unable to serve both vowels at the same time, the optimal way out is to stay floating and let another feature, the default [+l], fill the defective root nodes.

Chapter 5

Root allomorphy

One of the principal empirical arguments of MDT are cases of divergent allomorphy in reduplication. Theories that assume morphological identity between base and reduplicant can easily account for, and in fact predict the existence of, patterns in which base and reduplicant contain distinct suppletive allomorphs of the same morpheme. Theories of reduplication that rely on phonological copying, however, face the problem that morphological selection should not be accessible to the phonology proper because phonological computation belongs to a different grammatical module. If it can be shown that apparent suppletive relations between base and reduplicant can be derived by purely phonological operations, a strong argument in favor of phonological copying, and hence a modular theory of reduplication, will arise. The aim of this chapter is to present such a phonological analysis of verb root alternations in Sye, an Oceanic language of Vanuatu. My claim will be that the seemingly chaotic behavior of consonant and vowel mutations at the left edge of verb roots in Sye is in fact governed by a set of well-motivated phonological principles that are backed by general processes in the language. Differences in stem shape between base and reduplicant simply follow from the assumption that mutation is locally triggered by defective segmental material.

This chapter is organized as follows. In section 5.1, I present my case study of Sye. I start with a discussion of the relevant phonological and morphological background of Sye before proposing my phonological solution to the problem posed by root allomorphy. In section 5.2, I review further cases of potential suppletive allomorphy in reduplication and sketch why they are compatible with my theory of phonological copying. The chapter is concluded by an interim summary in section 5.3.

5.1 Multiple mutation in Sye

5.1.1 The problem

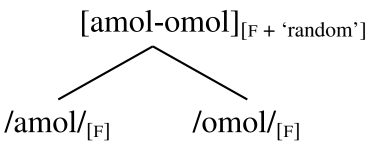
Like several other Oceanic languages, Sye has a process of root-initial mutation whereby verb roots appear in one of two shapes (*basic* and *modified*) depending on the morphological environment. Verb root alternations (VRA) in Sye may involve a nasal element, a vocalic element, and different kinds of vowel and consonant mutation. For that reason, they have been characterized as highly "complex" in the literature (Crowley 1998: 6; Thieberger 2012: 392). Sye also has a process of full verb root reduplication. When a reduplicated verb appears in a context that calls for a modified verb root, the base takes the shape of the modified root while the reduplicant appears in its unchanged basic form. This is illustrated by the case of *ɣw-amol-omol* 'they will fall all over' in (348).

(348) *Root allomorph mismatch in Sye reduplication* (Crowley 1998: 77)

BASIC	omol	BAS:fall	'fall'
MODIFIED	ɣw-amol	3PL:FUT-MOD:fall	'they will fall'
REDUP.	ɣw-**amol-omol**	3PL:FUT-MOD:fall-BAS:RED	'they will fall all over'

The apparently chaotic and unpredictable nature of Sye VRA have lead Inkelas and Zoll (2005) to conclude that the modified roots must be stored as suppletive allomorphs. If this is true, the consequence for theories of reduplication would be that the two copies must be separate morphological entities, as it is not clear how a string-based phonological copying could handle two suppletive allomorphs of the same morpheme appearing as base and reduplicant. The figure in (349) shows how the reduplicated stem *amol-omol* can be analyzed in MDT. The construction consists of a mother node with the phonological form [amol-omol] dominating two daughter nodes, one with the modified root form [amol] and the other with the basic form [omol]. Both daughters are instances of the same morpheme, i.e. the morpheme with the semantics [FALL], which allows the two daughters to bear different phonological and morphological specifications. The semantics of the mother node is the semantics of its daughters plus the component "all over", represented here as 'random'.

(349) *Sye reduplication as a morphological doubling construction*



where F = [FALL] (Inkelas and Zoll 2005: 11)

The goal of this chapter is to show that Sye VRA do not present a case of suppletive allomorphy but are instead deducible from entirely regular phonological processes, an intuition shared by Crowley (1998) and Frampton (2009). The core proposal of my analysis is that VRA are triggered by two floating subsegments and that adjacency to those subsegments is responsible for the various segmental changes in modified root forms. Using general phonological constraints active in Sye combined with a theory of feature geometry that allows the relevant floating elements to be linearly ordered, I argue that it is possible to account for the full range of attested verb root alternations. If the divergent behavior of verb roots under reduplication follows from local phonological processes rather than morphological selection, it is compatible with phonological copying and ceases to provide an argument for powerful reduplicative constructions and, more generally, doubling in morphology.

5.1.2 Mutation and reduplication in Sye

5.1.2.1 Background on Sye

Sye (alternate names: Sie, Erromangan) is an Oceanic (Southern Vanuatu) language spoken by approximately 1400 speakers in the Tafea province on the Erromango Island, Southern Vanuatu. The primary sources on Sye consulted here are the comprehensive grammar in Crowley (1998), the grammar outline in Lynch and Capell (1983), the vocabulary list in Capell and Lynch (1983), and the overview article in Crowley (2002).[100]

Sye phonology Sye has a canonical five vowel system consisting of /a, e, i, o, u/[101] and 14 consonants. The consonant inventory of Sye is given in (350) below. Previous studies disagree in the status of some of the consonants; the main differences are shown in the table in (351), where gray shading indicates sounds recognized in Lynch and Capell (1983) and Capell and Lynch (1983) but not in Crowley (1998, 2002).

(350) *Sye consonant inventory*

p	t		k	
mp	nt	nd	ŋg	
f∼v	s		ɣ	h
m	n		ŋ	
	l			
	ɾ			
w	j			

(351) *Comparison of previous proposals*

p		p^w	t		k	
				nd		
f	v		s		ɣ	h
m		m^w	n		ŋ	
			l			
			ɾ			
w			j			

The labialized consonants suggested by Lynch and Capell (1983) are reanalyzed as consonant-glide sequences in Crowley (1998, 2002). Crowley also proposes a simplification of the fricative series in that he recognizes only one phoneme /v/. He convincingly argues that the alleged contrast between /f/ and /v/ assumed by Lynch and Capell (1983) is not justified, as the labial fricative can have a number of different phonetic realizations: “The fricative /v/ can be realized as [v], [f] or [β]. For some individuals, /v/ is invariably realized as [v]. For others, [v] is in free variation with either [f] or [β], or all three are in free variation together. For yet others, [f] is preferred word-initially and [β] intervocalically before rounded vowels, with [v] being preferred elsewhere” (C8). The variation is also partially conditioned by dialect, as northern speakers of Sye tend to pronounce [f] more frequently than southern speakers, but

[100] Abbreviations for these sources used throughout this chapter are as follows: C = Crowley (1998), L = Lynch and Capell (1983), V = Capell and Lynch (1983), and O = Crowley (2002).

[101] Mid vowels sometimes alternate with zero in certain morphonological environments, cf. *tenom-jau* bury-1SG.O ‘bury me!’ vs. *tenm-i* bury-3SG.O ‘bury him/her!’, but *ovol-jau* turn-1SG.O ‘turn me!’ vs. *ovol-i* turn-3SG.O ‘turn him/her!’ (C15). Crowley (1998) and Crowley (2002) analyze alternating mid vowels as underlying /ə/ which either surfaces as /o/ (or, for some speakers /e/) or zero, but never as /ə/. Lynch and Capell (1983) proposes an alternative account based on a rule of vowel insertion.

in the end, “there is, in fact, no phonemic contrast in either variety of the language” (C9). I therefore follow Crowley (1998, 2002) in recognizing only a single labial fricative /f∼v/. I also adopt his treatment of consonant-glide sequences as true bisegmental sequences. Following the transcription tradition of Sye (and other Oceanic languages, too), I will use the symbol <v> for the labial fricative throughout this chapter.

I will now motivate my decision to include the prenasalized series which is entirely absent in Crowley (1998, 2002) and only represented by /nd/ (noted as <d>) in Lynch and Capell (1983) and Capell and Lynch (1983). My decision is mainly informed by phonotactic reasons. The main argument for treating sequences of /m+p/, /n+t/, /n+d/ and /ŋ+k/ as single segments is that this allows for a very simple generalization about permissible consonant clusters in Sye: biconsonantal clusters are fine, but clusters containing three or more consonants are not permitted. The table in (352) shows examples of intervocalic clusters that include a prenasalized stop as their first (a.) or second (b.) element. Crowley (1998) treats these clusters as sequences of three consonants but admits that they always “involve homorganic nasal-obstruent sequences” (C22). Once these NC sequences are understood as complex segments, restrictions on clusters in Sye can be stated in a much simpler and broader way.

(352) *Complex clusters involving prenasalized stops* (C22)

a.	empɣu	‘dance’	b.	nipmpend	‘kind of plant’
	wemplaŋ	‘butterfly’		japmpirai	‘kind of shellfish’
	nompwau	‘cloud’		titndit	‘kind of cicada’
	nimprau	‘semen’		etndoɣ	‘gnash teeth’
	naŋkrai	‘flying fox’		jahndor-	‘pull out’
	nemendŋo-	‘chest’			

Another piece of evidence is the observation that word-initially, only consonant clusters of rising or equal sonority (e.g. /s+j/, /p+w/, /m+l/, /n+m/) are possible. These clusters are overall not very frequent (C19). The sequences /n+t/ and /n+d/, however, do frequently occur in word-initial position (C19), which makes them exceptional under a bisegmental analysis both in terms of sonority and in terms of frequency. Under a monosegmental analysis that counts prenasalized stops as single segments and not as clusters, the generalization about initial clusters can be upheld. Furthermore, Sye has a ban on complex codas, but /nt/, /nd/, and /ŋk/ are attested in word-final position (C21). This again suggests that they should be treated as single segments.

Another argument for assuming prenasalized segments in Sye is that while Sye allows heterorganic /N+C/ clusters (e.g. *nowomti* ‘one-legged’ (V99), *tanpo* ‘good, right, just; goodness, justice’ (V108)), addition of a nasal element in modified root forms (see section 5.1.2.2 below) always yields a homorganic sequence such as *mp-* or *nt-*, never a heterorganic one. This strongly suggests that Sye attests (possibly heterorganic) bisegmental /N+C/ clusters as well as true (homorganic) prenasalized stops.

There is a final argument for a unary segment analysis coming from the phonetics. Riehl (2008), in her study of nasal-obstruent sequences in Sye and other Austronesian languages, argues that /nd/ should be considered a unary sound rather than a sequence of two distinct segments on acoustic grounds. The study primarily relies on durational differences as acoustic cues to distinguish /NC/ segments from /N+C/ sequences as well as from single /N/ and /C/ segments. Riehl found the combined duration of nasal and oral closure portion in /nd/ to be consistently of the same length as the overall duration of /n/ and /t/ (ca. 80 – 120 msec) across four different speakers (pp. 249–255). Other nasal-obstruent sequences, however, display a different behavior: /nt/ and /mp/ are significantly longer (ca. 140 – 160 msec) than their respective singletons (pp. 249–258). The situation with velar /ŋk/ is somewhat messy as /ŋk/ and /k/ are of equal overall duration (ca. 140 – 160 msec) and both are significantly longer than /ŋ/ (ca. 60 – 80 msec). The prenasalized and plain velar stops also share an aspiration period of about the same duration as the nasal closure portion in /ŋk/ (pp. 258–260).

Riehl (2008) concludes that /nd/ is a unary /NC/ segment and all other nasal-obstruent sequences are bisegmental.[102] There is, however, another possible explanation: The reason why /nt/ is longer than /n/, /t/, and /nd/ might be to enhance the contrast between /nt/ and both its plain and voiced counterparts. Since /nd/ does not contrast with /d/ in Sye, there is no functional need for it to be pronounced longer. In summary, Riehl's study offers support for a unary treatment of /nd/, and I extend this insight to all nasal-obstruent clusters in Sye.

The phonological generalizations made so far are pretty robust and apply to all word classes. More complex consonant clusters may occur as the result of adding possessive, number and nominalizing clitics to nominal bases. In these contexts, we find prenasalized stops followed by fricatives ((353)-a) as well as three- and even four-consonantal sequences without prenasalized segments ((353)-b). What is crucial for the present discussion of verb root alternations and verbal reduplication is that these clusters are restricted to the nominal domain and are not found in verbal inflection or derivation. For this reason, they do not devalidate the generalizations about /NC+C/ clusters or the arguments made for counting prenasalized stops as single segments.

(353) *Complex consonant sequences with nominal clitics*

a.	ra=nt=saɣ	LOC=NOM=ascend	'up the slope'	C286
	ave=nt=hai-me	brother=1PL.INC=brother-PL	'me and my brothers'	C180
b.	ovn=kuri	PL=dog[103]	'dogs'	C207
	ovn=kriŋriŋ	PL=freshwater.prawn	'freshwater prawns'	C25

Another crucial observation about Sye phonotactics is that not all possible combinations of /NC+C/ clusters are attested. Sye has several ideosyncratic restrictions on which consonants may or may not follow a prenasalized stop, as shown in the table in (354). The sounds that can never appear as the second members of a /NC+C/ cluster can be grouped together as follows: (i) the fricatives /v/, /s/, and /h/; (ii) the nasal /m/; (iii) homorganic nasals. These

[102] Riehl also includes a phonological discussion in which she discards the argument for a monosegmental analysis of /NC/ on the basis of onset clusters, arguing that "[i]t may be that speakers optionally append a nasal to roots beginning with other initial consonants, by analogy" (p. 89), given the overall large number of nasal-initial roots in Sye. This statement seems more like an open research question than a solid argument against prenasalized segments, however.

[103] Note that in other places, Crowley (1998) gives this nominal expression as two separate words, *ovon kuri* (C191, C201).

generalizations will become relevant in the discussion of (pre)nasalization mutation in Sye VRA in section 5.1.3.4 below.

(354) *Attested intervocalic /NC+C/ clusters* (C23)

	ɣ	n	ŋ	l	r	w	j
mp	+	+	+	+	+	+	
nt					+		
ŋk				+	+		
nd			+			+	

Sye generally tolerates sequences of two unlike vowels, as seen by forms such as *ai* 'blunt', *alei* 'lie down', *utɣoi* 'chin', *nalau* 'child', and *alou* 'run' (C18). Trivocalic clusters are never found in Sye. Intramorphemically, only sequences of a non-high vowel followed by a high vowel are attested (with the exception of *-eu-*). On the word level, intermorphemic vowel sequences are often subject to one of the numerous simplification strategies that depend on the exact nature of the sequence. For instance, "the two vowel sequences /ae/ and /ao/ are resolved by deleting the second vowel" (C29), while /u/ often changes into a glide when it appears as the first vowel in a VV sequence (C30). This suggests that Sye has an undominated constraint *VVV against sequences of three vowels and a fairly high-ranked constraint *VV against VV sequences that interacts with other (markedness) constraints to give rise to the various repair patterns. The exact details of those repairs are not of concern for the present work, but the idea of a constraint *VV will be taken up again in section 5.1.3.4.

Word stress in Sye is not distinctive and falls on the penultimate syllable.[104] Descriptions vary as to the position of secondary stress, which is sometimes characterized as falling on the initial syllable (L21f) and sometimes on the syllable preceding the antepenult (C17) ((355)-a). Both root and affix material can bear stress. Deleted segments such as the second vowel in *-or(o)ŋ-* 'hear' are invisible to stress ((355)-b), which means that stress assignment applies late, after all morphonological processes have taken place.

(355) *Word stress in simple and complex word forms*

a.			b.		
nvát	'stone'	C17	ɣ-oróŋ-jau	'(s)he heard me'	C17
nómu	'fish'	L21	ɣ-órŋ-oɣ	'(s)he heard me'	C17
nalíntoɣ	'lobster'	C17	joɣ-órŋ-i	'I heard it'	C17
sèsimáŋsi	'index finger'	C17	joɣ-orŋ-í-su	'I have heard it already'	C17
òrutenmóŋi	'to sink (trans.)'	L22			

Apart from differences in the analysis of Sye segmentism, there are a few systematic notational differences between the sources consulted and the IPA transcription adopted here:

[104] Vowel sequences behave as single units for stress assignment: *níkau* 'freshwater prawn', *nóuran* 'his/her bone' (C17). This could potentially be taken as an argument for treating those sequences as diphthongs. In Crowley (1998), the term "diphthong" is employed in the sections on word stress and vowel deletion (C17, C33) but seems to be used synonymously with the more widely used term "vowel sequence". Due to lack of any other evidence in favor of a diphthong analysis, I will stick to the general monophthongal analysis of all consulted sources and remain agnostic as to the status of vowel sequences for stress assignment.

(356) *Notational differences*

L, V	C, O	IPA (used here)
ŋ	g	ŋ
g̶	c	ɣ
y	y	j

Sye morphology Sye is a synthetic fusional language with a rich and predominantly prefixing verbal morphology. Fully inflected verb forms usually consist of the lexical root and one or more prefixes marking inflectional categories such as person and number of subjects, various TAM features ("imperative, recent past, distant past, dependent past, past habitual, present, future, optative, realis conditional, irrealis conditional and counterassertive", O705), and negation. Suffixes are used to mark person and number of objects, aspect and emphasis, though for some transitive verbs, synthetic object marking is not possible. Combinations of TAM and agreement categories are often expressed by single portmanteau affixes. Two examples of morphologically complex verb forms are given in (357) and (358).

(357) *ji-ta-ɣoh*
3SG:DISTPST-BAS:strike-1PL.INCL
'It struck us.' (O715)

(358) *jaɣo-etu-okil-oɣ-hai*
1SG:RECPST-NEG-BAS:know-2SG-EMPH
'I did not know you at all.' (C106)

5.1.2.2 Verb root alternations

Sye exhibits a series of non-trivial verb root-initial consonant and vowel mutations that are among the most complex within the Oceanic family (see Thieberger 2012 for an overview of mutation patterns in various Oceanic languages). Each verb root comes in two shapes, the *basic* and the *modified* root form. The two root forms can be identical, as in the case of *lau* ∼ *lau* 'be dry', minimally distinct (e.g. *tovop* ∼ *ntovop* 'laugh'), or substantially different (e.g. *vaŋ* ∼ *ampaŋ* 'eat'). Basic and modified root forms are glossed as BAS and MOD, respectively.[105]

The basic root form appears following imperative, past tense subject, negative, purposive, instrumental, and derivational prefixes. It is also used in compounds and causative constructions. The modified root form appears following future and present tense, conditional and past habitual prefixes (C77–80). In the following, I will adopt the convention of Lynch and Capell (1983) and refer to the former as *past* and to the latter as *non-past* contexts. The tables in (359) and (360) show a representative sample of prefixes calling for basic or modified root forms.

[105] I abstain from adopting Crowley's (1998) glosses BR and MR because these abbreviations are used for *base-reduplicant* and *manner* in this thesis.

(359) *Basic root forms following past prefixes*

ɣ-	3SG:RECPST	*ɣ-aruvo*	'(s)he has just sung'	C77
w-	2PL:IMP	*w-aruvo*	'sing!'	C77
epm-	PRIOR	*j-epm-aruvo*	'(s)he had sung'	C78
wor-	PURP	*wor-aruvo*	'in order to sing'	C78
ovj-	DESID	*jam-ovj-aruvo*	'I wanted to sing'	C78

(360) *Modified root forms following non-past prefixes*

ɣo-	3SG:FUT	*ɣo-naruvo*	'(s)he will sing'	C79
em-	PRS[106]	*ɣ-am-naruvo*	'(s)he is singing'	C79
kanli-	1PL.EXCL:IRR	*kanli-emle-naruvo*	'if I were to sing'	C114
japem-	1SG:COND	*japem-anduɣ*	'if I had bathed'	C113
rumo-	3PL:PST:HAB	*rumo-nta-i*	'they would weave'	C93

It should be noted that the basic form is indeed the default form, as it appears when no prefix is attached to the verb stem. This situation arises in causative constructions when a fully inflected causative verb takes a bare verb root as its complement, and in NV compounds; two examples are shown in (361).

(361) a. *ɣ-am-koh etehep*
3SG:FUT-MOD:CAUS-1PL.INCL BAS:sit
'(s)he will sit us down' (C79)

b. *neimah aɣur*
cassia BAS:wilt
'sensitive grass' (C79)

The morphological domain to which inflectional prefixes participating in VRA attach to is the verbal stem, which comprises the verb root and verbal derivation markers such as *ovju-* 'CAUS', *ovlu-* 'SIM', *omproɣ-* 'IMM', and *ovju-* 'DESID'. Mutation always targets the segment(s) immediately adjacent to a trigger affix, which means that it may be the derivational prefix that undergoes segmental alternations in complex stem forms ((362)–(363)).[107]

(362) *jaɣ-ampju-velom kik*
1SG:FUT-MOD:CAUS-BAS:come 2SG
'I will lead you here.' (O709)

(363) *ɣ-amproɣ-ov-jau etehep*
3SG:FUT-MOD:IMM-BAS:CAUS-1SG sit
'(S)he will just sit me down.' (O713)

[106] *em-* belongs to a class of affixes dubbed "fifth-order prefixes" in Crowley (1998: 106–108). *em-* can express a number of different tenses in combination with other TAM prefixes. In the example at hand, the recent past marker *ɣ-* and the prefix *em-* together mark present tense. Not all instances of *em-* call for the modified root form, and sequences of the same prefix and different versions of *em-* may appear with the basic form in one and with the modified form in a different tense.

[107] Sye has a set of echo subject prefixes used in multiclausal constructions which behave exactly as the prefixes they substitute with respect to verb root alternations. I assume that each echo prefix has two allomorphs, one belonging to the class of basic-root triggers selected for in the context of a past affix, the other belonging to the class of modified-root triggers occurring in the context of a non-past affix.

More examples for the strict locality of VRA are given in (364). The recent past prefix *ɣ(o)-* always selects for the basic root form (364-a). The root appears in the modified form in (364-b), however, because the negative future marker *etwo-*, which requires the modified root, is closer to the root than the past prefix. In (364-c), the future marker *jaɣ-* causes the adjacent desiderative prefix *ovj(u)- ∼ ampj(u)-* to appear in its modified form, but that prefix in turn triggers the basic form of the verb root despite the presence of the non-past prefix.

(364) a. *ɣ- aruvo*
3SG:RECPST- BAS:sing
'(s)he has just sung' (C77)

b. *ɣo- etwo- naruvo*
3SG:RECPST- NEG:FUT- MOD:sing
'(s)he will not sing' (C79)

c. *jaɣ- ampj- aruvo*
1SG:FUT- MOD:DESID- BAS:sing
'I will want to sing' (C78)

The table in (366) lists a significant percentage of attested root form pairs from all available sources. The shape of modified root forms may diverge quite far from that of the corresponding basic form. However, the modifications never affect any parts of the root beyond the initial two segments. Upon closer inspection, it is possible to identify four major alternation groups, summarized in (365): a. roots which add a nasal element, either as a segment /n/ before an initial V or as prenasalization of an initial C; b. roots which add a vocalic element, either as an additional segment /a/ before an initial C or by overwriting an initial V with /a/, and prenasalize the first root C; c. roots which add a vocalic but not a nasal element; and d. roots which have identical basic and modified forms (C-initial roots only).

(365) *Types of phonological changes in modified root forms*

	GENERAL	V-INITIAL	C-INITIAL
a.	Add a nasal	Add /n/	Prenasalization
b.	Add /a/ and a nasal	Overwrite V with /a/ + prenasalization	Add /a/ + prenasalization
c.	Add /a/	Overwrite V with /a/	Add /a/
d.	No change		

A final observation is that prenasalization always entails consonant mutation if the prenasalized C is a fricative or a rhotic. The changes are summarized in (367). Both voiced and voiceless fricatives turn into voiceless stops, while the rhotic /ɾ/ turns into a voiced /nd/. As with all prenasalized segments in Sye, the nasal is always homorganic with the obstruent part. Note that when followed by another consonant that must not appear as the second member of a /NC+C/ cluster, the fricative mutates into a plain nasal instead of a prenasalized stop (b"'. in (366)).

(366) *Basic and modified verb root forms*

	BASIC	MODIFIED		
a'.	owi	nowi	'plant'	C81
	omonki	nomonki	'drink'	C120
	ovi	novi	'cut'	L25
	orei	norei	'scratch'	L25
	oravi	noravi	'flow'	L25
	oral	noral	'flow'	L25
	esomsah	nesomsah	'breathe'	L25
	elɣavi	nelɣavi	'hold'	L25
	elimsi	nelimsi	'blow (of wind)'	L25
	eni	neni	'eat'	L25
	ehkar	nehkar	'hold feast'	C81
	aruvo	naruvo	'sing'	C79
	avan	navan	'walk'	C81
	alam	nalam	'grow'	C142, C288
	atipotni	natipotni	'start'	C260, C261
	aleipo	naleipo	'sleep'	C78
	ur	nur	'follow'	C65, C251
a".	tovop	ntovop	'laugh'	C82
	ta	nta	'weave'	C93
	torilki	ntorilki	'return'	C85
	ran	ndan	'break (of day)'	C82
b'.	etehep	antehep	'sit'	C84
	eti	anti	'give birth'	C285, C288
	evɣah	ampɣah	'defecate'	C84
	etpond	antpond	'be cold'	C24
	okili	aŋkili	'know it'	C84
	oɣep	aŋkep	'fly'	C84
	oɣol	aŋkol	'dig'	C80
	oɣu	aŋku	'say'	C122, C119
	oruɣ	anduɣ	'bathe'	C84
	orɣai	andɣai	'bathe'	C24
	orɣon	andɣon	'mix'	C24
	orjok	andjok	'pick up'	C24
	orwoŋ	andwoŋ	'wash'	C24
	ovoli	ampoli	'turn it'	C84
	ovju	ampju	'DESID'	C84
b".	pat	ampat	'be blocked'	C84
	vaŋ	ampaŋ	'eat'	C84
b"'.	oɣhi	aŋhi	'see it'	C84
	evsor	amsor	'wake up'	C84
c'.	ehkar	ahkar	'stare'	C81
	ehvo	ahvo	'be white'	C84
	ehri	ahri	'break'	C80
	elwo	alwo	'vomit'	C84
	emlu	amlu	'be crazy'	C84
	empɣu	ampɣu	'dance'	C30, C31
	omurep	amurep	'live'	C84
	owi	awi	'leave'	C84
	olki	alki	'hang'	C84
	eiti	aiti	'tie it'	C84
c".	etni	atni	'cook'	C84
	etmolaŋkau	atmolaŋkau	'look around'	C84
	opmah	apmah	'be hungry'	C84
	mah	amah	'die'	C84
d.	jep	jep	'descend'	C81
	wesisar	wesisar	'slip'	C81
	sompoŋ	sompoŋ	'snore'	C81
	lau	lau	'be dry'	C81

(367) *Prenasalization and mutation*

/v/	→	/mp/	in clusters: /m/
/ɣ/	→	/ŋk/	in clusters: /ŋ/
/ɾ/	→	/nd/	

What makes these patterns challenging for a phonological analysis – apart from the various segmental additions and mutations – is the fact that the modified form of a root is not predictable from the (surface) basic form. This is most clearly illustrated by the pairs of verbs in (368), which have homophonous basic forms but different modified forms, one with addition of a nasal /n/ and the other with mutating the first root vowel to /a/.

(368) *Basic form homonyms* (C81)

NASAL	*owi*	~	*nowi*	'plant'	*ehkar*	~	*nehkar*	'hold feast'
VOWEL	*owi*	~	*awi*	'leave'	*ehkar*	~	*ahkar*	'stare'

5.1.2.3 Reduplication

Sye has a productive pattern of full reduplication that adds an intensifying meaning to adjectives. On verbs, it conveys the idea "that an action takes place in a variety of locations at once" (O714) for verbs.[108] Reduplication copies the full verb root but never any affixal material. Some illustrative examples are given in (369) and (370) below. In isolated cases, reduplication may also involve other semantic shifts, cf. the added inchoative meaning in *aravarap* 'begin to get dark' < *arap* 'get dark' (C34).

(369) *Reduplication with adjectives*

isut	isut-isut	'very far away'	C34
metuj	metuj-metuj	'very softly'	C34
unmeh	unmeh-unmeh	'very early'	C34
potjon	potjon-potjon	'very short'	C34
tantop	tantop-tantop	'very long'	C34
viroɣ	viroɣ-viroɣ	'very small'	C145
au[109]	au-au (> awau)	'hot'	C30, C34

(370) *Reduplication with verbs*

omol	'fall'	omol-omol	'fall all over'	C34
alou	'run'	alou-alou (> alowalou)	'run all over'	C34
amon	'hide'	amon-amon	'hide all over'	C143
avan	'walk'	avan-avan	'walk all over'	C143
etru	'have hole'	etru-etru (> etretru)	'have many holes'	C34
ilar	'shine'	ilar-ilar	'shine brightly'	C34

[108]Reduplication in Sye is, however, not used as extensively and frequently as in some other Oceanic languages (C6).

[109]The status of *au* as an independent root meaning 'hot' is somewhat questionable, as it is not attested as such in any of the consulted sources. Capell and Lynch (1983) only list the reduplicated form *auau* 'hot' (V169, V178). A plausible alternative is that /au-au/ is derived from the verbal root /au/ 'burn, cook; be cooked' (V79), which would explain why it lacks the expected meaning of intensification.

It should be noted that most adjectives listed in (369) are in fact stative verbs. As in most Oceanic languages, the categorical distinction between adjectives and stative verbs rests on morphological and syntactic grounds in that "verbs receive prefixed inflectional marking for a variety of pronominal and other categories [while] adjectives have no inflectional marking for these categories" (C144). Adjectives can easily be derived from stative verbs by prefixing the adjectivizing prefix *n-* or the change of state marker *it(u)r-*. Thus, the fully inflected verb *ɣontelemte* in (371) and the postnominal modifier *ntelemte* in (372) are derived from the same lexical root, *telemte* 'be green'. The examples in (373) and (374) illustrate the difference between *n-* 'ADJZ' and *it(u)r-* 'COS'.

(371) *nur ɣo-ntelemte*
place 3SG:FUT-MOD:green
'The place will be green.' (C145)

(372) *kokeml-ante ra hai nur n-telemte*
1PL.INC:PRS-MOD:live LOC INDEF place ADJZ-green
'We live in a green place.' (C146)

(373) *nesi n-ovtar*
pawpaw ADJZ-BAS:rot
'pawpaw which is rotten' (C146)

(374) *nesi itr-ovtar*
pawpaw COS-BAS:rot
'pawpaw which has gone rotten' (C146)

Sye does not have a productive pattern of partial reduplication. A handful of lexical items appear to display reduplication of the initial or the final syllable, but all of them are either clearly lexicalized or dobious due to conflicting information in the consulted sources. An example of initial syllable repetition is *semsempari* 'protect' < *sempari* 'ibid.' (C143), but this could also well be a case of pseudoreduplication, as the vocabulary list in Capell and Lynch (1983) only recognizes the noun *semsempari* 'shield, protector' (V105). Even clearer cases of pseudoreduplication are the nouns *kilkil* 'fish hook' (C34) and *kirkiri* 'beads' (C18, V86). An example of final syllable repetition is *aɣumsusu* 'pitchblack' < *aɣumsu* 'black' (C143). Again, Capell and Lynch (1983) only list one of the two forms, in this case the non-reduplicated verb *aɣumsu* 'black' (V78).

When a reduplicated verb root appears in a context that requires a modified root form, only the first of the two verb roots is modified and the second root remains in its basic form. In other words, the modifications triggered by the presence of a specific prefix are only applied locally to the root adjacent to the prefix and are not copied onto the second root (375).

(375) *Reduplicated verb roots in an environment calling for a modified root*

ROOT	REDUPLICATED		
/omol/	ɣw-$_{\text{MOD}}$[amol]-$_{\text{BAS}}$[omol] *ɣwamolomol*	3PL:FUT-MOD:fall-RED 'they will fall all over'	C79
/ovol/	ɣw-$_{\text{MOD}}$[ampol]-$_{\text{BAS}}$[ovol] *ɣwampolvol*[110]	3PL:FUT-MOD:turn-RED 'they will turn all over'	C143
/au/	ɣame-$_{\text{MOD}}$[nau]-$_{\text{BAS}}$[au] *ɣamnawau*	3SG:PRS-MOD:hot-RED 'it is hot (hotter than X)'	C252

The independence of base and reduplicant in a mutation-triggering context is well in line with how reduplicated forms are treated in other phonological contexts. Thus, the regular processes of intervocalic /p/-spirantization (376-a), glide formation (376-b), and vowel deletion (376-c) are blind to the distinction between base and reduplicant and are carried out whenever the segmental context for their application is met, even when that causes non-identity between base and reduplicant. This strongly suggests that there is no building block that specifically oversees identity relations between base and reduplicant active in the grammar of Sye.

(376) a. /arap-arap/ (evening-RED) → /arav-arap/ 'begin to get dark' (C26)
b. /au-au/ (hot-RED) → /aw-au/ 'hot' (C30)
c. /etru-etru/ (have.hole-RED) → /etr-etru/ '(of wall) have many holes' (C34)

5.1.3 A phonological account of multiple feature mutation in Sye

5.1.3.1 Feature specifications

I will begin my analysis of verb root alternations by presenting my assumptions about featural specifications. The tables in (377) and (378) show the featural decomposition for consonants and vowels. The major division in the group of consonants is between [+son] and [-son] sounds: obstruents (plain or prenasalized) and the rhotic /ɾ/ are [-son], while nasals and glides are [-son]. Among the group of obstruents, stops are distinguished from fricatives by the feature [±cont] and prenasalized stops are distinguished from plain stops by the feature [nas]. Some fricatives have additional (non-contrastive) manner specifications: /s/ is [strident], /ɣ/ is [lax], and /f/ is optionally [lax] as it has a range of possible phonetic realizations (see discussion above). Following Morén (2003), I assume that the rhotic /ɾ/ too is specified for [lax] which is what makes it distinct from /t/.

[110]The loss of the initial vowel in the base is somewhat mysterious, especially since /ovol/ is cited as an example for verbs that do not show vowel-zero alternations (C15). The cited verb form is given only as *ampolvol-* without any further context (triggers or translation) in the cited source. For the purpose of illustration, I have extrapolated a likely context (the prefix *ɣw-*) from the preceding examples in the table.

(377) *Feature specifications of Sye consonants*

		MANNER							
	[±son]	[±cont]	[nas]	[lax]	[str]	LAB	COR	DOR	LAR
p	–	–				✓			
t	–	–					✓		
k	–	–						✓	
mp	–	–	✓			✓			
nt	–	–	✓				✓		
nd	–	–	✓	✓			✓		
ŋk	–	–	✓					✓	
f	–	+		(✓)		✓			
s	–	+			✓		✓		
ɣ	–	+		✓				✓	
h	–	+							✓
ɾ	–	–		✓			✓		
m	+	–	✓			✓			
n	+	–	✓				✓		
ŋ	+	–	✓					✓	
l	+	–					✓		
w	+	+				✓			
j	+	+					✓		

The relevant features for vowels are the manner features [±high] and [±low] as well as the place features COR and DOR. I assume that the front/back dimension in the vowel space is represented by the same place features as for consonants (Lahiri and Evers 1991, Clements and Hume 1995, Esling 2005). Thus, front /i, e/ are COR while back /u, o/ are DOR. The low vowel /a/ may have either a COR or a DOR place specification since place is not a contrastive feature along the [+low] dimension. Again, evidence for this feature decomposition comes from verb root alternations, where a low vowel element overwrites both coronal /e/ and dorsal /o/. Note that there is also no need for a feature [±cons] to distinguish consonants and vowels: consonants are specified for [±cont] and vowels are specified for [±low] and [±high]. In that respect, manner features dictate allegiance to a major class group, in a similar way to PSM (but see section 5.1.3.2).

(378) *Feature specifications of Sye vowels*

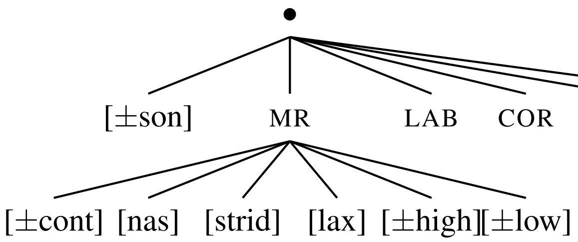
		MANNER			
	[±son]	[±low]	[±high]	COR	DOR
i	+	–	+	✓	
u	+	–	+		✓
e	+	–	–	✓	
o	+	–	–		✓
a	+	+	–	(✓)	(✓)

Segments in Sye do not contrast for laryngeal features with one notable exception: /nd/ is distinguished from its voiceless counterpart /nt/ only by voicing. I assume that this contrast can be represented in the same way as the contrast between /ɾ/ and /t/, i.e. as presence vs. absence of [lax]. The main argument here is that prenasalization of /ɾ/-initial verb root yields /nd/, which suggests the two sounds share a set of common features. As shown in table (377), they share all features except [nasal]. Major class and manner specifications are thus entirely sufficient to predict voicing: consonants that are [+son] or [lax] are voiced and all other consonants are voiceless. This eradicates the need for an additional phonological feature [voiced].

5.1.3.2 Manner geometry and linear order

A crucial ingredient of my analysis of verb root alternations in Sye is feature geometry with a separate manner tier, as proposed by Clements (1985) and Morén (2003, 2006, 2007). The basic idea behind manner geometry is that manner features such as [±continuant] are not directly associated to the root node but instead reside under a designated MANNER node. While the idea of a separate manner tier has not gained much support in most classical works on feature geometry (Sagey 1986, McCarthy 1988, Padgett 1994, Clements and Hume 1995, Halle et al. 2000, Uffmann 2011), it presents a natural extension of the more widely accepted notions of a laryngeal tier (hosting [±voice], [spread] etc.) and a place tier (hosting place features such as LABIAL).

(379) *Feature geometry for Sye with a separate manner tier*

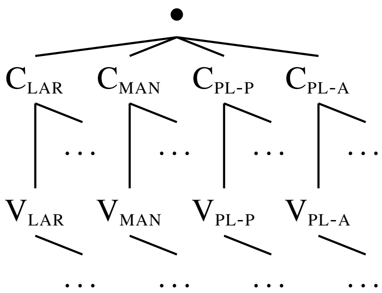


The tree in (379) shows the featural geometry of Sye. This geometry closely follows the model in Clements (1985) by placing [±nasal], [±continuant] and [±strident] under a manner node, with two exceptions: i) it does not include an additional supralaryngeal tier between the root node and the manner tier, and ii) place features are associated directly to the root node instead of an intermediate place node. I assume that major class features such as [±son] are linked to the root node the same way place or manner features are linked to their respective tier nodes. This decision follows naturally from basic assumptions of autosegmental phonology and Containment Theory. Featural nodes are thus not "inbuilt" into a segmental root node; rather, • nodes define structural positions to which phonological nodes are associated and which may instantiate segments depending on the featural nodes linked to them. Changing a segment's affiliation to a major sound class would be impossible in Containment if major class features were a structural property of root nodes.

By including both a manner tier and major class features, my model substantially deviates from the Parallel Structure Model (PSM, Morén 2003, 2006, 2007, Iosad 2012). PSM is a radical extension of V-place theory (Clements and Hume 1995, Halle et al. 2000) and assumes all phonological features to be exceptionlessly organized in a parallel fashion under C- and V-nodes: place features under C_{PL} and V_{PL}(further subdivided into active and passive

C_{PL} and V_{PL}), laryngeal features under C_{LAR} and V_{LAR}, and manner features under C_{MAN} and V_{MAN}. The general geometry assumed by PSM is shown in (380).

(380) *PSM architecture* (Morén 2003: 265)



PSM does not recognize major class features such as [±cons], [±son] and [±approx], which have, in one way or another, been an integral part of any theory of features since the early days of formal phonology (Jakobson et al. 1952, Chomsky and Halle 1968). In PSM, major class distinctions are computed solely on the basis of manner specifications, depending on whether or not C_{MAN} and V_{MAN} dominate at least one feature. As shown in (381), the defining characteristics of vowels is the absence of features under C_{MAN}. Sonorants are distinguished from obstruents by the presence of at least one feature under V_{MAN}. Any segment that one or more features under C_{MAN} counts as a consonant. Segmental features are exclusively privative in PSM.

(381) *Presence/Absence of features define major classes in PSM* (Morén 2003: 227)

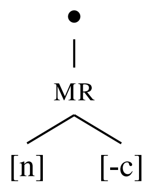
MAJOR CLASS	FEATURE UNDER C_{MAN}	FEATURE UNDER V_{MAN}
Consonant	✓	
Obstruent		✘
Sonorant		✓
Vowel	✘	

While some of the assumptions of PSM are rather stipulative and await further empirical evidence, the general idea that manner features are organized on a separate manner tier is attractive for two reasons. First, it allows to properly define precedence relations between otherwise heteroplanar floating manner features and make them subject to constraints against line crossing (382-a). Second, it provides a straightforward mechanism to capture operations that simultaneously delete all manner features of a single segment at once by marking the association line between the root node and the MANNER node as invisible (382-b). As will be demonstrated later on, both aspects are vital for the analysis of all facets of mutation in Sye VRA.

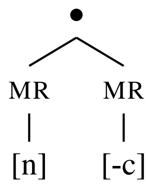
(382) a. *Line crossing* b. *Multiple overwriting*

A final remark is due concerning the number of MR nodes under a root node. While I assume that in the unmarked case, all manner features of a given segment are hosted under a single MR node, it is possible (but not mandatory) for a single segment to be linked to two MR nodes among which the relevant segmental features are distributed. In fact, it is a common conception that complex segments such as prenasalized stops are represented not by an unordered feature bundle but by two ordered features or nodes, e.g. as [+nas] [-nas] under a single structural node (Sagey 1986) or as two root nodes linked to the same skeletal slot (Rosenthall 1989; but see Padgett 1994 for critical discussion). The figures in (383) illustrate two ways of representing the manner features of a prenasalized stop, viz. as two features under a single MR node in (383-a) and two MR nodes each hosting one feature in (383-b). As regards Sye, I assume that both structures are possible representations of prenasalized segments.

(383) a. *One single manner node*



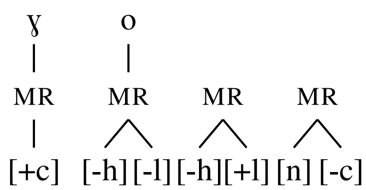
b. *Two manner nodes*



5.1.3.3 (Sub-)segmental representations and root shapes

Subsegmental representations As discussed in section 5.1.2.2, the modified root form appears after by one of several inflectional prefixes. I argue that all morphemes that trigger VRA share a common phonological property: they contain the three floating manner features [+low], [nas] and [-cont] to the right of all visible segmental material. Although those features are not associated to a segmental root node, they are associated to two MR nodes such that the left MR dominates [+low] and the right MR dominates [nas] and [-cont]. The lexical entry in (384) illustrates this for the 3SG:FUT marker *ɣo-*. For ease of representation, I will abbreviate [±high] as [±h], [±low] as [±l], [nas] as [n], and [±cont] as [±c] henceforth.

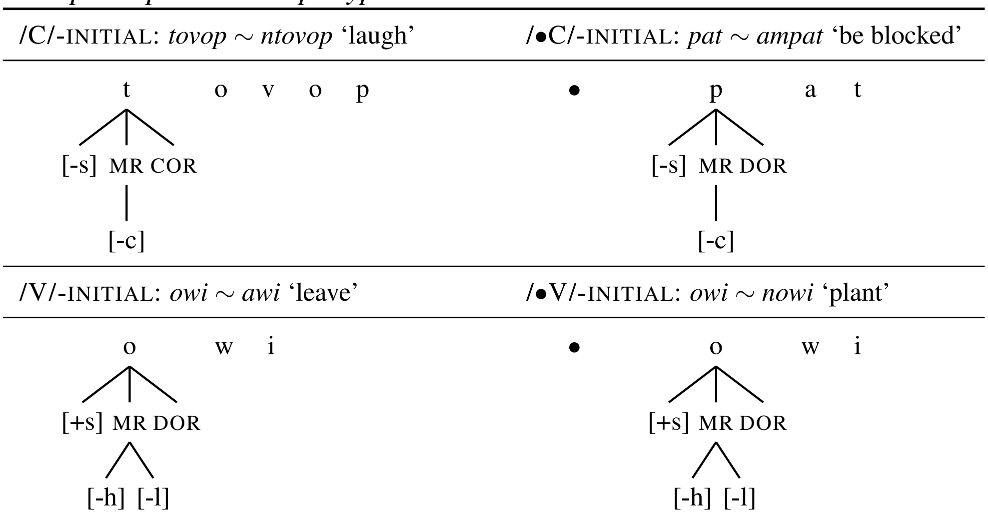
(384) [3SG:FUT] ↔



The two floating elements are larger than single features and smaller than full segments, making them *subsegments*, following the terminology by Zoll (1996). I argue that the two subsegments are sufficient to account for all attested root modifications in Sye VRA. Vowel accretion and mutation can be modeled by integrating the defective MR structure containing [+l] into the left root periphery, while addition of /n/ and prenasalization follow from integrating the second MR subsegment containing [n]. The different alternation patterns, including homonymous basic root pairs, follow from differences in the presence of defective material and constraints on licit output structures.

Root shapes Verb roots in Sye start either with a fully specified segment (vowel or consonant) or with a defective empty root node. Empty • provide a position for the association of (sub)segmental features but do not dominate any such features. The presence or absence of a defective • crucially delineates the space of possible association patterns for floating manner subsegments. The basic idea is that the requirement to integrate both floating MR into existing root nodes of the verb root may be outranked by markedness constraints on possible segment structures and segment sequences, leading to alternation patterns in which only one or even none of the two MR are realized. As verb roots with an initial empty • offer one additional landing site compared to verb roots without an empty •, the former will more often show alternation patterns where at least one MR subsegment is realized. In (385), I give one example each for true V-initial and C-initial roots as well as for roots starting with an empty root node followed by a V and a C.

(385) *Four principal root shape types*



Empty root nodes are usually not repaired by epenthesis or by associating underlyingly non-floating material (see discussion in section 5.1.3.4), which means that they are not visible on the surface apart from their effects on the shape of modified root forms. However, there is an additional piece of evidence for assuming that some verb roots start with an initial defective root node. (386) shows the general process of mid vowel deletion after /u/. Sequences of /u/ + mid vowel are resolved by deleting the mid vowel if the verb root does not include an empty • ((386)-a), but verbs which do start with an empty • resolve hiatus by changing /u/ into the glide /w/ ((386)-b). The empty • can thus be seen as a "rescuer" element preventing deletion, either by virtue of the fact that it intervenes between the two vowels and thus alleviates the violation of the respective phonotactic constraint or by providing a landing site for the disassociated vocalic features.

(386) *Mid vowel deletion after /u/* (C31)

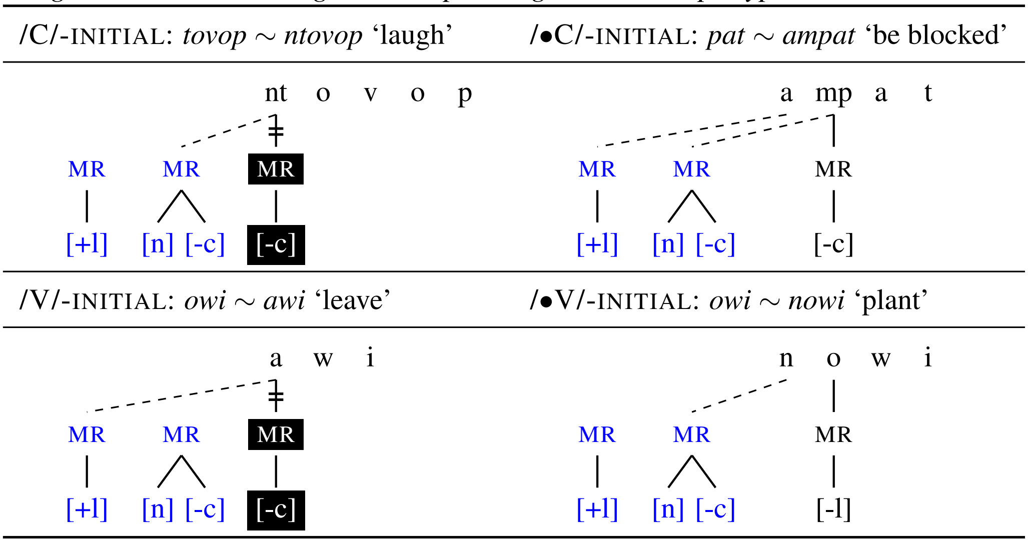
a.	/empɣu/	*empɣu* ∼ *ampɣu*	'dance'
	/u-empɣu/	*umpɣu* (**wompɣu*)	'you all dance!'
	2PL:IMP-BAS:dance		
b.	/•omonki/	*omonki* ∼ *nomonki*	'drink'
	/ɣu-omonki/	*ɣwomonki* (**ɣumonki*)	'they drank'
	3PL:RECPST-BAS:drink		

Finally, it is worth pointing out that there is some diachronic motivation for assuming initial defective root nodes in verb roots, too. There is good evidence that Sye underwent a diachronic process by which certain verb roots lost their Proto-Oceanic initial consonant, e.g. *eni* < **kani* 'eat', *orei* < **kori* 'scratch' (L25). The modified forms of such verb roots tend to be formed by addition of /n/ rather than vowel mutation in modern Sye, as if they were filling a consonantal slot that has been obscured by a diachronic process of consonant deletion.

Preview of analysis The various root shape modifications in verb root forms, however chaotic and unsystematic they may seem upon first glance, can be broken down into two principal phonological changes, viz. addition of a vocalic and a nasal element. The aim of this section is to lay out the basic principles of how the attested alternation types follow from restrictions on integrating manner subsegments into roots of different shapes, which will be discussed in greater detail and in a constraint-based theory in section 5.1.3.4. The table in (387) shows which of the manner subsegments from the non-past morphemes are integrated into the four verb roots presented in (385) above.[111] True C-initial roots such as *tovop* ∼ *ntovop* 'laugh' always fail to realize MR–[+l] because there is no vocalic • available in a local environment. They do, however, realize the nasal subsegment if the initial C is prenasalizable. True V-initial roots such as *owi* ∼ *awi* 'leave' always realize MR–[+l] by overwriting the initial V. The nasal subsegment is realized only if the second root segment is a prenasalizable consonant. /•C/-initial roots such as *pat* ∼ *ampat* 'be blocked' utilize the vocalic subsegment to fill the empty • and realize the nasal subsegment if the C can be prenasalized. /•V/-initial roots such as *owi* ∼ *nowi* 'plant' fill their empty • with the nasal subsegment resulting in /n/. The vocalic subsegment never overwrites the first root V because that would induce crossing of association lines with the line between the second MR node and the formerly empty root node.

[111]For ease of exposition, I will omit features that are not relevant for the present discussion in the following figures, in particular place features and [±h].

(387) *Integration and non-integration depending on root shape type*



The table in (388) contains the list of verb root pairs from (366), extended by my analysis of underlying basic root shapes which determine the shape of the modified root forms. The second important factor is prenasalizability of the first root consonant. The verbs in b'. and c'., for instance, are all truly /V/-initial, but they differ in whether their first C can be prenasalized. Accordingly, the modified forms in b'. show an additional nasal element while those in c'. do not. Note that prenasalizable fricatives change into prenasalized stops, e.g. *oɣep* ∼ *aŋkep* under b'. Another relevant factor is whether the first root C is part of a consonant cluster, and if so, whether it is an obstruent or a fricative. Thus, the verbs in b"'. and c". show vowel mutation but differ in if and how the nasal element is integrated: the fricatives in group b"'. mutate into nasal sonorants while the obstruents in group c". block prenasalization. However, not all clusters affect mutation behavior, as in the case of *orɣon* ∼ *andɣon* under b'.

(388) *Root type and prenasalizability define the shape of modified root forms*

	BASIC	MODIFIED		ROOT SHAPE	C prenas.?	
a'.	owi	nowi	'plant'	/●V.../	n/a	C81
	omonki	nomonki	'drink'			C120
	ovi	novi	'cut'			L25
	orei	norei	'scratch'			L25
	oravi	noravi	'flow'			L25
	oral	noral	'flow'			L25
	esomsah	nesomsah	'breathe'			L25
	elɣavi	nelɣavi	'hold'			L25
	elimsi	nelimsi	'blow (of wind)'			L25
	eni	neni	'eat'			L25
	ehkar	nehkar	'hold feast'			C81
	aruvo	naruvo	'sing'			C79
	avan	navan	'walk'			C81
	alam	nalam	'grow'			C142, C288
	atipotni	natipotni	'start'			C260, C261
	aleipo	naleipo	'sleep'			C78
	ur	nur	'follow'			C65, C251
a''.	tovop	ntovop	'laugh'	/C.../	yes	C82
	ta	nta	'weave'			C93
	torilki	ntorilki	'return'			C85
	ran	ndan	'break (of day)'			C82
b'.	etehep	antehep	'sit'	/VC.../	yes	C84
	eti	anti	'give birth'			C285, C288
	evɣah	ampɣah	'defecate'			C84
	etpond	antpond	'be cold'			C24
	okili	aŋkili	'know it'			C84
	oɣep	aŋkep	'fly'			C84
	oɣol	aŋkol	'dig'			C80
	oɣu	aŋku	'say'			C122, C119
	oruɣ	anduɣ	'bathe'			C84
	orɣai	andɣai	'bathe'			C24
	orɣon	andɣon	'mix'			C24
	orjok	andjok	'pick up'			C24
	orwoŋ	andwoŋ	'wash'			C24
	ovoli	ampoli	'turn it'			C84
	ovju	ampju	'DESID'			C84
b''.	pat	ampat	'be blocked'	/●C.../	yes	C84
	vaŋ	ampaŋ	'eat'			C84
b'''.	oɣhi	aŋhi	'see it'	/VSX.../	yes	C84
	evsor	amsor	'wake up'			C84
c'.	ehkar	ahkar	'stare'	/VC.../	no	C81
	ehvo	ahvo	'be white'			C84
	ehri	ahri	'break'			C80
	elwo	alwo	'vomit'			C84
	emlu	amlu	'be crazy'			C84
	empɣu	ampɣu	'dance'			C30, C31
	omurep	amurep	'live'			C84
	owi	awi	'leave'			C84
	olki	alki	'hang'			C84
	eiti	aiti	'tie it'	/VV.../	n/a	C84
c''.	etni	atni	'cook'	/VTX.../	yes	C84
	etmolaŋkau	atmolaŋkau	'look around'			C84
	opmah	apmah	'be hungry'			C84
	mah	amah	'die'	/●C.../	no	C84
d.	jep	jep	'descend'	/C.../	no	C81
	wesisar	wesisar	'slip'			C81
	sompoŋ	sompoŋ	'snore'			C81
	lau	lau	'be dry'			C81

5.1.3.4 Analysis

Preliminaries I: Root node specifications Before addressing the details of the various mutation patterns in Sye, I will briefly discuss the basic mechanisms of how empty root nodes behave in different contexts. First off, empty root nodes only interact with not-integrated subsegmental material, never with nodes associated to fully specified segments. I analyze the special status of defective material as the effect of the undominated constraints in (389) – (393). This avoids introducing constraints that make direct reference to floating vs. non-floating status such as *FLOAT or MAXFLOAT (see (42) and discussion in section 2.2.1.2).

(389)	DEP MR	Assign * for each colorless MR node.
(390)	DEP ●	Assign * for each colorless ●.
(391)	*MIX$^{\bullet}_{\text{MR}}$	Assign * for each triple of nodes (M_1, R_1, R_2) such that: (i) M_1 is a MR node and R_1 and R_2 are root nodes, (ii) M_1 is associated to R_1 via an underlying and to R_2 via an inserted line.
(392)	*MIX$^{\bullet}_{\text{PL}}$	Assign * for each triple of nodes (P_1, R_1, R_2) such that: (i) P_1 is a PLACE feature and R_1 and R_2 are root nodes, (ii) P_1 is associated to R_1 via an underlying and to R_2 via an inserted line.
(393)	ALT	Assign * for every epenthetic line that links two nodes of the same color. (= (70))

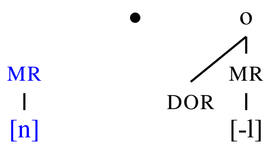
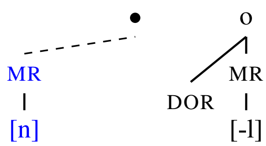
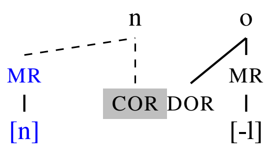
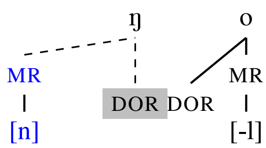
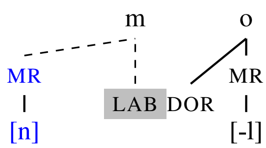
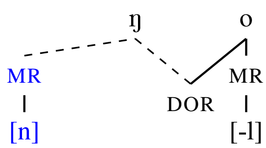
DEP(MR) ensures that no epenthetic MR node is inserted to repair defective root nodes, and by analogy, DEP(●) blocks insertion of epenthetic root nodes to repair manner subsegments. The two *MIX constraints prevent underlyingly integrated MR or place feature nodes from spreading to defective nodes. ALT(ERNATION) ensures that defective material is not repaired with phonological material of the same morphological color. Note that *MIX and ALT partially overlap in their functions.

When a featurally specified MR node associates to an empty ●, the root node still requires place specifications. The respective DEP constraints for those features must therefore be violable. Following a long tradition of work on featural markedness (Avery and Rice 1989; Prince and Smolensky 2004; Kang 2000; Lombardi 2002; Hirayama 2005; de Lacy 2006), I assume the place markedness hierarchy in (394), according to which COR is the least marked place and the preferred choice for insertion of a place feature.

(394) *Universal place hierarchy:*
COR ≺ {DOR, LAB}

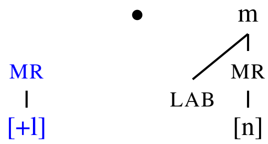
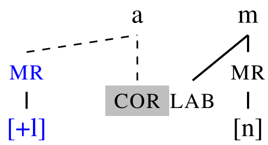
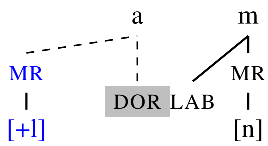
The tableau in (395) illustrates how linking a floating MR–[n] treelet to an empty root node results in a coronal rather than a bilabial or velar nasal. High-ranked ●→PL and ●→MR demand that root nodes dominate a MR node and a place feature, respecively. These constraints are fatally violated by the first two candidates. The candidate in f. involves spreading of a place feature from a fully specified segment, which is eliminated by undominated *MIX and ALT. The crucial competition is between candidates c., d., and e. Since DEP(LAB), DEP(DOR) and DEP(COR) are ordered obeying the hierarchy in (394), insertion of a coronal place feature is less costly than insertion of a labial or a dorsal feature. For that reason, the optimal candidate in c. is the one that satisfies •→PL by inserting COR, yielding the segment /n/.

(395) *Emergence of the unmarked in featural epenthesis*

	Input = a.	• ↓ PL	*MIX •/PL	ALT	• ↓ MR	• ↑ MR	DEP LAB	DEP DOR	DEP COR
	a. 	*!			*	*			
	b. 	*!							
☞	c. 								*
	d. 							*!	
	e. 						*!		
	f. 		*!	*					

When a vocalic subsegment associates to an empty •, feature insertion therefore proceeds completely analogously as for nasals. Recall that /a/ in Sye can be specified for either COR or DOR because it does not contrast for place with any other [+l] vowel. The tableau in (396) illustrates how association of the floating MR–[+l] treelet to an empty root node yields an /a/ specified for COR.

(396) *Vocalic filling of empty root nodes*

Input = a.	● ↓ PL	*MIX● | PL	ALT	● ↓ <u>MR</u>	● ↑ MR	DEP LAB	DEP DOR	DEP COR
a. 	*!			*	*			
☞ b. 								*
c. 							*!	

I furthermore assume that ● may interact with segmental features and manner subsegments, but no segmental features can interact with MR nodes: neither can an epenthetic line be inserted between a featural node and a MR node nor can an underlying line between a feature node and MR be marked as invisible. This is guaranteed by the undominated constraints in (397) and (398).

(397) DEP$^{\text{MR}}_{\text{F}}$ Assign * for each epenthetic line that links a MR and a segmental feature node.

(398) MAX$^{\text{MR}}_{\text{F}}$ Assign * for each phonetically invisible line that links a MR and a segmental feature node.

Preliminaries II: Unattested V mutations There are several conceivable but non-attested vowel muation patterns that I will now address before setting out my analysis of the attested alternation patterns. The fact that the treelet containing [n] never associates to a healthy vocalic root node can easily be captured by the constraint in (399), which, assuming Richness of the Base, is independently needed to account for the lack of nasalized vowels in the phonological system of Sye. The constraint needs to make reference to I-structure, as the respective P-structure-sensitive version would open up the possibility of overwriting.

(399) $*_{[n]}\bullet_{[l]}$ Assign one * for each ● associated to [n] and [l] in I.

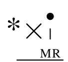
All vowels in Sye are monophthongs, meaning that there is a general ban on root nodes associated to more than one MR node hosting vocalic features. This is captured by the constraint in (400), which, unlike (399), makes reference to P-structure, as it would otherwise rule out attested cases of height overwriting. Note that (400) does not militate against structures such as candidate d. in (410) because it is not violated by a root node that is linked to one MR via a visible and to another MR via an invisible line.

(400) *<u>[+son]$_{\text{2MR}}$</u> Assign one * for each [+son] ● associated to more than one MR in P.

I assume that the constraints in (399) – (400) are undominated; consequently, candidates violating any of these constraints will not be considered in the following discussion.

Nasal accretion: /•V/-initial roots I will begin my discussion of verb root alternations with the class of vowel-initial root that add an accretive /n/ in their modified stem forms. I analyze such verb roots as having a defective root node at their left edge underlyingly. For example, I analyze the basic form of *owi* ∼ *nowi* ‘plant’ as /•owi/. The modified form *nowi* integrates the nasal but not the low vowel feature. The question that needs to be addressed is why only one of the two defective structures is realized and the other remains floating.

The case of *owi* ∼ *nowi* illustrates the crucial ordering between the two manner subsegments. In the tableau in (402), only candidate e. fully satisfies the constraint MR→• against floating MR nodes. However, the two inserted association lines intersect: the subsegment containing [+l] precedes the subsegment containing [n] on the MR tier and the target for the latter precedes the target for the former. As argued in section section 2.2.2.1, crossing of association lines is a marked but in principle possible structure generated by GEN that is handled by specific implementations of the general NOCROSSINGCONSTRAINT. The relevant version of that constraint for Sye is given in (401). The NCC is undominated in Sye, which is why /•V/-initial roots never show vowel mutation and accretion of /n/ at the same time, which would yield the ungrammatical form **nawi*. Note that candidates violating undominated constraints introduced in the preceding paragraph are not shown in the tableau: linking both treelets to the initial • is ruled out due to (399), as is linking MR–[n] to the root node of /o/.

(401) 

Assign one * for every ordered pair of • (R_1, R_2) such that:
(i) R_1 is associated to the node MR_2 via phonetically visible lines,
(ii) R_2 is associated to the node MR_1 via phonetically visible lines,
(iii) $R_1 \prec R_2$ and $MR_2 \prec MR_1$.

The comparison between candidates b. and c. reveals the importance of bidirectional structural markedness constraints: not only do MR nodes prefer to be linked to a •, but root nodes likewise prefer to dominate a MR node. Realizing the nasal treelet harmonically bounds realizing the vocalic treelet because the former case avoids incurring an additional violation of •→MR. It follows from this logic that /•V/-initial roots will always integrate the nasal subsegment instead of the vocalic subsegment.

(402) *Crucial ordering of floating manner subsegments*

Input = a.		*×• MR	• ↓ MR	• ↑ MR	*VV
	a. • o MR MR MR [+l] [n] [-c] [-l]		*!	**	
☞	b. n o MR MR MR [+l] [n] [-c] [-l]			*	
	c. • a MR MR MR [+l] [n] [-c] [-l]		*!	*	
	d. a o MR MR MR [+l] [n] [-c] [-l]			*	*!
	e. n a MR MR MR [+l] [n] [-c] [-l]	*!			

An alternative strategy to satisfy •→MR would be to fill the empty • with the vocalic subsegment, as shown in candidate d. This results in a sequence of two pronounced vowels. As discussed in section 5.1.2.1, hiatus is mostly avoided in Sye, which is captured by the constraint in (403). I assume that while VV sequences resulting from concatenation of underlying Vs may invoke several repair operations, creation of novel vowel sequences by filling an empty • is blocked by (403) when there is a more harmonic strategy, viz. realization of the nasal subsegment, available. The vocalic subsegment is thus never realized with /•V/-initial roots because association to the root V incurs a violation of •→MR or the NCC and association to the empty • violates *VV.

(403) *VV Assign * for each VV sequence in I. (Orie and Pulleyblank 1998)

Prenasalization and C mutation: /(X)C/-initial roots When the nasal subsegment is integrated into an underlying consonant from the verb root, it may have different effects depending on the nature of the C. If C is a prenasalizable non-continuant, the nasal subsegment will be integrated into the segment, creating a prenasalized version of the C (e.g. *p* → *mp*). If C is a prenasalizable continuant, the nasal subsegment will overwrite the manner specifications of the C, causing mutation and also creating a prenasalized stop (e.g. *v* → *mp*). If C is part of a cluster, special mutation patterns are observed which will be discussed further below.

The most common type of consonant mutation in Sye VRA involves alternations between a fricative and a prenasalized stop, as in the case of *vaŋ* ∼ *ampaŋ* 'eat'. This type of mutation is in line with the well-known cross-linguistic generalization that languages strongly prefer prenasalized stops over prenasalized fricatives (Padgett 1994). The constraint responsible for continuancy mutation is the feature co-occurrence constraint in (404) penalizing segments with a nasal and a continuant component. This constraint only checks P-structure and therefore drives total overwriting mutation of manner features on prenasalizable fricatives.

(404) $*_{\underline{[n]\bullet[+c]}}$ Assign * for each • associated to [n] and [+c] in P.

The tableau in (405) illustrates the effect of (404). The underlying representation of the basic form *vaŋ* is /•vaŋ/ with an initial defective root node responsible for the vocalic accretion in the modified form *ampaŋ*. In candidate b., the nasal subsegment coexists with the underlying continuant manner structure under the same root node, forming a complex prenasalized fricative and fatally violating (404). In the optimal candidate c., the nasal subsegment overwrites the underlying MR structure of the first root C. Since the mutated C is [-son], the resulting segment is a prenasalized stop, unlike empty root nodes, which yield a plain nasal /n/ (see below for more discussion).

(405) *Overwriting of root manner structure: [+c] unpronounced*

Input = a.	$*_{\underline{[n]\bullet[+c]}}$	• ↓ $\underline{\text{MR}}$	• ↑ MR	DEP|	MAX|
a. • v MR MR MR [+l] [n] [-c] [+c] ([lax])		*!	**		
b. a mv MR MR MR [+l] [n] [-c] [+c] ([lax])	*!			**	
☞ c. a mp MR MR MR [+l] [n] [-c] [+c] ([lax])				**	*

An intricate problem of Sye VRA is the status of voicing. The segment inventory suggests that voicing is phonologically weakly active, as it is contrastive only for the pair /nt, nd/. Voicing is a redundant feature elsewhere: sonorants are always voiced, plain and prenasalized stops are never voiced[112], /ɣ/ is always voiced, /s/ and /h/ are always unvoiced, and

[112] Pater (1999) proposes the constraint in (i), which in my view is not unproblematic. While voiceless prenasalized stops are unarguably more frequent than their unvoiced counterparts, the latter are no oddities, and some languages like Sye attest NC sounds without a *NC̥ counterpart. The relevant figures from the PHOIBLE database (Moran et al. 2014) are: /mp/, /nt/ and /ŋk/ are each found in at least 2% of the world's languages, compared to 12-13% for /mb/, /nd/ and /ŋg/.

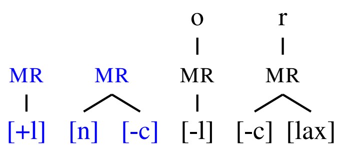
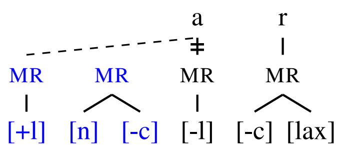
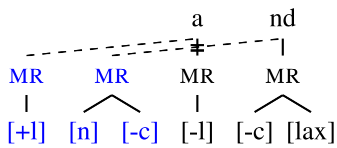
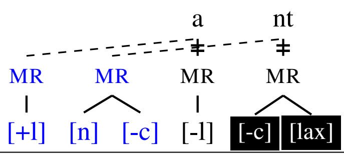
(i) *NC̥: No nasal/voiceless obstruent sequences. (Pater 1999: 313)

Even if Pater's *NC̥ holds as a universal constraint, it would need to be ranked low enough to never show any effect in Sye and can be safely omitted from the current discussion.

voicing is optional in /v∼f/. As mentioned before, I assume that there is no feature [v] active in Sye. Rather, I analyze voicing as an inherent feature of sonorants and as the phonetic interpretation of the feature [lax]. Recall from the table in (350) that /ɾ/ and /ɣ/ are [lax] and that /f∼v/ is optionally specified for [lax]. Since prenasalization of fricatives always entails overwriting due to their [+c] feature and $*_{[n]}\bullet_{[+c]}$, a [lax] under a MR node will never be pronounced in the prenasalized variant, and this is why prenasalized stops derived from fricatives are always voiceless.

Prenasalization of the non-continuant lax flap /ɾ/, however, involves association of the nasal subsegment to a • hosting not [+c], but [-c]. In this configuration, the floating MR does not overwrite the consonant's MR. Instead, both manner structures coexist under the segmental root node because there is no markedness constraint militating against the presence of [-c], [n] and [lax] under the same root node. The tableau in (406) illustrates why preserving laxness is optimal in the case of *oruɣ* ∼ *anduɣ* 'bathe'.

(406) *Coexistence of root and affix manner structures: [lax] survives*

	Input = a.	*×•/MR (underlined)	• ↓ MR	• ↑ MR	*×•/MR	MAX|
a.				*!*		
b.				*!		*
☞ c.					*	*
d.					*	**!

Candidates a. and b. leave at least one manner subsegment unassociated and are therefore not optimal. The crucial competetion is between candidates c. and d., which both satisfy MR→• by realizing both subsegments. Association of the nasal treelet to the second root segment inevitably leads to line crossing with the line connecting the first segmental • and its underlying MR node. That line, however, is not pronounced because the vocalic treelet also overwrites the initial V. Candidates c. and d. therefore do not violate the P-structure sensitive version of the NCC, but only the lower-ranked I-structure sensitive version in (407).

(407) *×•/MR — Assign * for every ordered pair of • (R_1, R_2) such that:
(i) R_1 is associated to the node MR_2 and R_2 is associated to the node MR_2,
(ii) $R_1 \prec R_2$ and $\text{MR}_2 \prec \text{MR}_1$.

The crucial difference between candidates c. and d. is that the former merely adds the nasal subsegment to the first root C while the latter overwrites the root C's underlying manner specifications. In candidate c., all segmental features of the underlying /r/ are preserved, including [lax], yielding a voiced /nd/ after mutation. Candidate d. lacks [lax] due to overwriting and therefore has a voiceless /nt/. As candidate c. does not incur any feature co-occurrence violations (e.g. against [+c] and [n] under the same •), it harmonically bounds the overwriting candidate in d. by virtue of the additional violation of MAXLINE. Note that the features are spread over two MR nodes, which in my analysis does not run against any relevant constraint.

Sonority mutation: /VCC/-initial roots On rare occasions, a prenasalizable fricative does not mutate into a prenasalized stop but instead into a homorganic nasal sonorant. This happens when the resulting prenasalized stop would be the first member of a phonotactically illicit consonant cluster. Recall from section 5.1.2.1 that prenasalized stops cannot be followed by /v/, /s/, /h/, /m/, or a homorganic nasal. The table in (408) is an excerpt from the more extensive list of stem forms undergoing VRA in (366) showing verb roots with medial consonant clusters. Among these verbs, three main types can be distinguished: the verbs in ((408)-a) show proper prenasalization because the resulting /NC+C/ clusters are licit. The second C in the clusters in ((408)-b) and ((408)-c) are not allowed as second members of /NC+C/ clusters, however. The verbs in ((408)-b) undergo sonority mutation, while the verbs in ((408)-c) do not realize the nasal component at all. The verbs in ((408)-d) have been added for the sake of completeness, but their failure to realize the nasal component is due to the fact that their first root C is generally not prenasalizable.

(408) *Prenasalization vs. full nasalization vs. lack of nasalization in C clusters*

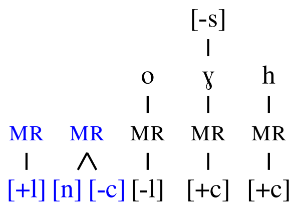
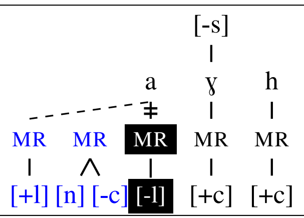
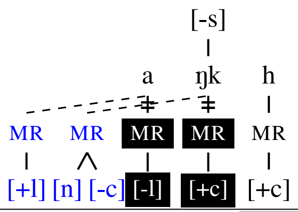
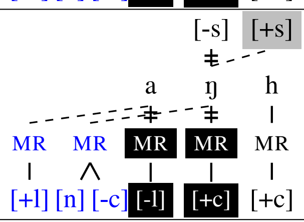
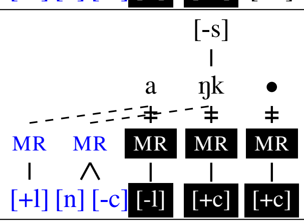
	BASIC	MODIFIED	
a.	etpond	antpond	'be cold'
	evɣah	ampɣah	'defecate'
	orɣai	andɣai	'bathe'
	orɣon	andɣon	'mix'
	orjok	andjok	'pick up'
	orwoŋ	andwoŋ	'wash'
	ovju	ampju	'DESID'
b.	oɣhi	aŋhi	'see it'
	evsor	amsor	'wake up'
c.	opmah	apmah	'be hungry'
	etni	atni	'cook'
	etmolaŋkau	atmolaŋkau	'look around'
d.	ehkar	nehkar	'hold feast'
	olki	alki	'hang'
	emlu	amlu	'be crazy'
	owi	awi	'leave'
	...	...	...

I will now show how the behavior of the alternation types ((408)-b) and ((408)-c) can be analyzed in accordance with the general phonotactic principles of Sye (cf. the table in (354)). To formalize these principles, I propose the cover constraint in (409), which militates against /NC+C/ sequences in which the second C is either /v/, /s/, /h/, /m/, or a homorganic nasal.

(409) *NCX Assign one * for each pronounced sequence of a prenasalized stop followed by /v/, /s/, /h/, /m/, or a homorganic nasal.

Take, for example, the verb pair *oɣhi* ~ *aŋhi* 'see it'. Under normal circumstances, /VC/-initial roots allow for realization of both floating MR structures, so the expected (but ungrammatical) output is **aŋkhi*. Due to high-ranked *NCX, however, a candidate with the sequence *-ŋkh-* cannot be optimal, and the structure requires some sort of additional repair. The tableau in (410) shows the competition between the illicit cluster in c., optimal sonority mutation in d., and deletion of /h/ in e.

(410) *Sonority mutation*

	Input = a.	*× MR	*NCX	↓ MR	↑ MR	DEP [+s]	*× MR	MAX
a.					*!*			
b.					*!			*
c.			*!				*	**
☞ d.						*	*	***
e.				*!			*	***

The candidates in a. and b. lose because they violate MR→•. The candidate in c., **aŋkhi*, loses because it violates *NCX. The candidate in e. repairs the ill-formed cluster by deleting the second consonant (marking the association line between • and MR as invisible). The intuition is that this strategy should be optimal because it satisfies both MR→• and *NCX. However, the • of /h/ is no longer associated to any MR node in P and violates •→MR, a high-ranked constraint sensitive to pronounced structure. The candidate in d. pursues a different repair strategy that succeeds in complying with all three problematic constraints. That strategy exploits the fact that prenasalized stops differ in only a single featural specification from plain nasals: /NC/ segments are [-son] and /N/ segments are [+son]. The constraint against insertion of an epenthetic [+son] feature, defined in (411), is ranked below the three markedness constraints violated by the other candidates. Since replacing the [-son] specification by a [+son] avoids violation of *NCX and is less costly than deletion (candidate d.), sonority mutation in d. is the optimal repair strategy.

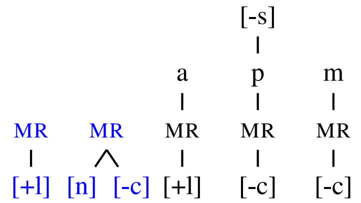
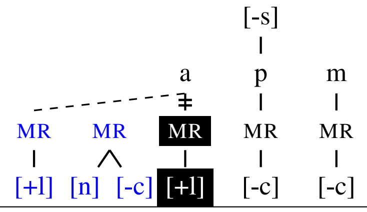
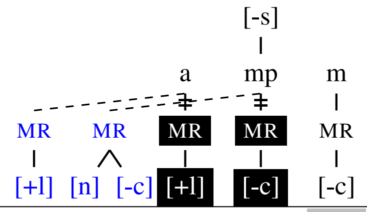
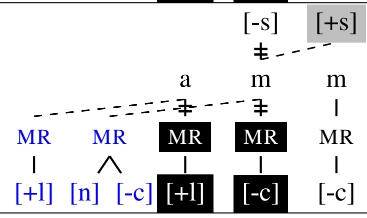
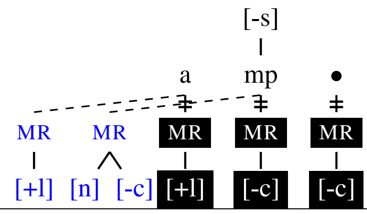
(411) DEP [+s] Assign * for each colorless [+s].

While the present constraint ranking derives sonority mutation in the verb roots in ((408)-b), the failure to realize the nasal subsegment in the verb roots in ((408)-c) still awaits explanation. Descriptively speaking, the difference between the two groups is that the initial C is a fricative in the former group but a stop in the latter group. On an intuitive level, this discrepancy is not unexpected: fricatives, which generally occupy a higher position in the sonority hierarchy than stops, are sonorous enough to undergo sonority mutation whereas stops are too distant perceptually and articulatorily from sonorants and cannot be converted into sonorant nasals. Such a generalization cannot be straightforwardly translated into phonological features, however, as stops are in fact more similar to nasal sonorants than fricatives by virtue of their shared [-c]. In order to formalize the idea that a segment which is not specified for [+c] underlyingly must not acquire a new [+s] feature, I propose the constraint in (412). This constraint is violated by any segment associated to an epenthetic [+s] but not to a [+c]; put differently, it penalizes underlying stops which acquire a new [+s] feature. Note that the more general version of this constraint is the mirror image of [-s]→[-c], a constraint that was crucial for my analysis of overapplication in Seereer-Siin (see section 3.1).

(412) [+s] ↓ [+c]
Assign one * for every • (R_1) such that:
(i) R_1 is associated to a colorless [+s] in I,
(ii) R_1 is not associated to a [+c] in I.

The tableau in (413) shows the derivation of the modified form *apmah* from /opmah/ 'be hungry'. The violation profiles mirror that of the previous tableau, with the exception of candidate d. which undergoes sonority mutation with an underlying stop, fatally violating (412). The actual winner is the candidate in b. which violates MR→• once but satisfies all higher-ranked constraints. The winning candidate leaves the nasal subsegment unassociated to a • and thus avoids both an illicit C cluster and sonority mutation with a stop.

(413) *Failure of sonority mutation*

Input = a.		[+s] ↓ [+c]	*× • MR	*NCX	• ↓ MR	• ↑ MR	DEP [+s]	*× • MR
a.						*!*		
☞ b.						*		
c.				*!				*
d.		*!					*	*
e.					*!			*

Failure of C mutation A final group of verb root alternations in Sye that needs discussion is that which never shows addition of a nasal feature in the modified form independently of consonant clusters. It is possible to identify three subgroups of sounds that consistently resist (pre)nasalization: (i) the coronal fricative /s/, (ii) the glottal fricative /h/, and (iii) all sonorant consonants (/j, w, l, m, n, ŋ/). In each case, a markedness constraint that outranks MR→• is responsible for the nasal subsegment remaining floating. The immunity of /s/ to prenasalization is due to the constraint in (414) protecting the perceptually highly salient feature [strident]. The immunity of /h/ to prenasalization is the effect of the feature co-occurrence constraint in (415) penalizing root nodes dominating both [n] and LAR.

Sonorants resist prenasalization by virtue of their underlying [+s] specification. The markedness constraint in (416) states that no colored [+s] segment may dominate more than one MR node in I. Note that a general version of (416) would conflict with cases of sonority mutation as in *oɣhi* ∼ *aŋhi* ‘see it’ (see discussion above). If (416) blindly militated against a • associated to two MR and one [+s], an underlying non-sonorant such as /ɣ/ would not be predicted to mutate into the sonorant /ŋ/. The constraint in (400) is a color-blind version of (416) for P-structure that blocks diphthong creation.

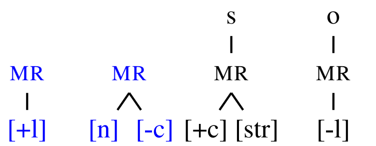
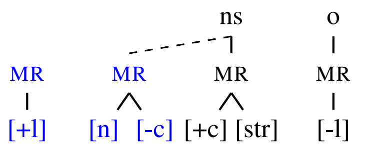
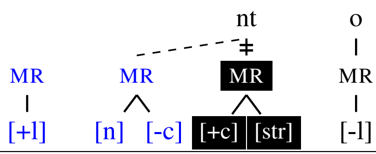
(414) MAX [str] — Assign one * for each [strid] feature that is phonetically visible in M but not in P.

(415) $*_{[n]\bullet\text{LAR}}$ — Assign one * for each • dominating both [n] and LAR in I.

(416) *[+s]$_{2\text{MR}}$ — Assign one * for each • (R_1) such that:
(i) R_1 is associated to a colored [+s],
(ii) R_1 is associated to more than one MR in I.

The tableau in (417) illustrates how these constraints favor non-integration of the floating nasal subsegment over integration (and mutation) of underlying segments for the verb root pair *sompoŋ* ∼ *sompoŋ* 'snore'. Since /s/ is a continuant, the nasal subsegment cannot associate to the • and coexist with the underlying MR node that hosts [+c]. Delinking of the MR structure containing [str] would result in a fatal violation of (414) (marking an association line between a featural node and a MR node invisible is not a viable option due to (398), either). For that reason, the faithful candidate in a. is rendered optimal. By the same token, root pairs such as *ehvo* ∼ *ahvo* 'be white' and *owi* ∼ *awi* 'leave' proceed analogously to that of *sompoŋ* ∼ *sompoŋ*.

(417) *Stridency immunizes /s/ against prenasalization*

Input = a.	*[+s]$_{2\text{MR}}$	MAX [str]	$*_{[n]\bullet\text{LAR}}$	$*_{[n]\bullet[+c]}$	• ↓ MR	• ↑ MR
☞ a. 						**
b. 				*!		*
c. 		*!				*

5.1.4 Alternative: Crowley's (1998) rule-based account

Crowley (1998: 81-84) offers a rule-based analysis of Sye VRA that crucially relies on the distinction between two lexical classes: *weak* verbs and *strong* verbs. The defining characteristic of weak verbs is that their modified form never adds the accretive vowel *a*-. Strong verbs, on the other hand, add an accretive *a*- to C-initial roots and overwrite the initial V in V-initial roots. Weak and strong verbs have in common that their modified form adds an accretive nasal to the basic form if possible. They differ, however, in that weak verbs always add a full segment *n-* to V-initial roots whereas strong verbs prenasalize the first consonant of such roots if it is prenasalizable; if not, nasal accretion is blocked. Crowley's analysis is an extension of the one in Lynch and Capell (1983), who also consider strong verbs to be derived regularly by a set of ordered rules but who treat weak alternation as exceptional.

The affiliation of a verb root is partially determined by its phonological shape: verb roots with an initial vowel /a, i, u/ or any consonant other than /p, v, m/ are always weak whereas roots with an initial labial consonant are always strong. Roots with an initial mid vowel /e, o/ can be either weak or strong. The affiliation of /e/- and /o/-initial roots is lexically specified, which explains the existence of (surface-)homonymous basic forms (418). About 75% of all Sye verb roots belong to the class of weak verbs.

(418) *Base form homonyms* (= (368))

WEAK	*owi*	~	*nowi*	'plant'	*ehkar*	~	*nehkar*	'hold feast'
STRONG	*owi*	~	*awi*	'leave'	*ehkar*	~	*ahkar*	'stare'

Under Crowley's account, modified forms of weak verbs are derived by addition of *n-* in the case of V-initial roots (*ehkar* ~ *nehkar* 'hold feast') and C-initial roots if the C is prenasalizable (*tovop* ~ *ntovop* 'laugh', but *lau* ~ *lau* 'be dry'). Strong verbs are derived by six ordered rules (C82–84), listed here in (419). A few sample derivations for strong verb roots are given in the table in (420) below.[113]

(419) a. *Nasal accretion*: C-initial verbs become prenasalised as they would in the weak alternation; V-initial verbs insert *n-* between a root-initial vowel and any immediately following prenasalizable consonant

b. *Assimilation*: Accreted nasals undergo place assimilation

c. *Despirantization*: Postnasal hardening (fricatives become stops)

d. *Cluster reduction*: $N_1CN_2 \rightarrow CN_2$, $NC_1C_2 \rightarrow NC_2$

e. *a-accretion*: *a-* is added at the beginning of all strong verb roots

f. *Vowel deletion*: *a-* overwrites an initial vowel (V → Ø/ #a __)

(420) *Deriving modified root forms of strong verbs by ordered rules* (C84)

UR	Nas. Accr.	Assim.	Desp.	Clst. red.	a-accr.	V del.	SR	
/pat/	npat	mpat			ampat		*ampat*	'blocked'
/vaŋ/	nvaŋ	mvaŋ	mpaŋ		ampaŋ	ampaŋ	*ampaŋ*	'eat'
/mah/					amah		*amah*	'die'
/owi/					aowi	awi	*awi*	'leave'
/etni/	entni			etni	aetni	atni	*atni*	'cook'
/eiti/					aeiti	aiti	*aiti*	'tie it'
/evɣah/	envɣah	emvɣah	empɣah		aempɣah	ampɣah	*ampɣah*	'defecate'
/oɣhi/	onɣhi	oŋchi	oŋkhi	oŋhi	aoŋhi	aŋhi	*aŋhi*	'see it'
/opmah/	ompmah			opmah	aopmah	apmah	*apmah*	'be hungry'

[113] The original table erroneously misses the vowel deletion step for /owi/ 'leave' and lists *awi* as the output of the *a-accretion* rule.

Crowley's rule-based analysis is successful in so far as it generates the correct modified root forms for any given verb root. As pointed out by Frampton (2009), it also obviates the need for separately listed root allomorphs. However, Crowley's approach also suffers from major drawbacks. First, it misses the generalization that the phonological modifications in weak verbs (prenasalization, C mutation) are a subset of those found in strong verbs. In the OT analysis laid out in the previous section, I have argued for a unified treatment of all attested productive alternation patterns that incorporates this generalization. Second, it relies on an arbitrary morphological diacritic feature, viz. the distinction between strong and weak verbs. What I have argued for instead is that the presence of nasal accretion in some but not in all modified root forms receives a more parsimonious account when one assumes that some but not all verbs have start in a defective segmental root node. Third, the fact that all non-accretion rules (b., c., d., f.) mirror general phonotactic constraints in Sye remains entirely accidental on Crowley's account. This criticism is especially obvious when it comes to the behavior of non-prenasalizable segments (*olki* ∼ *alki* 'hang', *lau* ∼ *lau* 'be dry'), but also with respect to constraints on permissible consonant clusters. Fourth, Crowley's criteria for assigning a verb root to a VRA class are far from unproblematic. For example, the reason why we do not find any strong verbs with a velar initial consonant is that the number of (verb) roots that start in a velar in Sye is very limited anyway. The only velar-initial verb root included in the vocabulary list by Capell and Lynch (1983) is *kavraɣ* 'hidden' (V86), whose modified form is unknown and which is not attested in Lynch and Capell (1983) or Crowley (1998, 2002). By the same token, the generalization that verb roots with a high initial vowel are always weak rests on a very small number of roots: only about 2% of Sye verb roots start in /i-/, and only about 1% begin with /u-/ (C21). The fact that there are no attested cases of strong *i*- or *u*-initial verb roots could be purely accidental. More extensive lists of verb root pairs would be needed in order to conclusively assess how reliably one can predict the shape of a modified form from surface phonological properties of a basic form.

5.1.5 Consequences for verb root reduplication

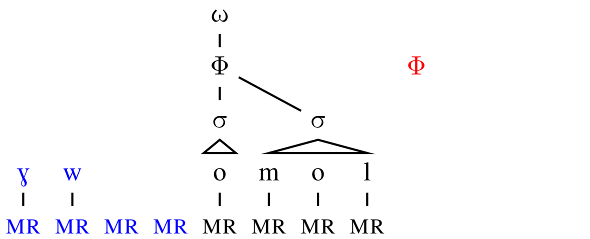
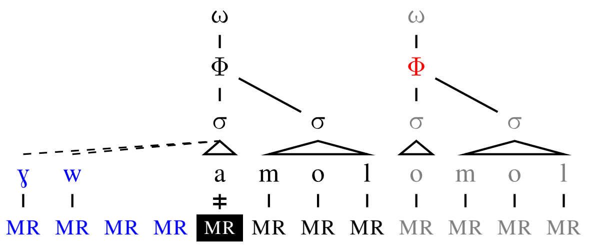
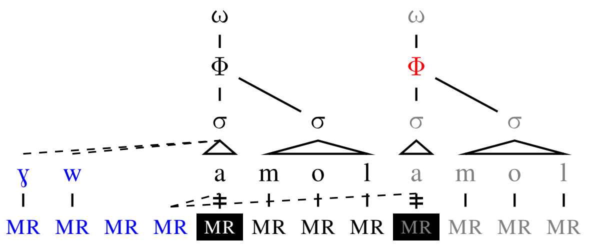
In the previous sections, I have argued that properly constrained autosegmental representations account for the seemingly arbitrary segmental changes in modified root forms. This has direct consequences for the analysis of reduplication. Recall from section 5.1.1 that when a reduplicated verb appears in a context that calls for a modified verb root, the copy adjacent to the triggering prefix takes the shape of the modified root while the other copy appears in its basic form. One of the examples discussed above is *ɣw-amol-omol* 'they will fall all over', repeated here as (421).

(421) *Root allomorph mismatch in Sye reduplication* (= (348))

BASIC	omol	BAS:fall	'fall'
MODIFIED	ɣw-amol	3PL:FUT-MOD:fall	'they will fall'
REDUPLICATED	ɣw-**amol-omol**	3PL:FUT-MOD:fall-BAS:RED	'they will fall all over'

Since the segmental modifications in modified verb roots are all deducible to regular phonological operations, the allomorphy displayed by pairs such as *omol* ∼ *amol* is purely phonological and not morphological. It is therefore not surprising that two different root forms of the same morpheme may appear in a reduplicated verb form. In fact, divergent allomorphy is the expected outcome when mutation applies locally to the closest copy, leaving the other copy in its base form. This is shown in the tableau in (422). Since reduplication in Sye is always total, I assume that the triggering element is a defective Φ that induces copying of the ω node which hosts the verb root. I follow Crowley (1998) in treating reduplication as suffixal, but nothing crucially hinges on this assumption, and a prefixal analysis of reduplication would fare equally well.

(422) *Local application of mutation in reduplicated forms*

Input = a.	*×• / MR	ω → Φ	• → MR	INT ω
a. 		*!	**	
☞ b. 			*	*
c. 	*!**		*	*

My analysis is monostratal, but there is no hard evidence ruling out an account on which reduplication takes place at an earlier level than mutation. As the triggering prefixes express inflectional categories whereas reduplication conveys a derivational meaning, a structure as in (423) seems not too far-fetched. If mutation applies at a point after reduplication has taken place, mutation can only apply locally because FULLREBIRTHING will obscure the difference between base and copied material.

(423) [...[TAM- [$\sqrt{}$ -RED]] ...]

As shown above, however, a stratal organization is not crucial for correctly deriving the Sye data. The monostratal analysis in (422) is entirely sufficient to correctly predict phonological non-identity between the two root allomorphs. Local transparent application of independent processes is the natural consequence of a grammar in which copying is input-driven and that lacks a morpheme-specific constraint overseeing faithfulness relations between base and reduplicant as well as reduplication-specific cophonologies.

5.2 Root allomorphy beyond Sye

5.2.1 Raga

Raga (alternate name: Hano) belongs to the Northern Vanuatu subgroup of Oceanic and is spoken by 6,500 people in the northern part of the island of Pentecost. Data discussed here come from Walsh (1982) and Vari-Bogiri (2011), abbreviated here as “W” and “V”. The case of Raga is highly relevant because it shows the same basic pattern as Sye: an apparently unnatural class of initial consonant alternations in verb roots conditioned on adjacency to specific morphemes, resulting in different stem allomorphs appearing in reduplicated verb forms. Since the nature of the alternations is quite different from Sye, Raga presents an ideal testing ground for the approach advocated in the previous section.

Raga has a canonical 5 vowel system and a moderately complex consonant inventory (424). It retains Proto-Oceanic labialized *b^w, *m^w, and *p^w(> v^w).[114] Syllable structure is mostly CV, and stress is usually on the penultimate syllable of a word.

(424) *Raga consonant inventory*

		t	k	
b	b^w	d	ŋg	
m	m^w	n	ŋ	
		s		h
v	v^w		ɣ	
w		l, r		

According to Walsh (1982), Raga has four pairs of alternating sounds, which are shown in (425). The modified forms occur following the continuous or “action-in-progress” marker *-m*/*-mwa*/*-Ø*, the pre-verbal particle *mom* ‘still’, and the “verb ligature” element *ba*.

(425) *Raga consonant alternations*

BASIC	MODIFIED	EXAMPLES	
v	b	vano ∼ bano ‘go’	W237, V32
v^w	b^w	v^weru ∼ b^weru ‘bend double’	W237
t	d	tunu ∼ dunu ‘burn’ (??)	W237
ɣ	ŋg	n/a (see below)	

As in Sye, mutation affects only the immediately adjacent reduplicant but not the base ((426)-a). Mutation is strictly local, as evidenced by more complex verb forms as in ((426)-b), where the continuous aspect marker *-m* triggers mutation on the immediately following reciprocal prefix *vi-* but not on any of the non-adjacent verb roots.

[114] Walsh (1982) describes these sounds as produced with “labio-velarisation”, while Vari-Bogiri (2011) simply refers to them as “labiovelar stop[s]” without differentiating between primary and secondary place of articulation. Walsh (2005: 160) uses the term “with labialised release”.

(426) *Local mutation in verb root reduplication* (W237)

a.	na-m ban-vano	1SG-CONT **MOD**:RED-go	'I keep on going'
	na-n van-vano	1SG-PFV **BAS**:RED-go	'I used to keep on going'
b.	ra-m bi-van-vano	3PL-CONT **BAS**:REC-BAS:RED-go	'they are going in all directions'
	ra-n vi-van-vano	3PL-PFV **MOD**:REC-BAS:RED-go	'they went in all directions'

The four alternations do not seem to follow from a single phonological operation: the case of *v(ʷ) → b(ʷ)* is an instance of continuancy mutation while *t → d* presents a case of voicing mutation and ɣ → *ŋg* involves prenasalization. On these grounds, Inkelas and Zoll (2005) arrive at the same conclusion for Raga as for Sye, viz. that stem alternations are suppletive.

The data analyzed in Inkelas and Zoll (2005) are based on the short section on Raga in Walsh's (1982) survey on consonant alternations in East Oceanic. At the time of writing, Inkelas and Zoll did not have access to the more recent comprehensive monograph on Raga by Vari-Bogiri (2011) which offers a number of corrections and extensions to Walsh's article. The following new data are crucial. First, while Vari-Bogiri acknowledges that /t/ sometimes alternates with /d/, she emphasizes that this is not a regular alternation pattern because it is limited to very few lexical items and it also occurs in contexts that do not coincide with the alternation triggers discussed above. For example, no mutation is observed in *mwa tasiga* 'he snores' (V89). Vari-Bogiri concludes that "there is no clear conditioning for this variation [between /t/ and /d/]" (V31). Second, the alternation ɣ-/*ŋg-* is not reckognized as a mutation process in Vari-Bogiri (2011). Consequently, in the paradigm of *ɣaɣaru* 'to swim', the initial consonant does not undergo mutation even when it is preceded by a trigger (V149f). The only instance where /ɣ/ changes into /ŋg/ is when /ɣ/ appears in a context where a more general assimilation rule causing nasal spreading to velar obstruents applies, as in the case of *ɣaɣa* 'fly' → *mwa ŋaɣa* 'it flies' (V29). Variation between a root-initial velar fricative and a prenasalized stop is therefore conditioned on the segmental environment and not on the morphological class of alternation triggers. This may well have been the principal reason why Walsh (1982) does not give a single example for this purported mutation.

What is left of VRA in Raga are the bilabials, which are the only sounds that do indeed alternate productively (V32). Following the general logic from my analysis of Sye, I assume that the lexical representations of mutation triggers have a floating [-c] feature that causes hardening of /v(ʷ)/ to /b(ʷ)/. /s/ is protected by faithfulness to stridency and /h/ by virtue of the fact that it does not have a non-continuant partner (*ʔ). The same is true of /ɣ/ (*g, DEP(nas)). Three sample evaluations are shown in the tableaux in (427), (428), and (429).

(427) *Successful mutation with labials*

[-c] + vano	DEP [n]	DEP [v]	• ↑ [+c]	DEP|	MAX|
a. vano			*!		
☞ b. bano				*	*

(428) *No mutation with velars*

	[-c] + ɣaɣa	DEP [n]	DEP [v]	• ↑ [+c]	DEP|	MAX|
☞	a. ɣaɣa			*		
	b. ŋgaɣa	*!			*	*

(429) *Vacuous integration of [-c] with underlying plosives*

	[-c] + tasiga	DEP [n]	DEP [v]	• ↑ [+c]	DEP|	MAX|
	a. tasiga			*!		
☞	b. tasiga				*	*
	c. dasiga		*!		*	*

The fact that mutation applies transparently in reduplicated forms follows from late ordering of mutatation: While reduplication can be safely assumed to be a lexcial process in Raga, mutation has to apply at the postlexical level, given that the trigger is affixed to a pronoun and the target is part of the verbal complex.

On a final note, it would not be impossible to devise a phonological account of all four alternations mentioned in Walsh (1982), given that the description may have been accurate for some variety of Raga at some point in the past. The representation of the triggering morphemes would need to be enriched by a floating [v] feature which associates vacuously to /b/, /bʷ/ and /ɣ/ but triggers voicing on /t/. Since all other consonants in Raga are either voiced or do not have a voiced counterpart, no unattested further mutations would be predicted. If the nasal feature of /ŋg/ could be reanalyzed as non-contrastive, the floating [-c] could associate to /ɣ/ with prenasalization being added redundantly.

5.2.2 Kawaiisu

Another example of apparent root allomorphy is the case of Kawaiisu, a Numic (Uto-Aztecan) language spoken by only a few people in Kern County, California. All Kawaiisu data discussed here come from Zigmond et al. (1990), which contains a description of the grammar, 19 pages of glossed texts, and a dictionary. The case of Kawaiisu is briefly discussed as evidence for arbitrary (and hence morphological) root allomorphy in Inkelas and Zoll (2005: 48); however, as I will argue, closer inspection of the phonological system of Kawaiisu reveals that this interpretation is incorrect. In (430) and (431), I present the vowel and consonant inventories of Kawaiisu.[115] Realization of /v/ varies freely between [v] and [β].

(430) *Kawaiisu vowel inventory*

i iː		ɯ ɯː	u uː
e eː			o oː
	a aː		

[115] I am using IPA symbols to represent the sounds of Kawaiisu. The following are the notational differences between the symbols used here (placed between slashes) and those used in Zigmond et al. (1990): /ʃ/ = <š>, /ʒ/ = <ž>, /ɣ/ = <g>, /ɣʷ/ = <gw>, /ts/ = <c>, /ʧ/ = <č>, /ɾ/ = <r>, /j/ = <y>, /ɯ/ = <i>, /Vː/ = VV.

(431) *Kawaiisu consonant inventory*

p	t			k kʷ	ʔ
b	d				
	s		ʃ		h hʷ
v	z		ʒ	ɣ ɣʷ	
	ʦ		ʧ		
m	n			ŋ	
	ɾ	l			
w			j		

Reduplication in Kawaiisu marks inceptive and repetitive aspect (Z97). The reduplicant is a CV-sized copy of the first syllable of the verb stem, as in *ka-ɣaː* 'RED-sing', from *kaː* 'to sing' (Z210). It is important to note that the voiceless plosive *k-* from the simple verb is still present in the reduplicant but not in the base, where it has changed into a voiced fricative -ɣ-. This example illustrates an important observation about reduplication in Kawaiisu: a root-initial consonant may undergo certain alternations when the root is reduplicated while the initial consonant in the copied syllable seemingly retains the original initial consonant.

The *k-*/-ɣ- alternation is not the only initial consonant alternation in reduplicants. In other roots, we find *kʷ-* changing into -ɣʷ- and *t-* changing into -*d*- or -*ɾ*-. What makes these alternations challenging is the fact that they occur only in some roots, while the initial consonant in other roots never changes, and it is not predictable from the phonological shape or the lexical semantics of a given verb root whether or not its initial consonant will undergo alternation (and, in the case of *t-*, which effect it will have). The following table shows all attested alternation patterns in reduplication.

(432) *Root-initial C alternations in Kawaiisu reduplication*

ALTERN.	SIMPLE	REDUP.		
p	*pitahni*	*pi-pitahni*	'to vomit'	Z255
p	*pidɯɪ*	*pi-pidɯɪ*	'to arrive (SG)'	Z253
k	*koʔo*	*ko-koʔo*	'to cut, as with a knife'	Z215
k∼ɣ	*kaʔa*	*ka-ɣaʔa*	'to eat'	Z8
k∼ɣ	*kija*	*ki-ɣija*	'to laugh; to play'	Z214
kʷ	*kʷiʒi*	*ku-kʷiʒi*[116]	'to pile up'	Z221
t	*takaʔna*	*ta-takaʔna*	'to step'	Z272
t	*tapuzi*	*ta-tapuzi*	'to break'	Z273
t∼d	*tɯnija*	*tɯ-dɯnija*	'to tell'	Z280
t∼d	*tono*	*to-dono*	'to hit; to pierce; etc.'	Z284
t∼ɾ	*tahna*	*ta-ɾahna*	'to put down/away (PL.O)'	Z272

Inkelas and Zoll (2005) treat these alternations as lexically suppletive allomorphy. Their argument is informed by three observations: (i) the fact that some roots undergo mutation while others do not, (ii) the fact that /t/ alternates with more than one other sound, and

[116] The change from *kʷiː-* to *ku-* in the reduplicant is an instance of an independent alternation pattern involving labial(ized) consonants followed by a high vowel that is abundant in Kawaiisu morphonology (Z11). The important point for the present discussion is the stability of the base consonant.

(iii) the lack of predictability with respect to (i) and (ii). Inkelas and Zoll conclude that Kawaiisu reduplication is best described as a construction consisting of two distinct lexically listed allomorphs, culminating in the strong claim that "[n]o phonological copying theory of reduplication can account for this sort of effect" (Inkelas and Zoll 2005: 48).

While all three observations hold, Inkelas and Zoll miss a crucial generalization about the phonotactics of Kawaiisu: the voiced obstruents /b/, /d/, /v/, /z/, /ʒ/, /ɣ/, /ɣʷ/ and the tap /ɾ/ never occur word-initially (cf. the table in (430), where illicit consonants in word-initial position are indicated by grey shading).[117] This observation can be formulated in the following constraint:

(433) *$_{\omega}$[D Voiced obstruents and /ɾ/ are not allowed in word-initial position.

It is not immediately obvious which is the underlying initial consonant in a root such as *kaʔa-* 'to eat'. If the underlying consonant is /k/, the alternation under reduplication would in fact be mysterious. However, if we assume that the initial root consonant is /ɣ/, we have no difficulties in explaining the discrepancies between base and reduplicant: in both the unreduplicated and the reduplicated verb forms, the word-initial fricative changes into a voiceless stop in accordance with the constraint in (433). In the reduplicated form, the root-initial consonant of the base is not in a word-initial position and is therefore under no pressure to undergo hardening. In a root like *koʔo-* 'to cut', the underlying form contains an initial /k/, which surfaces faithfully in both base and reduplicant. In other words, the alternation between voiced and voiceless consonants in Kawaiisu follows from a general ban on voiced obstruents in word-initial position, assuming that illicit sounds are repaired by making them voiceless (and non-continuant).

This analysis can have a number of possible formal implementations, all of which are essentially phonological in nature. In a parallel model, the constraint in (433) needs to be ranked higher than the relevant faithfulness constraints against featural epenthesis and/or marking of underlying lines as invisible; in fact, given that the ban on word-initial voiced obstruents and /ɾ/ is exceptionless in Kawaiisu, that constraint can be assumed to be undominated. In a derivational model, it is sufficient for *$_{\omega}$[D to outrank the relevant faithfulness constraints after reduplication has taken place to rule out overapplication. In (434) and (435), both options are briefly sketched.

(434) *Base-independent repair*

	μ + dono	*$_{\omega}$[D	FAITH
	a. dodono	*!	
	b. dotono	*!	*
☞	c. todono		*
	d. totono		**!

(435) *No overapplication*

	SIMPLE	REDUP.
LEXICON	/dono/	/dono/
STRATUM 1		do-dono
STRATUM 2	[tono]	[to-dono]

An additional complication pointed out by Inkelas and Zoll (2005) is presented by consonant alternations in compounds and incorporated nouns. The examples given in (436) show that one and the same morpheme may be stable in some and undergo alternations in other constructions. The examples in (437) illustrate that this variability cannot be easily pinned down

[117] These sounds occur morpheme-initially in suffixes, e.g. *-vaː* 'FUT', *-dɯ* 'NMLZ', *-ga* 'EXIST'.

to the morpheme preceding a potential undergoer stem because, again, one and the same morpheme can occur in constructions with and without consonant alternations, a situation reminiscent of the "genitive-s" in Korean (Kim 1986, Choo and O'Grady 1996). Furthermore, alternations in compounds and incorporated nouns are a superset of those found in reduplication (shown in (432)) and additionally include *p-/v-*, *p-/b-*, and *k*ʷ*-/ɣ*ʷ*-*.

(436) *Unpredictability of undergoer morphemes*

ʔaga-	**k**arɯ-dɯ	red-sit-NMLZ	'Scodie Mountain'	Z9
tavi-vɯni-	**k**arɯ	sun-look-sit	'to sit and watch the sun'	Z8
ʔaː-	**ɣ**arɯ	quietly-sit	'to sit quietly'	Z9

(437) *Unpredictability of trigger morphemes*

ʔaga-	**k**arɯ-dɯ	red-sit-NMLZ	'Scodie Mountain'	Z9
ʔaga-	**t**ɯbi-paʔa-dɯ	red-rock-high-NMLZ	'Red Rock Canyon'	Z9
ʔaga-	**ɣʷ**iʃa	red-pile.up	'be a bright thunderhead'	Z9

I concur with Inkelas and Zoll (2005) in that consonant alternations in compounds are challenging for a phonological account. However, it is often the case that the meaning of the whole compound cannot be derived from the meaning of the compound elements compositionally. The table in (438) shows some of the most striking cases of lexicalization; since such words have to be stored as separate lexical entries due to their semantics, their segmental make-up does not need to be derived in the phonology. Note that in the case of *ʔaːɣa-tɯnija* 'to tell a secret', the verb root has a voiced stop *d-* in the reduplicated form (suggesting an underlying /d/), but a voiceless stop *t-* in the compound (i.e. devoicing), which demonstrates that phonological neutralization in reduplication and unpredictable alternations in compounding are completely independent processes.

(438) *Lexicalized compounds and constructions*

STEM1	STEM2	COMPLEX	
ʔaga- 'red'	karɯ-dɯ 'sit-NMLZ'	ʔaga-karɯ-dɯ 'Scodie Mountain'	Z9
nɯ- 'REC'	piya 'mother'	nɯ-biya 'stepmother'[118]	Z255
totsi- 'red'	kɯra 'to pile up'	totsi-ɣɯra- 'be a bright thunderhead'	Z215
tsɯɣa- 'rough'	totsi 'head'	tsɯɣa-ɾotsi- 'tangle-haired'	Z8
ʔaːɣa- 'quietly'	tɯnija 'to tell'	ʔaːɣa-tɯnija 'to tell a secret'	Z280
ta- 'sun'	puːtsiː-vɯ 'star'	ta-vuːtsiː-vɯ 'morning star'	Z261

Kawaiisu also has a considerable number of transparent and semi-transparent compounds, e.g. *moʔo-paʔa* ‘to stir by hand’, from *moʔo* ‘hand’ and *paʔa* ‘to stir’ (Z245), or *to͡tsi-ɣɯɾa* ‘to cut hair’, from *to͡tsi* ‘head’ and *kɯɾa* ‘to cut, as with scissors’ (Z215). However, the question of whether or not consonant alternations in these semantically less opaque compounds can be derived phonologically by recurring to, for instance, floating features, does not have any bearing on the proposed solution for the alternation patterns in reduplication. The latter are regular sound changes brought about by a single, well-motivated phonotactic constraint. Reduplication in Kawaiisu does therefore not pose a problem for theories of reduplication that assume phonological copying because it can easily be accounted for without invoking reduplication-specific cophonologies.

5.2.3 Chechen and Ingush

The Nakh languages Chechen and Ingush have a syntactic process of verb doubling that occurs in negative imperative constructions (439) and in certain clause chaining constructions involving the chaining clitic =*ʔa* (all data from Conathan and Good 2000, abbreviated here as “CG”). The clitic requires a VP-internal host and must directly precede the medial verb, which appears in a special stem form (440). When no VP-internal host is available, a copy of the medial verb is inserted at the left edge of the VP to act as a host for =*ʔa*. The copy always appears in the infinitive stem and never carries inflectional afffixes ((441) – (443)).

(439) *ga ma guo*
see.INF NEG see.IMP
‘Don’t look!’ (Chechen, CG49)

(440) *Muusaaz kinashjka =ʔa diishaa ghealie lota-jar*
M.ERG book =& read.CVANT cigarette light-J.AUX.WP
‘Musa read the book and (then) lit a cigarette.’ (Ingush, CG50)

(441) *Aħmad ʕa =ʔa ʕiina dʕa-vaghara*
A. stay.INF =& stay.PP DX-V.go.WP
‘Ahmad stayed (for a while) and left.’ (Chechen, CG50)

(442) *Muusaa balkha ga =ʔa gejna avtobusaa t’eħa-vysar*
M. work.ADV delay.INF =& delay.CVANT bus.DAT miss.WP
‘Musa was hung up [sic!] at work and missed the bus.’ (Ingush, CG53)

(443) *kiekhat daat’a =ʔa deatt’a telkhara*
paper rip.INF =& rip.PP spoil.IMP
‘The paper ripped and was spoiled.’ (Chechen, CG53)

The phonological shape of a medial head verb stem may differ considerably from that of the corresponding infinitive stem, and the infinitive stem occurring in a doubling construction may again be minimally different from the infinitive stem used elsewhere. As shown in

[118] Other meanings of *nɯ-biya* are ‘mother’s younger sister’ and ‘father’s younger brother’s wife’.

(444) and (445), the form of allomorphy between the infinitive and the head verb stem can safely be described as instances of true suppletive allomorphy.

(444) *Chechen suppletive stem allomorphs* (CG54)

INFINITIVE	DOUBLED	HEAD VERB	
Dala	(Da)la	lwo	‘give’
Dã	Dã(ħa)	Dãħa	‘bring’
Dagha	Dagha, Duoda	Duedu	‘go’
Daã	Daã	Dooghu	‘come’

(445) *Ingush suppletive stem allomorphs* (CG55)

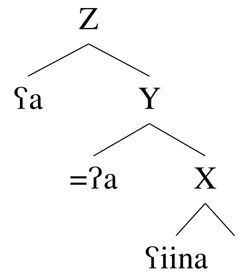
INFINITIVE	DOUBLED	HEAD VERB	
vie	vie	vie	‘kill’
qiera	qiera	qiera	‘fear’
sejsa	sejsa	sejsacha	‘rise’
lakha	lakha	lakhaa	‘find’
gaa	ga	gejna	‘delay’
viela	viila	viilaa	‘laugh’

Cases of suppletive stem allomorphy in reduplication pose a genuine problem for any theory that locates the copy operation in the phonological component because under a strictly modular feed-forward architecture of grammar, the phonology does not have access to the building blocks necessary for selecting suppletive stem allomorphs listed in the lexicon. Verb doubling in Chechen and Ingush thus cannot be a case of phonological copying but has to be something else. Indeed, what we are dealing with is a syntactic doubling construction, i.e. a construction in which the same syntactic object is spelled out more than once. The reasons for considering the copies syntactic rather than phonological are quite obvious: copies in the clause chaining construction are sensitive to syntactic domains (the VP), and copies in the negative imperative construction constitute separate words between which other constituents (such as the negative particle *ma* in (439)) can intervene. This case of verb doubling therefore does not fall under the definition of reduplication employed here. Distinguishing between phonological and syntactic copying is crucial as it has far-reaching consequences for what patterns a theory of reduplication has to be able to derive (see also Saba Kirchner (2013)).

Overt copying of syntactic objects is a widespread process in many languages. It appears in a number of different guises, the most prominent examples being predicate fronting, wh-copying, and DP-internal doubling, and numerous syntactic accounts for these processes have been put forward in the literature (McDaniel 1986; Ritter 1988; Nunes 2004; Landau 2006; Barbiers 2008; Harbour 2008; Korsah 2016; Müller 2016; Hein 2017, among many others). Verb doubling in Chechen and Ingush presents another instance of syntactic copying, and it is consistent with our current understanding of what kind of structures syntactic operations can create or manipulate. For that reason, the characterization of the Chechen and Ingush data as divergent allomorphy in Inkelas and Zoll (2005: 8–9) is accurate, but it has no consequence for phonological theories of reduplication because the phonological component is not the place where the relevant copy operation takes place. The obvious question is then how the occurrence of the suppletive stem allomorphs can be accounted for in the syntax.

In postsyntactic theories of morphology such as DM (Halle and Marantz 1993, 1994, Harley and Noyer 1999, Embick and Noyer 2007), lexical insertion rules may contain syntactic information which specifies certain positions in the syntactic tree. Thus, separately listed verb roots may be selected depending on the syntactic head that dominates the target position (see Bobaljik 2000 and Harley 2014). The syntactic status of clitics as well as their role in syntactic derivation has been the subject of considerable debate in the literature (Kayne 1989, Sportiche 1996, Bošković 2001, Grüter 2009) and, as Kupula Ross (2016: 192) accurately points out, a number of fundamental questions may well "[lack] a clear-cut and crosslinguistically valid answer". Conathan and Good (2000) propose a syntactic analysis of Chechen and Ingush couched in HPSG (Sag and Wasow 1999) in which a single VP head contains the two verb forms and the clitic element =*ʔa* in between.

(446) *Chechen doubling construction*



(447)
a. $\sqrt{}_n$ ↔ "stay"
b. $\sqrt{}_n$ ↔ /ʕa/ / [[Z] $\_\__{\surd}$]
c. $\sqrt{}_n$ ↔ /ʕiina/ / [[X] $\_\__{\surd}$]

I will assume a very simple syntactic structure to illustrate the mechanism of context-dependent allomorph selection. In the tree in (446), the higher (infinitival) copy is in the specifier position of node Z and the lower (inflected) copy is in the specifier position of node X. The lexical rules in (447) specify that for the lexical item with the meaning "stay", the allomorph /ʕa/ is inserted if it appears in a specifier position of Z and the allomorph /ʕiina/ is inserted if it appears as specifier of X. The crucial point is that albeit the PF-rules in (447-b) and (447-c) apply at the syntax-phonology interface, the phonology is not involved in the creation of the copies or the selection procedure for the different root allomorphs. For this reason, the case of true suppletive allomorphy in Nakh copy constructions does not disprove the hypothesis that reduplication derives from affixation of prosodic nodes.

5.3 Interim summary

In this chapter, I have discussed four alleged cases of suppletive root allomorphy in reduplication. In all four cases, two phonologically distinct allomorphs appear in a specific morphological context. Non-identity between base and reduplicant are in principle well compatible with my theory of reduplication, which lacks a mechanism for compelling faithfulness between the two copies. Genuine suppletion in reduplication would, however, pose a non-trivial challenge to my theory. The question of whether a given allomorphy pattern is suppletive depends on whether or not the phonological shape of one allomorph is predictable from the other.

What I have tried to argue for the cases of Sye, Raga, and Kawaiisu is that it is possible to derive the shape of the altered root from that of the basic root. In the case of Sye, I proposed a unified analysis of the various verb root alternations in the non-past. I claimed that consonant and vowel mutation are caused by two defective MR nodes hosting the segmental features [+l], [n], and [-c]. My account of VRA in Sye offers three key insights. First, it shows that morphemes may contain more than one internally complex subsegment. This is important for defining ordering relations between the defective elements. Second, it demonstrates the necessity for proper constraints on autosegmental association. When the relevant triggers contain more structure than just a single floating element, the REALIZE MORPHEME (RM) constraint family runs into serious problems because it will be satisfied as soon as a single substructure is realized. This applies to both perseverance-based versions (Akinlabi 1996) and anti-faithfulness versions (Kurisu 2001) of RM (cf. discussion in Wolf 2005 and Zimmermann 2017a). Third, it lends support to phonological theories of mutation and reduplication. The fact that mutation in Sye applies locally to the verb root adjacent to the trigger follows naturally if both copying and segmental alternations are the result of local phonological operations.

Another major insight of the case studies in this chapter is the importance of checking one's analysis against other aspects of the grammar. In the case of Sye, the fact that VRA obey the general phonotactic constraints on consonant clusters and hiatus avoidance of the language is instructive as to the feasibility of a phonological approach. Likewise, the observation that segment alternations in reduplication obey the same constraints on consonants in word-initial position as word forms outside of reduplication is indicative of the non-suppletive nature of consonant alternations in Kawaiisu.

Non-identity may also result from a situation in which base and reduplicant are seemingly targeted by different processes. Inkelas and Zoll (2005: 82–92) discuss some relevant cases under the label *divergent modification*. One of them is Hua intensifying reduplication, in which a stem-final vowel is replaced by /u/ in the first and by /e/ in the second copy (448). This can be reconciled with copying in phonology if the intensifying morpheme is analyzed as a circumfix containing not only the reduplication trigger but also different floating vowel features which induce divergent mutations in base and reduplicant. I conjecture that it should in principle be possible to account for other cases of divergent modification along these exact same lines.

(448) *Hua divergent modification*

kveki	kveku kveke hu	'crumple/crumple'	IZ82
ebsgi	ebsgu ebsge hu	'twist/twist and turn'	IZ82
ftgegi	ftgegu ftgege hu	'coil/all coiled up'	IZ82
havari	havaru havare hu	'grow tall/grow up'	IZ82

The doubling construction in the Nakh languages Chechen and Ingush undisputably presents a true case of suppletion: the two allomorphs are phonologically too distinct from each other and the modifications are not predictable. I have argued that this is due to syntactic and not phonological copying. In Sye, Raga, and Kawaiisu, root allomorphs also have non-identical phonological shapes but they are still similar enough to make a phonological analysis possible, unlike classical examples of suppletive allomorphy such as English *go/went* or Georgian *-ar-/-kn-/-q'-/-q'op-* 'to be'. It is paramount to critically assess whether or not a given allomorphy pattern is truly beyond the reach of phonological computation. The decision which allomorphs are listed in the lexicon has immediate consequences for theories of reduplication because the claim that cases of divergent suppletive allomorphy exist is one of the main pillars of MDT. The conclusion of this chapter – and at the same time a hypothesis that should be scrutinized in future research – is that all cases of divergence in doubling constructions can be modeled as either syntactic or phonological copying, eliminating the need for reduplicative doubling constructions.

Chapter 6

Discussion

6.1 Towards a typology of interactions

A major desideratum in the literature on reduplication to date is an exhaustive typological overview of how reduplication interacts with mutation and other processes in general. Such an empirical database would not only enable the linguist to identify potential language-internal and external factors that might restrict or foster certain interaction types but would also be extremely useful as a reference for theoretically guided further research on this topic. While it is beyond the scope of this dissertation to provide such an exhaustive overview, this section presents data from a sample covering a total of 35 languages with various mutation and non-mutation patterns which – despite its obvious limitations – reveals a number of interesting observations and is intended as a starting point for more systematic typological work in the future.

6.1.1 Reduplication and mutation

Fox (Algonquin; sources: Bloomfield 1925, 1927, Dahlstrom 1997) has a process of vowel mutation also known as *Initial Change* that affects the first vowel in a word and applies **transparently** to reduplicated forms • This pattern was discussed in detail in section 3.2

(449) a. amw- ‘to eat’ D222
b. eːmw-aːʧihi ‘the ones whom they eat’
c. **eː**mwa-h-amw-aːʧihi ‘the ones whom they (repeatedly) eat’

Kulina (Arawak; source: Dienst 2014) exhibits an **underapplication** pattern whereby copies of a mutation trigger fail to induce mutation on their own base • This pattern was discussed in section 4.2

(450) /Ø-ha-za-pʰa-pʰa/ hez**i**pʰ**a**pʰa ‘1NSG-AUX-in-water-RED’ D293

Lakota (Sioux; sources: Shaw 1980, Ullrich 2011) presents an **underapplication** pattern whereby final stem vowels that normally undergo mutation before a trigger suffix fail to mutate in reduplicated stems • This pattern was discussed at length in section 4.1

(451) a. apʰa 'strike'
b. apʰ**e**-ʃni 'strike-NEG'
c. apʰa-ʰ**a**-ʃni 'strike-NEG-RED'

Nivkh (isolate; source: Shiraishi 2006) attests a number of consonant alternations, more specifically spirantization and hardening, that are confined to derived environments within certain syntactic domains (S90ff) • Reduplication copies the whole root or a full syllable, is suffixal, and conveys an intensifying, iterative or multiplicative meaning (S92) • Consonant mutation also applies **locally and transparently** in reduplicated forms

(452)

INPUT SEQUENCE		MUTATED SEQUENCE
Vowel - Plosive	→	Vowel - Fricative
Glide - Plosive	→	Glide - Fricative
Plosive - Plosive	→	Plosive - Fricative
Fricative - Fricative	→	Fricative - Plosive
Nasal - Fricative	→	Nasal - Plosive

(453)

a.	pulk	pulk-vulk-u-	'round'	S92
b.	cʰerk	cʰerk-serk-	'break'	S92
c.	ɣur(d)	ɣur-kurd-	'to stick'	S92
d.	cʰaf	cʰaf-cʰava-	'wet'	S92
e.	qal	qal-ʁal	'bright'	S88

Paamese (Oceanic; source: Crowley 1982) attests CV-, CV(C)V-, and -CV(C)V reduplication in verbal derivation • Like other Oceanic languages, Paamese has a complex system of root-initial consonant alternations. Four root forms, each appearing in different morphological contexts, need to be distinguished. Also, there are six verb classes, each showing a different set of alternations • In the default case, mutation applies **locally** in reduplicated forms ((454) – (455)). However, mutation is exceptionally blocked in one of the six classes, giving rise to an **underapplication** pattern (456) • CV-reduplication automatically triggers alternations between *p*∼*v* and *d*∼*r* independent of other triggers of mutation

(454) *buusii ro-**gu**-**k**ulu-tei*
cat 3SG.REAL.NEG-RED-swim-PART
'Cats don't swim.' (C141)

(455) *kaie **v**ane-**h**ane enaute vasiie*
3SG RED-copulate SP.place all
'He is promiscuous (i.e. copulates anywhere, anytime).' (C153)

(456) *muali **t**a-**t**aunu (expected: *ra-taunu)*
3SG.REAL.walk RED-play
'He is strolling along.' (C126)

Pulaar (Fula, Atlantic; source: Mc Laughlin 2005a) forms deverbal agent nouns in a similar way to Seereer-Siin, i.e. by prefixal reduplication and the addition of a noun class marker

• Unlike Seereer-Siin, mutation in Pulaar is **strictly local** and never overapplies • Deverbal agent nouns are often marked with noun class and segmental affixes but without reduplication in Atlantic languages (cf. Childs 1995 for Kisi and Watson 2015 for Kujireray) • ICM in Pulaar can be readily analyzed as featural affixation (Mc Laughlin 2005a) ⇒ the same grammar that licenses local mutation in Seereer-Siin (i.e. one with high-ranked *×) can derive the Pulaar facts

(457) *Pulaar agent nouns and local mutation* (M112)

a.	**h**ul-de	'to fear'	**k**ul-**h**ul-i	'frightening things'
b.	**s**eer-de	'to separate'	**c**eer-**s**eer-o	'divorcee'

Raga/Hano (Oceanic; sources: Walsh 1982, Vari-Bogiri 2011, discussion in Inkelas and Zoll 2005) attests verb root-initial consonant mutations that always apply **locally** in reduplicated forms • This pattern was discussed in section 5.2

(458) (W237)

	FOLLOWING A TRIGGER			FOLLOWING A NON-TRIGGER	
a.	na-m	**b**an-**v**ano	b.	na-n	van-vano
	1SG-CONT	RED-go		1SG-PFV	RED-go
	'I keep on going.'			'I used to keep on going.'	

Rotuman (Oceanic; discussion in Blevins 1994, McCarthy 2000, Blenkiron and Alderete 2015) has a morphological phenomenon commonly referred to as *phase* that is characterized by an alternation between two different forms for each content morpheme, termed *complete* and *incomplete* phase, the distribution of which is governed by phonological, morphological, syntactic, and semantic factors • Reduplication in Rotuman is a-templatic, with the reduplicant never exceeding one σ and copying 2 or 3 moras depending on the phonological shape of the base • Reduplicants behave like incomplete phases, with one notable exception: umlaut (coalescence) regularly **underapplies** in reduplicants

(459) *Phase differences* (M148)

		COMPLETE	INCOMPLETE	
a.	*Deletion*	tokiri	tokir	'to roll'
		tiʔu	tiʔ	'big'
b.	*Metathesis*	iʔa	iaʔ	'fish'
		seseva	seseav	'erroneous'
c.	*Umlaut*	mose	mös	'to sleep'
		futi	füt	'to pull'
d.	*Diphthongization*	pupui	pupu̯i	'floor'
		lelei	lele̯i	'good'
e.	*No alternation*	rī	rī	'house'
		sikā	sikā	'cigar'

(460) *Reduplication and phase* (Blenkiron282)

	COMPLETE	INCOMPLETE	REDUPLICATED	
a.	sapo	sap	sap-sapo	'to take hold of'
b.	pure	puer	puer-pure	'to rule'
c.	mose	mös	**mos**-mose	'to sleep'
d.	rue	rue̯	rue̯-rue	'to move to and fro'
e.	rī	rī	rī-rī	'house'

Seereer-Siin (Atlantic; source: Mc Laughlin 2000, discussion in Zimmermann and Trommer 2011) attests optional **overapplication** of ICM in deverbal agent nouns • This pattern was discussed extensively in section 3.1

(461)

INFINITIVE	AGENT NOUN				
fec	o-**p**eː-**f**ec	∼	o-**p**eː-**p**ec	'dance / dancer'	MM334
xoːx	o-**q**oː-**x**oːx	∼	o-**q**oː-**q**oːx	'cultivate / farmer'	MM334

Sesotho (Bantu; source: McNally 1990, mentioned in McCarthy and Prince 1995) attests a variety of ICM also referred to as "strengthening" that comprises a number of fortition process triggered by certain immediately adjacent prefixes • This process **overapplies** in reduplicated forms[119]

(462)

a.	le-ba-rata	'you:PL love them'	McN338
	le-n-thata	'you:PL love me'	McN338
	le-i-thata	'you:PL love yourselves'	McN338
b.	le-ba-rata-rata	'you:PL love them a little'	McN338
	le-n-thata-thata	'you:PL love me a little'	McN338
	le-i-thata-thata	'you:PL love yourselves a little'	McN338

Sye (Oceanic; source: Crowley 1998, discussion in Inkelas and Zoll 2005) has a complex sytem of verb root-initial mutations that always apply **locally** in reduplicated forms • This pattern was discussed at length in section 5.1

(463) *Root-initial mutation and reduplication in Sye* (C77)

BASIC	omol	BAS:fall	'fall'
MODIFIED	ɣw-amol	3PL:FUT-MOD:fall	'they will fall'
REDUP.	ɣw-**a**mol-**o**mol	3PL:FUT-MOD:fall-BAS:RED	'they will fall all over'

Tawala (Oceanic; source: Ezard 1997) attests several vocalic alternations, all morphologically conditioned or restricted • Elision of V_1 is observed in a number of contexts across word boundaries, while elision of V_2 is restricted to the derivational prefix *om-* (464) • In

[119] Sesotho words usually have one syllable bearing primary stress. When the base of a Φ-sized reduplicant carries stress, the corresponding reduplicant vowel is stressed, too, resulting in a word with two stressed syllables. McCarthy and Prince (1995) interpret these facts as "overapplication" of stress, which I find to be a palpably false conclusion: If reduplication involves affixation of a Φ to a base that is already headed by a Φ, the expected outcome are two independent domains for stress assignment and hence two stressed syllables.

addition, certain vowels and vowel sequences (diphthongs?) undergo mutation before certain suffixes (potentially related to stress shift) (465) • In reduplicated word forms, both elision and mutation **overapply**

(464)	a.	/meka e-nenae/	mekenenae	'where are you going'	E35
		/nima i-tutu/	nimitutu	'five (a hand is joined)'	E35
	b.	/ani-om-giluma/	animgiluma	'pen (writing thing)'	E36
		/a-om-poya/	ampoya	'I apply heat (magic)'	E36
	c.	/RED-tona-e-ya/	ton**e**ton**e**ya	'DUR-pierce-TRV-3SG'	E38
		/RED-dewa-iyai/	dew**i**dew**i**yai	'DUR-make-1PL.EXCL'	E38
		/pitapita-ei/	pit**e**pit**e**i	'bush-ABL'	E38

(465)	a.	/mayau-na/	mayouna	'that tree'	E37
		/meyagai-na/	meyageina	'that village'	E37
		/wiwam-ge-ya/	wiwomgeya	'make it into a boat'	E38
	b.	/RED-wayau-na/	way**o**way**o**una	'cold-3SG'	E37
		/RED-witai-na/	wit**e**wit**e**i<na>	'heavy'	E38
		/RED-tenam-na/	ten**o**ten**o**m<na>	'floating'	E38

6.1.2 Reduplication and other processes

Akan (Kwa, Atlantic-Congo; source: Dolphyne 2006, discussion in McCarthy and Prince 1995, Raimy 2000a,b) has a ban on CV sequences where C is dorsal and V front/coronal • This ban is lifted (i.e. it **underapplies**) in fixed [+high] vowel reduplication

(466)	a.	ȶɛ	*kɛ	'divide'	Rb549
		çɪ	*hɪ	'border'	Rb549
	b.	kɪ-kaʔ	*ȶɪ-kaʔ	'bite'	Rb549
		hɪ-hawʔ	*çɪ-hawʔ	'trouble'	Rb549

Chukchee (Chukotko-Kamchatkan; sources: Bogoras 1922, Krause 1980, discussion in Bobaljik 2006) has a process of apocope that affects stem-final vowels in word-final position • Apocope always applies **transparently** in reduplicated nouns (reduplication marks ABS.SG for some nouns) • Reduplicants generally observe a maximally CVC template; any further truncations are again not backcopied to the base

(467)		ABS.SG	ABS.PL		
	a.	milut	milute-t	'hare'	K85
		ʔuwequtʃ	ʔuwequtʃi-t	'husband'	K85
	b.	nute-nut	nute-t	'earth'	K156
		tala-tal	tala-t	'pounded meat'	K156
		ele-el	ele-t	'summer'	K156
		piŋe-piŋ	piŋe-t	'falling snow'	K156
	c.	tirk-ə-tir	tirk-ə-t	'sun'	K156
		mərɣo-mər	mərɣo-t	'seaweed'	K156

Chumash (Ineseño) (†, isolate; source: Applegate 1976, discussion in Mester 1986, McCarthy and Prince 1995, Raimy 2000a) attests three general phonological processes, none of which apply transparently in reduplication • Prefixal CVC-sized stem reduplication, prefixes outside of the stem domain are usually not copied • Onset formation **overapplies** when a C-sized prefix is added to a V-initial stem • Glottalization (coalescence of C+ʔ→ C') too **overapplies** in reduplicated forms • Precoronal *l*-deletion **overapplies** when it has to apply independently of reduplication; when the context for its application (i.e. a coda /l/ in the reduplicant followed by a coronal onset in the base) is created by reduplication, however, l-deletion **underapplies** • All of the above interactions are amenable to analysis in terms of cyclic effects: For instance, if *l*-deletion applies at an earlier level than reduplication, both the over- and the underapplication patterns fall out naturally

(468)	a.	ʧʰumaʃ	ʧʰum-ʧʰumas'	'islanders'	A273
	b.	s-kitwon	s-kit-kitwon	'it is coming out'	A273
(469)	a.	s-ikuk	sik-sikuk	'he is chopping, hacking'	A279
	b.	s-iʃ-expeʧ	ʃi-ʃex-ʃexpeʧ	'they two are singing'	A279
(470)	a.	k-ʔanɨʃ	k'an-k'anɨʃ'	'my parental uncles'	A279
	b.	s-ʔamin'	s'am-s'amin'	'he is naked'	A279

(471)	a.	s-pil-kowon	>	spilkowon	'it spills'	A281
		s-pil-RED-kowon	>	spilpilkowon	'it is spilling'	A281
	b.	s-pil-tap	>	spitap	'it falls in'	A281
		s-pil-RED-tap	>	spitpitap	'it is falling in'	A281

(472)	a.	s-tal'ik	ʃ-tal-tal'ik'	'his wives (i.e. of a chief)'	A281
	b.	ʦ'aluqaj	ʦ'al-ʦ'aluqaj'	'cradles'	A281

Fox (Algonquin; sources: Bloomfield 1925, 1927, Dahlstrom 1997, discussion in Burkhardt 2001) has a process of word-initial vowel raising that **overapplies** in reduplicated forms • This pattern was discussed in detail in section 3.2

(473)	a.	ena:pi-	'to look'	D216
	b.	ina:pi-wa	'he looks'	
	c.	**i**na-h-**i**na:pi-wa	'he looks (repeatedly)'	

Hehe (Bantu; source: Odden and Odden 1985, discussion in Mester 1986) has full root reduplication • Hehe also has a ban on high vowels preceding any other vowel, which is repaired by changing the high V into a glide and compensatory lengthening of the second V • Glide formation **overapplies** in reduplicated forms and the resyllabified prefix C is copied as if it was part of the root

(474)	a.	kú-haáta	'to ferment'	kú-haata-haáta	'to start fermenting'	O500
	b.	mi-dóodo	'little'	mi-doodo-dóodo	'fairly little'	O500

(475) a. kw-íita (< ku-ita) 'to spill' O499
b. my-áangufu (< ku-angufu) 'fast' O499

(476) a. kwíita-kwiíta (< ku-ita-RED) 'to pour a bit' O501
b. myoolofu-myóolofu (< mi-olofu-RED) 'fairly plentiful' O501

Indonesian (Austronesian; sources: Lapoliwa 1981, Krause 2004, discussion in Cohn 1989, Raimy 2000a, Pater 2001, Zaleska 2018) has a process of coalescence (also known as *nasal substitution*) whereby the final nasal of the active voice prefix *məŋ-* blends with a following voiceless root consonant • In reduplicated forms, coalescence affects both the initial consonant in the base and in the reduplicant ⇒ **overapplication** • Ordering copying after prefixation seems to conflict with the observation that the nasal from the prefix is not copied in V-initial roots • Zaleska (2018) proposes a phonological account within the framework of ESC that exploits the special prosodic status of the prefixe *məŋ-*

(477) *Nasal assimilation (a.) and substitution (b.)*

a.	ambil	məŋ-ambil	'take'	K132
	buka	məm-buka	'open'	K133
	gambar	məŋ-gambar	'draw'	K132
b.	kirim	mə-ŋirim	'send'	K132
	potoŋ	mə-motoŋ	'cut'	K133
	tulis	mə-nulis	'write'	K133
	səsal	mə-nyəsal	'regret'	K133

(478) *Reduplication with V-initial roots (a.), local assimilation (b.), and substitution (c.)*

a.	/məŋ-əlu-RED-kan/	məŋ-əlu-əlu-kan	'to welcome with decorations, to praise'	L111
b.	/məŋ-baca-RED/	məm-baca-baca	'to read without serious attention'	L111
	/məŋ-geleŋ-RED-kan/	məŋ-geleŋ-geleŋ-kan	'to shake one's head (repeatedly)'	L111
c.	/məŋ-pilih-RED/	mə-milih-milih	'to be selective'	L110
	/məŋ-tulis-RED/	mə-nulis-nulis	'to write without any definite purpose'	L111

Irish (Old) (†, Indo-European; sources: Thurneysen 1909, 1946, McCone 2005, discussion in Anderson 2016, Zukoff 2017) preterite stems[120] were formed by ATB C_1-reduplication with a fixed vowel /e/, i.e. $C_1(C_2)V_1\ldots \rightarrow C_1e\text{-}C_1(C_2)V\ldots$ • Lenition, which in Old Irish affected all intervocalic consonants and all stops in a V__{l,r,n} environment (T69/74), applied **transparently** in reduplicated forms

(479) a. canid ce-chan- 'sing' T393/424
b. gleinn ge-[ɣ]lann- 'learn' T393/424, Z24
c. braigid be-[v]rag- 'bleat' T393/424, Z24

[120] Zukoff (2017: 217) also discusses another type of preterite stems, namely those derived by vowel lengthening, e.g. *fich-* [fʲixʲ-] → *fích-* [fʲiːxʲ-] 'fight'. Zukoff adumbrates that this lengthening might be the reflex of a formerly reduplicated stem form (**fi-fx*) that underwent deletion and compensatory lengthening, in light of the fact that reduplication is the prevalent means for deriving preterites in Old Irish. If this is correct, Old Irish (and perhaps Indo-European in general) would attest a diachronic shift from one type of non-concatenative exponence (reduplication) to a different type of non-concatenative exponence (morphological lenghtening).

Japanese (Japonic; source: Mester and Itô 1989, discussion in McCarthy and Prince 1995, Kager 2004) has an allophonic distinction between [ŋ] and [g] whereby the nasal never occurs word-initially but the plosive does • In reduplicated mimetic forms, [g] appears in both base and reduplicant, which could be described as either **overapplication** of initial velar stop denasalization or **underapplication** of velar stop nasalization • If one analyzes the underlying sound as /ŋ/, the allomorphy as being driven by a ban on ω-initial [ŋ], and reduplication as copying of a ω, the absence of nasals in the reduplicant is expected and fully **transparent**

(480)	a.	gai-koku	*ŋai-koku	'foreign country'	K241
		koku-ŋai	*koku-gai	'abroad'	K241
	b.	gara-gara	*gara-ŋara, *ŋara-ŋara	'rattle'	K242
		geji-geji	*geji-ŋeji, *ŋeji-ŋeji	'centipede'	K242
		gera-gera	*gera-ŋera, *ŋera-ŋera	'laughing'	K242

Javanese (Austronesian; source: Dudas 1976, discussion in Steriade 1988, Archangeli 1995, Kager 2004) has a process of word-final low vowel rounding/advancing (/a/ → [ɔ]) and another process of closed syllable laxing/retraction affecting high vowels (e.g. /u/ → [ʊ]) • Both rounding/advancing and laxing/retraction **overapply** in reduplicated word-final forms even though the context for their application is only met by one of the two constituents[121]

(481) *Javanese overapplication*

a.	/donga/	dongɔ	dongɔdongɔ	'prayer'	D206
	/donga-ne/	dongane	dongadongane		
b.	/abur/	abʊr	a.bʊ.ra.bʊr	'flight'	D207
	/abur-e/	a.bu.re	a.bu.ra.bu.re		

Karuk (isolate; source: Sandy 2017) has a process of vowel epenthesis to break up illicit consonant clusters • Epenthesis applies **locally** when an illicit cluster is created by reduplication

(482)	a.	/u-ikyiv-vrath/	ukyív-i-vrath	'he fell in (to the sweathouse)'	S150
	b.	/taxvuk-RED/	taxvuk-ú-xvuk	'to crochet, to tat'	S49
		/chatnak-RED/	chatnak-á-tnak	'to crack nuts repeatedly'	S51
		/vutnus-RED/	vutnus-ú-tnus	'to puncture repeatedly'	S51

Lakota (Sioux; sources: Shaw 1980, Ullrich 2011) exhibits both **overapplication** of progressive palatalization and **local** application of C deletion and other phonotactically driven C alternations • These patterns were discussed in section 4.1

Maragoli/Logooli (Bantu; discussion in Adler and Zymet 2018) uses reduplication to mark second- and third-person possessives • In addition, the language has attests glide

[121] Kager (2004: 198f) treats the overapplication of rounding/advancing as a transparent interaction and analyzes the lack of rounding/advancing in *dongadongane* as underapplication, which suggests that he considers the process in question to be sensitive to the ω domain and the reduplicant to be headed by a separate ω node.

formation and low vowel deletion (both accompanied by compensatory lengthening) as repairs for hiatus • Both these processes **overapply** in reduplicated forms: the base for copying is always the first two segments of the outcome of glide formation and low vowel deletion, tailored to the exceptionless reduplicative CVː- template

(483)	a.	/vi-aŋɛ/	vjaːŋɛ	'AGR8-my'	A16
	b.	/ma-uva/	muːva	'CL.6-sun'	A16
	c.	/RED-e-ɔ/	jɔː-jɔ	'RED-AGR9-your'	A17
		/RED-vi-ɔ/	viː-vjɔ	'RED-AGR8-your'	A17
		/RED-to-ɔ/	tuː-twɔ	'RED-AGR13-your'	A18
		/RED-ga-ɔ/	gɔː-gɔ	'RED-AGR6-your'	A18

Paiute (Southern) (Uto-Aztecan; source: Sapir 1930, discussion in McCarthy and Prince 1995, Kager 2004) shows an allophonic distribution of [ŋʷ] and [w] whereby the nasal never occurs word-initially and the glide never occurs post-vocalically • In CV-reduplicated forms, base and reduplicant C_1's are always identical • When the reduplicant is preceded by a V-final prefix, C_1 = [ŋʷ] as expected because both C's are postvocalic • When the reduplicant is word-initial, C_1 = [w] despite the general ban on postvocalic [w] ⇒ **underapplication** of postvocalic nasalization in the base, potentially backcopied from the reduplicant

(484) *Identity effects in Southern Paiute (transcriptions simplified)*

a.	wa'aŋi	'to shout'	ti-ŋʷa'aŋi	'to give a good shout'	K245
	waixa-	'to have a council'	niavi-ŋʷaixa-pi	'council (of chiefs)'	K245
b.	wini	'to stand'	ya-ŋʷi-ŋʷinixa'-	'while standing and holding'	K247
c.	wiɣi	'vulva'	wi-wixiA-	'vulvas (obj.)'	K246
	waɣi-	'several enter'	wa-waxipiɣa	'all entered'	K246

Rabha (Sino-Tibetan, source: Joseph 2007) attests local dissimilation in lexical compounds (485) and non-local dissimilation between roots and the reduplicative causative prefix (486) • Bilabial and velar stops in the base alternate with coronal stops in the reduplicant while coronal stops alternate with velars • /a/ in the base regressively dissimilates to /ɨ/ in the reduplicant; when the base contains a non-low vowel, however, some stems show progressive dissimilation affecting the base vowel • The reduplicant is a prefix for monosyllabic stems and an infix for polysyllabic stems and obligatorily adheres to a CV shape • Reduplicated word forms may undergo one or both dissimilation processes at the same time, and when they do, dissimilation always applies **locally**

(485) *Rabha compounds*

a.	/pan-cuŋ/	paŋ-cuŋ	tree-big	'jackfruit tree'	J125
b.	/pan-tʰóŋ/	paŋ-thóŋ	tree-a.cross-sectional.section	'log'	J125

(486) *Rabha causative reduplication*

a.	ki	ti-ki	‘to fall’	J199
	kʰeŋ	tʰe-kʰeŋ	‘to live’	J200
	gur	du-gur	‘lie down’	J201
	pur	tu-pur	‘to fly’	J199
	pʰel	tʰe-pʰel	‘to fly’	J200
	bí	di-bí	‘to break’	J201
	trok	ko-trok	‘to dance’	J200
	tʰɨ́r	kʰɨ-tʰɨ́r	‘to bounce off’	J200
	dúŋ	gu-dúŋ	‘to climb’	J201
b.	dap	gɨ-dap	‘be covered’	J201
	bar	dɨ-bar	‘to come back, to return’	J201
c.	bɨr	dɨ-bar	‘to descend’	J198
	dɨk	gɨ-dak	‘to subside’	J198
	bokʰot	bo<tʰo>kʰat	‘stomach be full and not hungry’	J204
	dugut	du<du>gat	‘to sink, to drown’	J204

• Base-faithful C dissimilation and base-unfaithful V dissimilation yield multiply opaque surface forms ((486)-c) which poses a serious challenge to standard parallel BRCT (487) • Let DISS!(C) and DISS!(V) be the constraints responsible for dissimilation (violations of BR-FAITH due to coda truncation are not counted). Candidate e., which outsources all segmental modifications necessary to satisfy DISS! to the reduplicant, harmonically bounds the desired winner in d. – what is missing is a constraint that would ensure identity between a high central vowel in the input and in the reduplicant

(487) *Unresolved opacity in BRCT*

RED + dɨk	DISS! C	DISS! V	FAITH BR	FAITH IO
a. dɨ-dɨk	*!	*		
b. dɨ-dak	*!		*	*
c. gɨ-dɨk		*!	*	
☹ d. gɨ-dak			**	*!
☛ e. ga-dɨk			**	

Palauan (Austronesian, source: Flora 1974) has a process of unstressed vowel reduction that exceptionally fails to apply to fixed /e/ in monosyllabic reduplicants • This **under-application** is not an identity effect; in fact, it gives rise to surface *non-identiy* between the reduced base vowel and the full vowel in the reduplicant • The only other source for unreduced vowels in unstressed positions is coalescence of G+V → V (F182) • It is unlikely that the exceptional behavior of fixed /e/ is due to a special prosodic node heading the reduplicant because UVR applies across the board in complex word forms (490) • Dormant features[122] allow to account for this puzzle in a straightforward way: The subsegmental fea-

[122] Kawamura (2004) puts forward an account of the Palauan facts that rests on an Urbanczyk-style distinction between an indexed BR-FAITH$_{\text{root}}$ and a general BR-FAITH and the templatic constraint RED = Φ. On her account, the reduplicant has to contain a full vowel because this satisfies high-ranked FT-BN better than /ə/ assuming the latter never projects a μ. /e/ is then chosen as optimal because it is the least marked full vowel.

tures of /e/ are introduced at the same level as monosyllabic reduplication (possibly SL) but stay dormant until after vowel reduction has applied (plausibly at PL) (491)

(488) *Unstressed vowel reduction* (F44)

a.	mád	mədá-k	mədə-mám	'eyes/my eyes/our eyes'
b.	kér	kərí-k	kərə-mám	'question/my question/our question'

(489) *Fixed segment reduplication* (F164)

a.	sméʔər	se-sméʔər	'sick/kind of sick'
b.	dəkíməs	de-dəkíməs	'wet/sort of wet'

(490) *ATB reduction* (F166)
[mə-[te-[təbə-[tábək]]]] 'patch:PRS:MED' < /tabak/ 'patch'

(491) *A stratal account*

ROOT	STEM	WORD	PL
tabak	taba-tabak	me-t•$_{\text{COR, [-h], [-l]}}$-tabatabak	mətetəbətábək

Sanskrit (†, Indo-European; source: Morgenroth 1999, discussion in Mester 1986, McCarthy and Prince 1995, Kiparsky 2010) presents a case of **overapplication** of retroflexation • This pattern was discussed in section 1.2

(492)

a.	havis-aː	haviʂ-aː	'by the offerings'	M61
b.	saɲɟ	pari-ʂa-ʂaɲɟ	'to be attached to'	K5

Squamish (Salishan; source: Kuipers 1967, discussion in Wilbur 1973a and mentioned by McCarthy and Prince 1995) has three allophonic variants for stressed /i/ depending on the consonantal context • In reduplicated forms, if the consonantal context in the base is different from that in the reduplicant, there is optionality with respect to which allophone is chosen, but crucially both vowels have to realize the same allophne, i.e. the respective lowering operation **overapplies** • If this description is accurate and the example below represents a more general process in the language (Kuipers gives only this one example though), then Squamish presents a case of unexpected and theoretically challenging base-reduplicant faithfulness to non-contrastive features (see section 4.1.6.2 for a discussion of a related issue in Lakota)

(493)

	PHONE	CONTEXT	EXAMPLE		
a.	[e]	C$_{\text{-uvular}}$ __ C$_{\text{-uvular}}$	/tsix^{w}/ → [tsex^{w}]	'reach'	K26, W151
	[ɛ]	C __ C$_{\text{+uvular}}$	/t'iq^{w}/ → [t'ɛq^{w}]	'cold'	K26,W151
	[ɛi]	C$_{\text{+uvular}}$ __ C$_{\text{-uvular}}$	/q'it/ → [q'ɛit]	'be morning'	K26,W151
b.	varies		/ɬ'i-ɬ'iχ^{w}-ai/ → [ɬ'e-ɬ'eχ^{w}ai] or [ɬ'ɛ-ɬ'ɛχ^{w}ai]	'brook trout'	K27, W151

The latter two assumptions are mere stipulations that are not supported by independent evidence. Furthermore, Kawamura's account wrongly predicts that consonants should be affected by TETU, too.

Mojeño Trinitario (Arawak; source: Rose 2014) has a process of rhythmic vowel deletion whereby the first vowel of a prosodic word (which is roughly equal to a grammatical word barring certain agreement prefixes) and then every odd-numbered vowel to the right are deleted. Word-final vowels are never deleted (ab.) • Reduplication is suffixal, deradical, and CV-sized • If the reduplicant vowel is in a position that would normally call for deletion, deletion **underapplies** and the counter for deletion is set to zero (c.) • Vowel deletion proceeds transparently if it is the base vowel that undergoes deletion (d.)

(494) *Vowel deletion in Mojeño Trinitario*

a.	/pokure/	ˈpkure	‘canoe’	R378
	/su-pokure/	ˈspokre	‘her canoe’	R378
b.	/ti-ko-xuma/	ˈtkoxma	‘he/she/it is sick’	R378
	/ti-a-ko-xuma/	takˈxuma	‘may he/she/it be sick’	R378
c.	/nu-tse-RED-ko-wo/	ntsetsekwo	‘I am almost ready.’	R392
d.	/pi-sopo-RED-xi-ko-nu/	psoppoxkonu	‘You half-believe me.’	R390

Warlpiri (Pama-Nyungan; source: Nash 1980, mentioned by McCarthy and Prince 1995) has two processes of labial harmony affecting high vowels • Regressive harmony is triggered by the past tense suffix *-rnu* and is normally blocked by root boundaries and the low vowel /a/; in reduplicated roots, however, all root vowels harmonize regardless of blockers, i.e. harmony **overapplies** • Progressive harmony spreads rightwards from the root to most suffixes; the fact that reduplicated roots do not undergo this type of harmony is expected under the view that the copy also counts as a root for the purpose of harmony; if the reduplicative morpheme is analyzed as an affix, however, it would have to be considered a case of **underapplication**

(495)

a.	pangi-ka, kiji-ka	‘dig-IMP’, ‘throw-IMP’	N84
	pangu-rnu, kuju-rnu	‘dig-PST’, ‘throw-PST’	N84
	pirri-kuju-rnu (*purru-kuju-rnu)	‘pick.up-throw-PST’	N85
	yirra-rnu (*yurra-rnu)	‘dig-PST’	N85
	pangu-pangu-rnu (*pangi-pangu-rnu)	‘pick.up-RED-PST’	N86
b.	kurdu-kurlu-rlu-lku-ju-lu	‘child-PROP-ERG-then-me-they’	N86
	maliki-kirli-rli-lki-ji-li	‘dog-PROP-ERG-then-me-they’	N86
	yukiri-yukiri (*yukiri-yikiri)	‘green-RED’	N88

Washo (isolate; source: Jacobsen 1964, discussion in Wilbur 1973b, Kager 2004) has a general process of coda devoicing that applies **locally** to CVC-reduplicants without back-copying to the base

(496) *Normal application of coda devoicing*

	a.	RED-wis-i	wis-wisi	'it's squeaking'	K231
	b.	RED-wed-i	wet-wedi	'it's quacking'	K231
		RED-bag-i	bak-bagi	'he's smoking'	K231
		RED-ʃub-i	ʃup-ʃubi	'he's crying gently'	K231

Yapese (Oceanic; source: Jensen 1977, mentioned in McCarthy and Prince 1995) has a process of /ɑ/-fronting ("lightening") that shifts the place of articulation of /ɑ/ to a front [æ] when it appears before a dental or retroflexed C before a word-final high vowel (497) • Yapese also has a rule of final short vowel deletion accompanied by compensatory lengthening that feeds fronting • Fronting **overapplies** in reduplicated word forms (498)

(497)	a.	/ʔɑdi/	ʔæːd	'liver'	J72, J77
		/ʔɑdi-gu/	ʔɑdiːg		
	b.	/mɑ-ni/	mæːn	'closed'	J72
	c.	/mɑlu/	mæːl	'war'	J73
	d.	/jɑru/	jæːr	'knife'	J73

(498)	a.	/ʔɑru-j/	ʔɑruj	'to stir up, make cloudy, of water'	J112
	b.	/ʔɑru-ʔɑru/	ʔærʔæːr	'muddy, cloudy, of water'	J112

Yeri (Nuclear Torricelli; source: Wilson 2017) has a process of /e/-deletion before vowel-initial morphemes that **overapplies** in reduplication • This pattern was discussed in section 2.2.2.3

(499)	a.	w-nabe-nabe	REL-RED-good	'very good (food)'	W117
		w-ei-nabi-nab<e>-i	REL-PL-RED-good-PL	'(the) very good (ones)'	W118
	b.	w-lope-lope-n	REL-RED-big-SG.M	'a lot (of rice)'	W117
		w-ei-lopi-lop<e>-i	REL-PL-RED-big-PL	'very very big'	W118

Yoruba (Atlantic-Congo; source: Pulleyblank 1988, discussion in McCarthy and Prince 1995) has a process of denasalization of [n] to [l] before non-high vowels that is fed by vowel deletion • In reduplication, denasalization optionally **overapplies** in connected speech

(500)	a.	/ni-irun/	nírun	'have hair'	P251
		/ni-owo/	lówó	'have money'	P251
		/oni-bata/	oníbàtà	'shoe; shoemaker'	P239
		/oni-epo/	elépo	'palm-oil; palm-oil seller'	P239
	b.	/RED-ni-owo/	níní owó (slow speech), lílówó (connected speech)	'having money'	P266

6.1.3 Summary

The table in (501) sums up the various processes and interaction types included in the sample presented above. There are no clear correlations between the type of process (V and C alternations), the type of trigger (phonological, morphological), and the tpye of interaction.

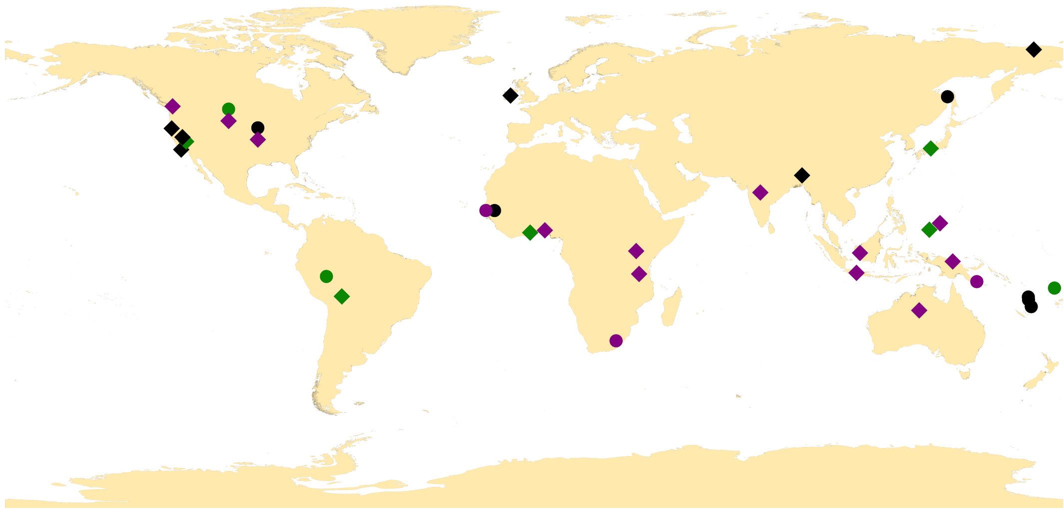
It is thus not the case that, say, V mutation is overwhelmingly more likely to overapply than C mutation, or that mutation induced by prefixes tends to be more local than mutation triggered by suffixes.

(501) *Processes and interaction types in the 35 languages sample*

Language	Process	Trigger	Type
Akan	*Palatalization*		UNDER
Chukchee	*Apocope*		LOCAL
Chumash (Ineseño)	*Onset formation*		OVER
	Glottalization		OVER
	l-deletion		OVER/UNDER
Fox	*V mutation*	Suffixes	LOCAL
	Raising		OVER
Hehe	*Glide formation*		OVER
Indonesian	*Nasal substitution*		OVER
Irish (Old)	*Lenition (phonological)*		LOCAL
Japanese	*Denasalization*		(OVER)
	Nasalization		(UNDER)
Javanese	*V rounding/advancing*		OVER
	V laxing/retraction		OVER
Karuk	*Epenthesis*		LOCAL
Kulina	*V mutation*	Suffixes	UNDER
Lakota	*V mutation*	Suffixes	UNDER
	C deletion/modification		LOCAL
	Palatalization		OVER
Maragoli	*Glide formation, V deletion*		OVER
Nivkh	*C mutation*	Reduplication	LOCAL
Paamese	*C mutation*	Prefixes	LOCAL/UNDER
Paiute (Southern)	*Nasalization*		UNDER
Palauan	*V reduction*		UNDER
Pulaar	*C mutation*	Prefixes	LOCAL
Rabha	*Dissimilation*		LOCAL
Raga/Hano	*C mutation*	Preceding suffixes	LOCAL
Rotuman	*V mutation*	Phase	UNDER
Sanskrit	*Retroflexation*		OVER
Seereer-Siin	*C mutation*	Prefixes	OVER
Sesotho	*C mutation*	Prefixes	OVER
Squamish	*/i/-lowering*		OVER
Sye	*C+V mutation*	Prefixes	LOCAL
Tawala	*V mutation*	Suffixes	OVER
	V elision		OVER
Mojeño Trinitario	*V deletion*		UNDER
Warlpiri	*Harmony*	Roots	UNDER
		Suffixes	OVER
Washo	*Coda devoicing*		LOCAL
Yapese	*Fronting*		OVER
Yeri	*/e/-deletion*		OVER
Yoruba	*Denasalization*		OVER

The map in (502) shows the areal distribution of the languages included in the sample. Overall, the three interaction types are fairly equally distributed across language families and macro-areas. The map reveals a slight tendency for overapplication in Sub-Saharan Africa and Oceania/Papunesia as well as an inclination towards underapplication in South America. Map created with R version 3.4.4 (R Development Core Team 2018), script courtesy of Hans-Jörg Bibiko.

(502) *Underapplication (green), overapplication (purple) and local application (black). Circles indicate mutation and squares indicate other processes.*



It should be stressed this survey has certain limitations and one should be careful not to draw any unwarranted conclusions from it. Any further research on this topic needs to bear in mind that there are three fallacies which complicate typological work in this area. The first issue is data sparseness: while grammars sometimes give very detailed descriptions of how reduplication and other processes behave in isolation, they rarely go into detail about how they interact with each other. Second, there exists a striking descriptive bias towards overrepresenting opaque interactions. It seems that transparent interactions are often assumed to be the default case even in the descriptive literature, which is why they tend to be discussed less often and less explicitly than over- and underapplication. Moreover, cross-linguistic studies on this topic may focus on only one type of interaction (e.g. the list of overapplication patterns in appendix B of McCarthy and Prince 1995). Third and finally, over- and underapplication are sometimes just two sides of the same coin, and identity effects can be plausibly analyzed as one or the other depending on the analysis of the processes involved. Nevertheless, I hope that the survey will still be useful in that it inspires future research in this field of inquiry.

6.2 Directions for future research

This section discusses more empirical and theoretical issues that could not be addressed in this dissertation but deserve further scrutinization in the future.

6.2.1 Tonal mutation

This thesis has focussed on the interaction between reduplication and segmental mutation. A related field that deserves further attention in the future is the interaction between reduplication and tonal mutation. In order to gain an understanding of this interaction, however, one first needs to ask what conditions the tonal shape of reduplicated forms outside of mutation contexts. In general, two patterns can be distinguished: tonal identity and tonal non-identity. Myers and Carleton (1996) argue that tonal identity between base and reduplicant ("tonal transfer") is the default case in full verb reduplication and partial noun reduplication in Chichewa unless the resulting structure would violate some general high-ranked constraint on the distribution of tones in the language. Li and Thompson (1981) observe that reduplicants of monosyllabic verb stems in Mandarin Chinese are generally toneless while repetition of verb phrases (which may be as small as a single verb) yields copies with identical tone patterns. More languages with patterns of tonal (non-)identity in reduplication are listed in (503). Alternations between faithful and non-faithful reduplicant tones are not uncommon; one case in point is Bari, where reduplicant tones may or may not be identical to base tones depending on the tonal properties of the base (504). Languages in which the same reduplicative morpheme sometimes shows identical tones and sometimes does not are classified as "non-identical" here.

(503) *Segmental and tonal identity*

Language	Family	Size	ID(S)	ID(T)	
Akan	Atlantic-Congo	varies	✘	✘	Ofori (2013)
Koasati	Muskogean	CV-	✘	✘	Kimball (1985)
Bari	Nilo-Saharan	CV-	✓	✘	Yokwe (1987)
Hup	Nadahup	varies	✓	✘	Epps (2008)
Lao	Tai-Kadai	full	✓	✘	Enfield (2007)
Ts'ixa	Khoe	full	✓	✘	Fehn (2014)
Kurtöp	Sino-Tibetan	full	✓	✓	Hyslop (2017)
Ma'di	Nilo-Saharan	full	✓	✓	Blackings and Fabb (2003)

(504) *Reduplication in the Bari non-past*

a. Pòní là-lák 'Poni unties it.'

b. Pòní nyé-nyér 'Poni cuts it.' (Yokwe 1987: 93)

Non-identity may be caused by non-copying of base tones. In Akan, an underlying L tone associates to the leftmost stem mora and spreads to the rightmost stem mora ((505)-a). L also associates to the leftmost mora of reduplicated stems but spreading onto the base is blocked, leading to insertion of a polar H tone ((505)-b). Attenuative reduplication in Lao ((506)-a) copies all base segment but drastically simplifies the prosodic features of the reduplicant, including shortening of vowels and loss of tones. Intensive reduplication ((506)-b), however, copies all base segments and overwrites the final tone of the reduplicant with a fixed 2 tone. This is consistent with an analysis that assumes no copying of tones, resulting in toneless copies unless the reduplicative morpheme contains a tone on its own which docks onto the reduplicated segments.

(505) *Reduplication in Akan*

		'sprout, thrive'	'draw'	
	a.	fɛ̀	sàǹ	
	b.	fì-fɛ́	sìǹ-sáń	(Ofori 2013)

(506) *Attenuative (a.) and intensive (b.) reduplication in Lao*

a. *hùan² phen¹ sung-suung³*
house 3 RED-high
'His house is tallish.' (Enfield 2007: 254)

b. *man² [jaak⁵-paj²]-[jaak⁵-paj³]*
3 [RED]-[want-go]
'He really wanted to go.' (Enfield 2007: 255)

Other languages attests perfect tonal transfer, as shown by the Ma'di data in (507). Any theory of reduplication thus needs to account for why tones are copied in some but not all languages. In autosegmental theories built around melody copying, tonal non-transfer is predicted to be the default pattern. Base-driven theories such as BMR and MDT, on the other hand, predict that the reduplicant is identical to the base (barring further independent modifications), which entails full copying of all (associated) base tones. In derivational frameworks such as ESC, both patterns can be captured by different orderings: tonal transfer arises when tones are associated to the copied TBUs at the time of reduplication while tonal non-transfer arises when tones are underlyingly floating and associate to the base TBUs only after reduplication has taken place. The powerful machinery of BRCT also predicts both patterns by virtue of BR-FAITH and tonal markedness constraints. However, tonal non-identity may also be driven by a number of independent factors: Apart from non-copying, possible sources include TETU effects, fixed tones, boundary tones, and the interaction of reduplication with independent processes. Moreover, GNLA straightforwardly predicts reduplication to as a repair for floating tones, a potential field of interaction that has attracted surprisingly little attention (one exception being the discussion of Chichewa by Downing 2018).

(507) *Ma'di full reduplication*

a.	ājísé-ājísé	'green (grass-grass)'	(Blackings and Fabb 2003: 41)
b.	àʔú-élé-àʔú-élé	'yellow (hen-egg-hen-egg)'	(ibid, 41)
c.	àlí-àlí	'shortish (short-short)'	(ibid, 105)

The interaction of reduplication and morphological tone still awaits systematic and rigorous examination. Let us briefly consider the case of Ma'di, which shows two intricate types of interactions. Abstract nouns in Ma'di are formed by imposing a ML pattern on nominal and adjectival roots (508). When a reduplicated word form undergoes abstract noun formation, tonal overwriting applies to the whole reduplicated form (508-c). In other words, abstract noun formation affects reduplicated forms in the same way as other word forms and is blind to their internal morphological structure, a situation reminiscent of Swati and related Bantu languages, where reduplicated stems are treated as single domains for the relevant tonal processes (Downing 2003).

(508) *Ma'di abstract noun*

a.	àlí	'short'	ālì	'shortness'	(ibid, 97)
b.	péléré	'clean'	pēlērè	'cleanness'	(ibid, 97)
c.	àlí-àlí	'shortish'	ālī-ālì	'shortness'	(ibid, 98)

The data in (509) show a different reduplication pattern in the same language. Reduplication with subsequent overwriting of the tones in the second copy by an HM pattern gives the reading of 'an individual from a set of x'. In this case, tonal overwriting only affects one constituent, and the tonal changes are not copied onto the other constituent.

(509) *àlí álī rɨ̀ ɔ̀nʤɨ́*
short:SG short.ones DEF bad:SG
'The shorter ones are bad.' (ibid, 98)

Overall, the interaction between tone and reduplication is still poorly understood, but it will present a promising avenue for future research which will potentially hold important theoretical implications.

6.2.2 Templatic backcopying

The main insight of Saba Kirchner (2010, 2013) and Zimmermann (2013a, 2017a) is that predictable allomorphy involving reduplicative and non-reduplicative allomorphs (length manipulation, stress shift, epenthesis) follows from affixation of empty prosodic nodes. What still needs further exploration is the question of how reduplication interacts with other morphological prosodic processes.[123]

There are a few reported cases of templatic overapplication, i.e. cases where a templatic restriction that holds on a reduplicant is also imposed on a base. Caballero (2006) discusses the case of Guarijio (Uto-Aztecan), where the reduplicant adheres to a CV template and, interestingly, the base in reduplicated forms is also shortened to CV (510). Caballero claims this is due to phonological backcopying as predicted by BRCT. The Guarijio reduplication data are amenable to reanalysis in terms of a prosodically defective circumfix consisting of two components: a prefixal part that triggers reduplication and a suffixal part that causes truncation. The fact that there is a clear size difference between the reduplicated portion (μ) and the truncated chunk (up to 2 σ in the given data set) suggests that the prefixal and the suffixal components contain different prosodic nodes. This should make it possible to derive both reduplication and truncation as different repair strategies under the same grammar (see Trommer and Zimmermann 2014 and Zimmermann 2017a on how subtractive morphology follows from affixation of defective prosodic nodes). Alternatively, it does not seem implausible to assume that only a single Φ is prefixed, which, to comply with foot minimality,

[123]Out of the five languages analyzed in this thesis, only one, Seereer-Siin, displays phonemic length; I am not aware of any MLM operation in Seereer-Siin that targets deverbal agent nouns.

triggers reduplication of the first stem syllable and at the same time links to the base σ, causing non-interpretation of all structure dominated only by the underlying stem foot.

(510) *CV-reduplication and truncation in Guarijio* (Caballero 2006: 278)

a.	toní	to-tó	'to boil / to start boiling'
b.	sibá	si-sí	'to scratch / to start scratching'
c.	suhku	su-sú	'to scratch body / to start scratching the body'
d.	muhíba	mu-mú	'to throw / to start throwing'

Another purported case of templatic backcopying is Tonkawa (†, isolate). As in Guarijio, the reduplicant in Tonkawa is a prefix with a fixed CV shape ((511)-ab). When reduplication targets a stem with a long vowel in the initial syllable, that long vowel shortens, giving the impression of backcopying ((511)-cd).

(511) *CV-reduplication and shortening in Tonkawa*

a.	topoʔs	to-topoʔs	'I cut it'	
b.	salkoʔs	sa-salkoʔs	'I pull'	
c.	naːtoʔs	na-natoʔs	'I step on it'	
d.	soːpkoʔ	so-sopkoʔ	'he/I swell(s) up'	(Gouskova 2007: 369)

However, Tonkawa also has a general process of second-syllable shortening that applies when a CVː-initial stem combines with a CV-sized prefix (512). Gouskova (2007) argues that this shortening falls out from general metrical constraints in the language which require exhaustive footing, trochaic feet, and adherence to the Weight-to-Stress Principle (WSP, Prince 1991). Thus, /xa-kaː-na-oʔ/ can only yield (ˈxaka)(ˈnoʔ) but not (ˈxakaː)(ˈnoʔ) (violates the WSP) or (xaˈkaː)(ˈnoʔ) (contains a iambic foot).

(512) *Shortening after CV prefixes* (Gouskova 2007: 371)

a.	/xa-kaː-na-oʔ/	(ˈxaka)(ˈnoʔ)	'he throws it far away'
b.	/ke-jaː-loːna-oʔ/	(ˈkeja)(ˈloː)(ˈnoʔ)	'he kills me'
c.	/ke-taː-notoso-oʔ/	(ˈketa)(ˈnot)(ˈsoʔ)	'he stands with me'
d.	/we-seːl-oʔs/	(ˈwesʔe)(ˈlʔoʔs)	'I scratch them'

The data so far are ambiguous between regular second-syllable shortening and backcopying.[124] Gouskova argues that the latter option is supported by word forms in which a reduplicated stem is preceded by another prefix. In such cases, the base vowel is shortened, too (513). Unlike in second syllables, there is no general ban on long vowels in the third syllable in Tonkawa. The fact that shortening exceptionally applies to base material would then be easily captured by attributing length identity to BR-FAITH constraints compelling backcopying.

(513) *Third-syllable shortening* (Gouskova 2007: 382f)

a.	jaː-tsoʔs	he-ja-jatsewoʔs	'I see him/several look at it'
b.	mʔeːjtsoʔ	he-mʔe-mʔejtsoʔs	'he/I urinate(s)'

[124] Gouskova (2007: 374) claims that "[t]he terms 'underapplication' and 'overapplication' are due to Wilbur (1973) [= Wilbur (1973b)]", a statement that has also been formulated by Pylkkänen (1999) using almost the exact same wording. In fact, at no point do Wilbur (1973a) or Wilbur (1973b) use the term 'underapplication'; instead, they choose the phrase 'failure of (a) rule' to refer to exceptional non-application of a rule.

Since Tonkawa is by now extinct, it is not possible to assess the synchronic productivity of this type of reduplication, which is variably glossed as repetetive, continuative, or not at all in Gouskova (2007). But even if the data and the descriptive generalizations are correct, second and third-syllable shortening would also follow from a derivational account that assumes that the (inner) reduplicative prefix is added at an earlier point than the remaining (outer) prefixes. The level 2 prefixes would then come too late to block shortening of the base syllable which has already undergone regular shortening at the time the reduplicative prefix is introduced at level 1. Such a derivational analysis is sketched in (514).

(514) *Transparent shortening and counterbleeding opacity in Tonkawa*

	LEVEL 1 *2nd σ shortening*	LEVEL 2	
/topoʔs/	to-topoʔs		'I cut it
/jaː-tsoʔs/	ja-jatsewoʔs	he-ja-jatsewoʔs	'I see him/several look at it'

The case of Tonkawa holds some additional complications with respect to other stress-related processes such as syncope, none of which, however, devalidate the basic logic that a derivational account is equally well-suited to account for the apparent "backcopying" effect as a BRCT-style analysis. The nature of the interaction between reduplication and other instances of prosodic morphology and their theoretical implications deserve more attention in future research.

6.2.3 The limits of Stratal Containment

Rebirthing and deletion One of the central theoretical claims in this dissertation is the absence of interstratal deletion of invisible material, a principle I term FULL REBIRTHING. I have argued that FULL REBIRTHING is not only more consistent with the overall architecture of ESC. It is also empirically motivated by the interaction of mutation and independent processes in Seereer-Siin, Fox, and Lakota. FULL REBIRTHING is radically different from what has been assumed in much work on Lexical Phonology. This raises the question of how FULL REBIRTHING can be reconciled with the accumulated evidence in favor of post-cyclic Stray Erasure. One answer could be that FULL REBIRTHING is not a universal principle but a language-specific parameter such that certain languages apply FULL REBIRTHING after certain strata while others apply simple REBIRTHING. A perhaps less stipulative solution would be to abandon Containment Theory and allow GEN to delete phonological nodes. The obvious model to choose would be Correspondence Theory, which provides much finer control over the interstratal transmission of floaters because it decouples penalties for floating from penalties for deletion.[125] Adopting such an approach would be possible without losing the basic insight that reduplication is a phonologically driven repair process. Thus, Saba Kirch-

[125]The intuition that FULL REBIRTHING needs some additional fine-tuning is further nourished by reports of languages that seem to retain floating material in some but not all contexts. Thus, Michaud (2017) argues that floating tones in Yongning Na are regularly deleted at the end of an evaluation domain. In certain environments, however, a floating lexical H tone reveals itself by lowering following tones across a phrase boundary (p. 313). If Michaud's analysis is correct, the tonology of Yongning Na provides an argument for stratal grammars that differ in whether they allow deletion of phonological nodes.

ner (2010) and Zimmermann (2017b) have argued for a version of Correspondence Theory which crucially abandons the notion of a RED morpheme and instead implements copying as phonological fission.

However, it is well possible that Containment Theory already comes with technical devices that is powerful enough to mimic true deletion in Correspondence Theory by distinguishing visible and invisible association lines as well as pronounced and unpronounced nodes. This way, much of the "evidence" for true deletion in the literature becomes less convincing. For example, Clark (1990) proposes a cyclic rule of "free feature deletion" that deletes unassociated tones in Igbo. Clark motivates the rule by examples such as (515), where the H tone from the imperative suffix is not realized because the final vowel is associated to a low tone underlyingly. In addition, Igbo also has a rule of L-deletion that is responsible for the loss of L in the first syllable and subsequent default H-insertion. In both cases, nothing crucially hinges on the stipulation that the relevant tones are truly deleted – if the H tone from the suffix simply remains floating, and the line between the L tone and the TBU in the initial verb root is marked as invisible, and the TBU then links to an epenthetic H tone, phonetic spell-out will yield the exact same surface form as under an analysis that assumes deletion.

(515) *wéfụ̀*
wè -fụ̀ -H
pick.up -go.out -IMP
'take out!' (Clark 1990: 33)

It thus remains an open question whether the true empirical situation can indeed be characterized as such that floating material introduced at a given point in the derivation may either associate, remain dormant until later in the derivation, or be deleted. One type of evidence that would prove problematic for a Containment-based version of FULL REBIRTHING could come from languages in which unpronounced material is retained at one lexical level but is fully erased at another lexical level, or from languages in which only certain nodes are preserved while others are fully removed. Strata-depending phonetic effects, however, do not necessarily belong to this group of evidence. For instance, Zsiga (1995) discusses two guises of palatalization in American English: caterogical palatalization at the lexical level (*confess/confession*) and gradient optional palatalization at the postlexical level (*confess/confess you*). The palatalization data present a convincing argument for a general distinction between lexical and post-lexical phonology but are ill-suited to convince a proponent of Containment of the necessity of true deletion. This is because, as suggested by Zsiga herself, palatalization on the lexical level operates on different features than postlexical palatalization: the former can be analyzed as spreading and delinking of a coronal place feature while the latter is best represented in terms of partially overlapping articulatory gestures. Since gestures are always gradient, the fate of the unpronounced material from the lexical level is irrelevant in account for the two different types of palatalization. However, if more pressing evidence of the kind sketched above should indeed exist, it would be an interesting endeavor to try and determine whether a version of ESC can be developed that attains the required degree of control while retaining the other advantages of Containment Theory.

Association lines Barring the question of phonological node deletion, another radical innovation in my version of ESC is the treatment of assocation lines. Recall that I assume that assocation lines store information about the relation between two nodes (pronounced vs. unpronounced) and the (underlying vs. epenthetic). Crucially, once GEN inserts an epenthetic line or turns a pronounced line into an unpronounced one, the updated line status cannot be modified further and is retained across all subsequent strata. As shown in section 4.1, this grants the required look-back powers to the phrase-level phonology to distinguish between underlying and derived mid vowels in Lakota. One might find it worrying that these look-back powers would in principle allow the phrase-level phonology to detect phonological insertion in the most deradical cycle, which would be a gross violation of inward cyclic locality.[126]

Two comments are due as a response to such criticism. First, FULL REBIRTHING of lines is already a very modest look-back device. It does not store any information about on which level a line was modified. Also, at no point does the phonology have access to the information how deletion or insertion of a line affected the harmony score of a given candidate. Moreover, it fully complies with bracket erasure due to merging of morphological colors just like Trommer's REBIRTHING.

Second, one encounters even more dramatic cases of extensive look-back once one leaves the realm of segmental mutation and enters the empirical field of grammatical tone. Consider the case of Buli (Gur) in (516) below (data from Akanlig-Pare and Kenstowicz 2002 and Schwarz 2004). Buli attests a phrase-final low boundary tone (L%) that overwrites high affix tones, e.g. the H tone on the various plural suffixes in (516).

(516) *Phrase-final L% on high suffix vowels* (S41f)

a.	léé-bà	'daughters'
	léé-bá bà-yɛ̀	'two daughters'
b.	bí-sà	'children'
	bí-sá-ŋá	'the children'
c.	dáá-tà	'beers'
	dáá-tá kāʔ	'there are no beers'

Buli also has a process of vowel epenthesis that inserts a copy of the last root vowel after C-final roots. Although this process is optional, it has to be lexical because it also applies to suffixed root forms that do no longer meet the structural requirement for epenthesis at the postlexical level (517).

(517) *Root-final epenthesis* (A60)

a.	núr(ú)	'person'
b.	núr(ú)-wá	'the person'
c.	núr(ú)-bà	'persons'
d.	núr(ú)-má	'the persons'

[126] One way to restrain backtracking would be phonological buffers that preserve information about line status for a fixed number of cycles before merging epenthetic lines with non-epenthetic ones (see Müller 2016 for a related proposal in syntax). While it would be technically feasible to apply this idea to the Lakota data, arbitrarily assigning "expiration dates" for line status seems rather ad-hoc and the success of such an enterprise would depend heavily on the number of cycles and strata that one assumes for a given analysis.

The low boundary tone interacts in interesting ways with vowel epenthesis. The main point to note here is that L% fails to be realized on epenthetic vowels: a spread H tone from the root cannot be overwritten by L% if it has spread onto an epenthetic vowel (518). This is surprising because under standards assumption about cyclic locality, the phrasal phonology should not be able to distinguish between underlying and deradical epenthetic material and thus not treat them differently. However, this is exactly the kind of effect that is predicted under FULL REBIRTHING. By virtue of non-merging of association lines, epenthetic lines inserted in the most deradical cycle can still be identified as such by the phrase-level phonology.

(518) *Blocking of L% by epenthetic vowels*

UR	SL OUT	WL OUT	PL OUT		
kɔ́k	kɔ́k	kɔ́k-sá	ká kɔ́k-sà L%	'They are mahagoni trees.'	S42
júm	júm	júm-á	júm-à L%	'Fish.PL.'	S43
núr	núr u	núrú	núrú	'Person.'	A60

Thus, there seems to be real empirical warrant for line preservation as stated by FULL REBIRTHING. But even if one finds the given examples wanting, the danger of overgeneration does not necessarily have to be a fallacy. The fact that empirical support for FULL REBIRTHING of association lines is currently scarce may be due to the fact that data that could further substantiate it are still awaiting discovery.

Morphological and prosodic constituency Another interesting avenue for future research are morphologically complex reduplicants and the question how strata relate to morphological constituents in general. Copying of heteromorphemic material is possible in BMR and the necessity for such a mechanism was demonstrated for the case of Fox in chapter 3. In Fox, however, the copied material are introduced at the same stratum as the reduplication trigger. A striking example of reduplication that seems to defy stratal domains comes from Ndebele (Bantu), as discussed in Sibanda (2004), Inkelas and Zoll (2005), Hyman et al. (2009), and Inkelas (2014). In Ndebele, reduplicants strictly obey a disyllabic template. When the verb root is two syllables or longer, only root material is copied ((519)-a). When the verb root is shorter and followed by derivational suffixes, the template is met by copying both root and suffix material ((519)-b). If the verb root is monosyllabic and followed by inflectional suffixes, however, a default vowel is inserted to meet the template ((519)-c). So far, the Ndebele data look like a good candidate for a stratal approach: if reduplication and derivational affixes are located at the stem level, and inflectional markers as well as the infinitive prefix are word-level affixes, failure to copy the latter falls out naturally as a counterfeeding effect.

(519) *Word-level affixes are not reduplicated in Ndebele* (Inkelas 2014: 158)

a.	uku-nambith-a	uku-[nambi]-nambith-a	‘INF-RED-taste-FV’
	uku-bonakel-a	uku-[bona]-bonakel-a	‘INF-RED-appear-FV’
b.	uku-lim-el-a	uku-[lime]-lim-el-a	‘INF-RED-cultivate-APPL-FV’
	uku-lim-is-a	uku-[limi]-lim-is-a	‘INF-RED-cultivate-CAUS-FV’
c.	uku-lim-a	uku-[lim-a]-lim-a	‘INF-RED-FV-cultivate-FV’
	uku-lim-e	uku-[lim-a]-lim-e	‘INF-RED-FV-cultivate-SUBJ’
	uku-lim-ile	uku-[lim-a]-lim-ile	‘INF-RED-FV-cultivate-PERF’
	uku-thum-e	uku-[thum-a]-thum-e	‘INF-RED-FV-send-SUBJ’
	uku-thum-ile	uku-[thum-a]-thum-ile	‘INF-RED-FV-send-PERF’

Upon closer inspection, a stratal approach is not so straighforward, however. The major complication is that reduplication may optionally ignore the presence of certain affixes. Thus, derivational suffixes such as *-el* may not be copied, which is why there exists an alternative form *lim-a-lim-el-a* with an epenthetic vowel next to *lime-lim-el-a* with a copied vowel ((519)-b). Vowelless roots “show a dazzling variety of reduplication possibilities” (Hyman et al. 2009: 285), as illustrated in (520). Ndebele allows to fill the template by inserting a dummy vowel *a*, a dummy syllable *yi*, copying of suffixal material, and combinations thereof. When a subminimal root is combined with an object-agreement prefix, the reduplicative morpheme may be right-aligned with the verb root, resulting in non-copying of the object marker ((520)-c), or right-aligned with the object marker, resulting in copying of the agreement-root complex ((520)-d). And while SOT in principle allows for selectionally underspecified affixes (Kiparsky 2015: 8), it is not obvious if this could account for the whole range of data or which (potentially problematic) predictions would follow from overabundant stratal underspecification.

(520) *Consonantal roots and stem-level suffixes* (Hyman et al. 2009: 285–288)

a.	uku-dl-a	uku-[dl-a-yi]-dl-a	‘INF-RED-FV-*yi*-eat-FV’
b.	uku-dl-el-a	uku-[dl-el-a]-dl-el-a	‘INF-RED-FV-eat-APPL-FV’
	uku-dl-el-a	uku-[dl-a-yi]-dl-el-a	‘INF-RED-FV-*yi*-eat-APPL-FV’
	uku-dl-el-a	uku-[dl-e-yi]-dl-el-a	‘INF-RED-*yi*-eat-APPL-FV’
c.	uku-zi-dl-el-a	uku-zi-[dl-el-a]-dl-el-a	‘INF-CL.10-RED-FV-eat-APPL-FV’
	uku-zi-dl-el-a	uku-zi-[dl-a-yi]-dl-el-a	‘INF-CL.10-RED-FV–*yi*-eat-APPL-FV’
	uku-zi-dl-el-a	uku-zi-[dl-e-yi]-dl-el-a	‘INF-CL.10-RED-*yi*-eat-APPL-FV’
d.	uku-zi-dl-el-a	uku-[zi-dl-a]-zi-dl-el-a	‘INF-RED-FV-CL.10-eat-APPL-FV’
	uku-zi-dl-el-a	uku-[zi-dl-e]-zi-dl-el-a	‘INF-RED-CL.10-eat-APPL-FV’

Another language in which morphological constituency delineates domains for the interaction between reduplication and other processes is Klamath (Penutian). Klamath has a process of vowel reduction/syncope that affects the second syllable from the left in certain derived stems ((521)-a). However, reduction is not observed with reduplicated stems ((521)-b).

(521) *Vowel reduction underapplication in Klamath* (Inkelas and Zoll 2005: 113, citing Barker 1963)

a.	domna	so-dəmna	'REC-hear'
	čonwa	hos-čənwa	'CAUS-vomit'
	wp'eq'a	ʔi-pq'a	'PFX-apply.to.face'
b.	beq'-l'i	beq-beq-l'i	'RED-be.bay.colored-SFX'
	Liw'-a	Liw-Liw'-a	'RED-shiver-SFX'

McCarthy and Prince (1995) claim that underapplication of vowel reduction is the result of BR-FAITH. An opposing view is entertained in Inkelas and Zoll (2005), who argue that application of vowel reduction depends on the morphological constituency of the verb complex (522). They provide further evidence for this analysis, including underapplication of syncope in root-suffix combinations and non-underapplication in cases when a reduplicated stem is preceded by outer prefixes. If the intensive construction is coupled with a non-reducing cophonology and the causative construction with reducing cophonologies, the different effects of the affixes are covered for.

(522) *Klamath verb complex* (Inkelas and Zoll 2005: 114)

-5	-4	...	-1	0	+1
DISTR	CAUS, REC	...	INTENS (= RED)	*root*	SFX
			[*No reduction/syncope*]		
	[	*reduction/syncope*		]	

The cophonology analysis does not easily translate into a stratal account. If the intensive is reanalyzed as a stem-level affix and the stem-level phonology protects vowel features, and the causative is reanalyzed as a word-level affix and the word-level phonology favors reduction, it is not obvious what blocks reduction from affecting reduplicated stems at the word level. It would be interesting to see if a tighter coupling of prosodic and morphological constituency might help provide a solution to this issue.

Chapter 7

Summary and Conclusion

In this dissertation, I have explored three types of opaque interactions between reduplication and segmental mutation: overapplication (including "backcopying" of mutation from a reduplicant to a base), underapplication (or "blocking" of mutation in the presence of reduplication), and alleged cases of morphologically governed allomorphy selection. Superficially, all three interaction types seem to suggest a strong involvement of the morphological component. Overapplication and underapplication could be analyzed as identity effects enforced by constraints indexed to a reduplicative morpheme. Suppletive allomorphy is consistent with morphological doubling in reduplicative constructions.

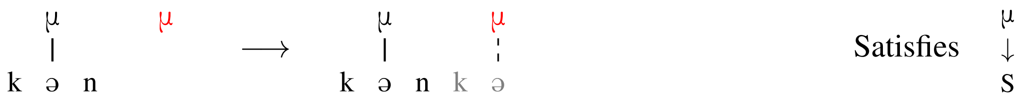
The claim that I have defended in this dissertation is that all three types of interactions are derivable in a modular framework that assumes a strict division of labor between the phonological component and other parts of the grammar. The theory that I have proposed to account for all three interaction types builds on the main insights of Generalized Non-linear Affixation (Bermúdez-Otero 2012, Trommer and Zimmermann 2014) and was motivated in detail in chapter 2. I proposed a number of modifications to the theory of Extended Stratal Containment (Trommer 2011). The main innovation is the notion of FULL REBIRTHING, which confines inter-stratal "clean-up" to morpheme colors (Bracket Erasure) but crucially excludes deletion of unpronounced nodes or lines (Stray Erasure). FULL REBIRTHING has far-reaching consequences for any theory that assumes autosegmental representations and a derivational feed-forward architecture of grammar. One of the empirical arguments for FULL REBIRTHING comes from exceptional devoicing in Seereer-Siin singular agent nouns which I analyze as an instance of counterfeeding opacity; the crucial set of data are repeated in (523) below. I assume that the initial obstruents in the verbal root /pind/ in (523) are underlyingly voiceless. Voicing is induced by a [v] feature from the infinitive morpheme which is introduced at the stem level but is prohibited from linking to a segmental node by the stem and the word level phonologies. The [v] is still floating when reduplication applies at the word level and can get realized only at the phrase level, where it is singly linked to the base C. Since there are no Base-Reduplicant faithfulness constraints, voicing is not copied onto the reduplicant C.

(523) *Derivational history of singular agent nouns* (cf. (170))

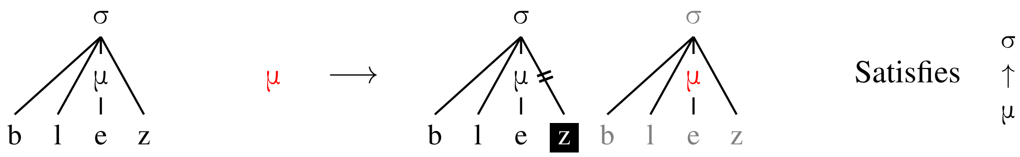
SL *in*	SL *out*	WL *in*	WL *out*	PL *in*	PL *out*	
p$_{[v]}$ind	p$_{[v]}$ind	o $_{[-c]}$ $^{\mu\ \mu}$ p$_{[v]}$ind	o pi: p$_{[v]}$ind	opi:p$_{[v]}$ind	**opi:bind**	'writer'

Another innovation that I proposed is the theory of Bidirectional Minimal Reduplication. BMR builds on the idea of downward copying in Minimal Reduplication (Saba Kirchner 2010), which analyzes copying of segmental material as a repair operation to fill defective moras (524). Copying is optimal when the respective markedness constraint against unassociated moras, μ→ •, outranks INTEGRITY. BMR adds an important tweak to this theory: markedness constraints may not only be downward but also upward. Upward constraints drive copying of larger prosodic constituents, including the famous case of full-syllable copying, as attested in Lakota (525).

(524) *Downward copying* (= (13))



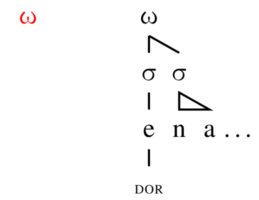
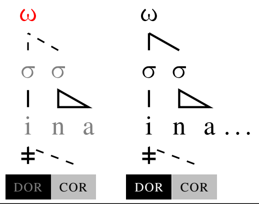
(525) *Upward copying* (cf. (296))



In chapter 3, I discussed two cases of overapplication: optional morphological backcopying in Seereer-Siin and seemingly unmotivated word-medial raising in Fox. I reanalyzed the overapplication data in Seereer-Siin as a markedness effect, starting from the very general observation that the sound inventory of the language strongly prefers non-continuant obstruents over fricatives. Outside of reduplication, the relevant markedness constraint cannot be satisfied because conflicting constraints are ranked too high. Agent noun reduplication involves two differently colored continuants and a floating [-c] feature. This special configuration provides a loophole that the language can take advantage of to satisfy the markedness constraint against fricatives given the NCC is ranked sufficiently low.

In the case of Fox, the process of Initial Change always affects the first stem vowel. Since mutation and σσ reduplication apply on the same stratum and reduplication is prefixal, Initial Change mutates the vowel in the reduplicant but not the base vowel. Another process in Fox, word-initial raising, overapplies in the context of σσ reduplication. I argued that overapplication is optimal because raising applies to every phonological word and both base and reduplicant constitute separate ω domains (526).

(526) *Raising applies under each ω node* (cf. (255))

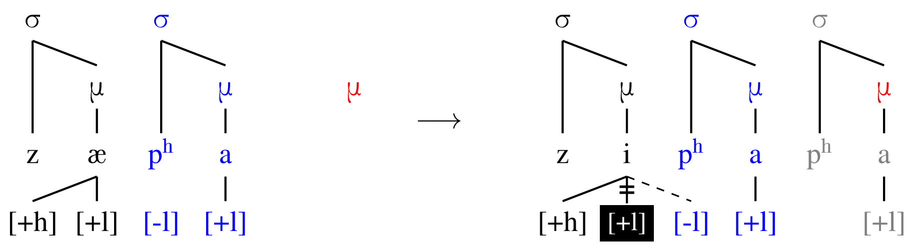
WL	Input = a.	ω[2σ]	*(μ • DOR)ω	MAX • DOR	DEP COR	INT σ
	a. 	*!	*			
☞	b. 			**	**	**

In chapter 4, I offered a phonological account of mutation underapplication in Lakota and Kulina. Although the misapplication patterns in the two languages differ considerably in their details, they both ultimately boil down to the assumption that reduplication is a repair-driven process that is governed by designated markedness constraints on association of phonological nodes. This key property of BMR correctly predicts that when a potential mutation target is conjoined with less triggers than usual in a reduplicated form, underapplication may become optimal. In Lakota, a defective μ is repaired by copying of a stem syllable to the exclusion of floating features. A single floating mutation trigger then faces the Too Many Targets Problem (527): realization of the floating feature becomes suboptimal when it does not help fully satisfy the constraint requiring • nodes to be linked to a certain class of features.

(527) *The Too Many Targets Problem* (= (16))
Let F be a feature that triggers a segmental alternation A and let T be a potential target for A. When there is an equal number of T's and F's, application of A is optimal. When there are more T's than F's, not applying A is optimal.

Underapplication in Kulina also falls out from the assumption of minimal copying. A reduplicated trigger affix loses its ability to induce mutation because what is copied are only segmental and prosodic nodes but not floating features (528). A loss of morphonological potential would be unexpected under theories assuming morphological identity.

(528) *Copying disarms mutation triggers*



Another noteworthy insight from the case studies on Kulina and Fox is that a certain prediction of BMR with respect to multiple reduplication is borne out: the presence of multiple reduplication triggers in parallel yields iterative non-recursive copying (Kulina) whereas a stratally diverse distribution of triggers yields recursive copying (Fox).

Syllable copying and underapplication in Lakota fill two gaps in the typology of markedness constraints that has largely been overlooked: if upward markedness constraints for features are needed to explain why floating features (F) strive to associate to a •, and if downward markedness constraints for prosodic nodes (ρ) are needed to derive minimal copying, we should also expect to find evidence for the opposite constraints. As seen in (529), these constraints are indeed well-motivated by the Lakota data.

(529) *Typology of upward and downward markedness constraints*

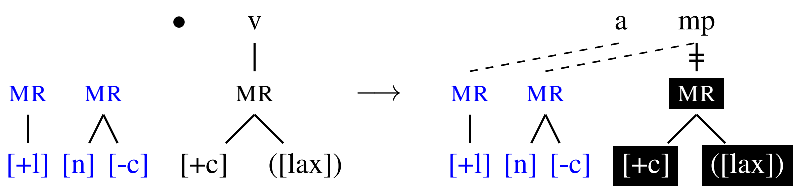
	↑	↓
• F	mutation	full specification
ρ ρ	full copying	minimal copying

In chapter 5, I addressed the issue of suppletive allomorphy in reduplication. Purported evidence for reduplicative constructions selecting divergent allomorphs have been one of the pinnacles of the morphological doubling hypothesis in Inkelas and Zoll (2005). I offered an in-depth analysis of the putative case of suppletion in Sye verb root alternations, which involve addition of a nasal element, a low vowel, and root-internal modifications (530). I argued for a unified account that succeeds at deriving the whole range of observed segmental alternations from a single underlying representation (531). Non-identity between base and reduplicant is the result of unexceptional local application of mutation. My account thus reconciles the case of Sye with theories of phonological copying.

(530) *Sye quirky mutation*

	BASIC	MUTATED	PATTERN	
a.	jep	jep	root	'descend'
b.	owi	nowi	/N/ + root	'plant'
c.	eti	anti	/a/ + /N/ + root + *deletion*	'give birth'
d.	vaŋ	ampaŋ	/a/ + /N/ + root + *mutation*	'eat'

(531) *Quirky mutation as realization of multiple features*



Transparent application is the default pattern expected from parallel application of copying and mutation. The reason for this is that the copy space in BMR is restricted to the input and material from the output cannot be selected for copying. The case studies of vowel and quirky mutation in Fox and Sye in sections 3.2 and 5.1 proved that this provision does indeed have welcome results.

The table in (532) offers an overview of the various environments that give rise to the three interaction types in the case studies discussed in the previous chapters.

(532) *Environments for transparent application and misapplication*

TRANSPARENT APPLICATION			
V mutation	Parallel application: Input-driven copying	*Fox*	Section 3.2
C/V mutation	Parallel application: Input-driven copying	*Sye*	Section 5.1
C mutation	REDUP. applies before MUT.	*Raga*	Section 5.2
C alternation	Parallel application: Base-driven copying	*Kawaiisu*	Section 5.2
OVERAPPLICATION			
C mutation	Markedness	*Seereer*	Section 3.1
V raising	Domain sensitivity	*Fox*	Section 3.2
C palatalization	REDUP. applies after MUT.	*Lakota*	Section 4.1
UNDERAPPLICATION			
V mutation	Trigger shortage: Too Many Targets	*Lakota*	Section 4.1
V mutation	Trigger shortage: Lossy Copying	*Kulina*	Section 4.2

While certain facets of transparent and overapplication are predicted by the derivational architecture of grammar, overapplication in Seereer-Siin and Fox emerge from the interplay of independent factors, viz. markedness asymmetries and domain-sensitivity. The same is true of the underapplication patterns, which fall out of the assumption that reduplication is minimal and floating material is usually not copied. Crucially, what all three interaction types have in common is that they are independently predicted by the pieced-based approach to non-concatenative exponence within the broader reserach program of GNLA pursued here.

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