Phonological Aspects of Western Nilotic Mutation Morphology

Habilitationsschrift
zur Erlangung des akademischen Grades Dr. phil. habil.

der Philologischen Fakultät der Universität Leipzig

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geb. 13.12.1970, Neustadt an der Waldnaab

angefertigt am Institut für Linguistik

Beschluss über die Verleihung des akademischen Grades vom: 24. Juli 2011

“Can there be any rebirth where there is no transmigration?”

“Yes there can”

“Just as a man can light one oil lamp from another
but nothing moves from one lamp to the other”

“Or as a pupil can learn a verse by heart from a teacher
but the verse does not transmigrate from teacher to pupil”

Chapter 1

Problems

It is the cornerstone of non-traditional linguistics that a lexicon of a language consists of arbitrary pairs of morphological and phonological representations: morphemes. In this book, I want to defend the hypothesis that the interface of Phonology and Morphology is essentially blind to this arbitrariness: Morphology is not allowed to manipulate the phonological shape of morphemes. Phonology is barred to access the identity and idiosyncratic features of morphemes. Morphology may not convey diacritic symbols to Phonology allowing to identify (classes of) morphemes, or control the operation of phonological processes for the sake of specific morphemes (see Scheer 2004, Bermúdez-Otero 2011, for similar positions). This excludes many theoretical devices which are standardly used to derive non-concatenative morphology:

Word Formation Rules (Anderson 1992): Morphological rules equipped with the full power of derivational phonological rules in classical Generative Phonology (Chomsky and Halle 1968).

Readjustment Rules (Halle and Marantz 1993, Embick and Halle 2005, Embick 2010): Phonological rules which are triggered by the morphosyntactic context and a standard means in Distributed-Morphology to capture ablaut and similar patterns.

Indexed Constraints (Pater 2006, 2007) Optimality-theoretic phonological constraints which are restricted to (induce constraint violations only for) specific morphemes.

Cophonologies (Inkelas and Zoll 2005): Optimality-theoretic subgrammars whose constraint ranking is determined idiosyncratically by specific morphemes.

Morphophonological Pheromones: The Red and Trunc morphemes of Generalized Template Theory (McCarthy and Prince 1994, 1995) whose only motivation consists in triggering copying or truncation in Phonology. Another case are the boundary symbols of Frampton (2010) which are generated by Morphology and trigger copying or metathesis operations in Phonology.

Put positively, I assume that Phonology has only access to very general grammatical information, boundaries of morphemes and morphological constituents (allowing the construction of prosodic element such as Phonological Words), the categorization of morphemes as roots/affixes (McCarthy and Prince 1995, Urbanczyk 2006), heads, adjuncts or complements of morphological constructions (Revithiadou 1999, Bachrach and Wagner 2007), and general levels of phonological stratification (Kiparsky 2000, Bermúdez-Otero 2011). In the framework I will assume in this book - a stratal and fully autosegmental implementation of the Colored Containment version of Optimality Theory (van Oostendorp 2006b, Revithiadou 2007), this means that the essential information phonology has about morphology is that underlying phonological material has specific colors which makes it possible to reconstruct whether two phonological entities are affiliated to the same morpheme or to different morphemes.

The empirical area of Nonconcatenative morphology I will affront is mutation morphology in Western-Nilotic, where I will understand 'mutation morphology' with Wolf (2005a, 2007) as comprising not only consonant mutation, but any morphologically induced phonological alternation which at a naive descriptive level targets segments: changes in vowel quality, segmental length and tone patterns, which are all abundantly documented in Western Nilotic as shown in (1) with examples from Thok Reel (Reid 2010):

(1) **Mutation Morphology in Thok Reel** (Reid 2010:29)

a. **Vowel Quality**

(i)	ɟɔ̤̂ːr	'forest:NOM:SG'	~	ɟâ̤ːr	'forest:NOM:PL'
(ii)	tèt	'dig:3SG'	~	tɛ́t	'dig:1SG'

b. **Tone**

(i)	cɔ́w	'husband:NOM:SG'	~	cɔ̀w	'husband:NOM:PL'
(ii)	nó̤ːːp	'send:AP:3SG'	~	nò̤ːːp	'send:3SG'

c. **Vowel Length**

(i)	gàt	'child:NOM:SG'	~	gàːːt	'child:NOM:PL'
(ii)	mí̤t̪	'feed:AP:3SG'	~	mì̤ːːt̪	'feed:3SG'

d. **Voice Quality**

(i)	ròːːk	'molar.tooth:NOM:SG'	~	rò̤ːːk	'molar.tooth:NOM:PL'
(ii)	nóːːŋ	'bring:AP:3SG'	~	nó̤ːːŋ	'bring:3SG'

e. **Stem-Final Consonant**

(i)	ɟíc	'belly:NOM:SG'	~	ɟît̪	'belly:NOM:PL'
(ii)	ré̤ːc	'rat:NOM:SG'	~	ré̤ːːj	'rat:GEN:SG'

In fact, Western Nilotic exhibits some of the most striking and complex patterns of mutation found in the languages of the world. Consider for example the "process" derivation in Anywa (Reh 1993:247-248) where verbs acquire an inchoative meaning by five logically independent phonological changes:[1]

- Non-liquid root-final consonants are nasalized
  (*cán*, 'be poor' ⇒ *c`ʌn*, 'become poor')
- Root-final consonants are geminated
  (*pǒːl*, 'be blunt' ⇒ *pòːlː*, 'become blunt')
- Verb roots adopt low tone
  (*ɟóːm*, 'be soft' ⇒ *ɟòːmː*, 'become soft')

[1]Note that gemination in Anywa does not generally trigger shortening of preceding vowels.

- Root vowels get [˧]
  (*pɔ́ːt̪*, 'be smooth' ⇒ *pɔ̀ːn̪ː*, 'become smooth')

- Non-mid root vowels are shortened
  (*dɪ̌ːɲ*, 'be narrow' ⇒ *dɪ̀ɲ*, 'become narrow')

The general approach to morphology I assume is what I call the *Concatenativist Hypothesis* stated in (2) (see Stonham 1994, Lieber 1992, Wolf 2007, Bye and Svenonius 2011, for related approaches):

(2) **The Concatenativist Hypothesis:**
Morphology = Concatenation + Suppletion + Phonology

In particular, I will assume with Bermúdez-Otero (2011) that 'nonconcatenative morphology' is the consequence of affixing 'defective' (or incomplete) phonological material which attaches to phonological material of the morphological base – Bermúdez-Otero calls this approach 'Generalized Nonlinear Affixation'. Thus I assume that the Anywa process morpheme contains i.a. a low tone and the feature [˧] which consequently show up on verb roots since the affix itself lacks adequate segmental (or prosodic) material which could serve as a host.

A potential danger the restrictiveness of Generalized Nonlinear Affixation faces is that incomplete phonological structure might be used diacritically by invoking constraints which specifically refer to (underlyingly) floating pieces of phonology. In this way, floating phonological material might be abused as a trigger for essentially morphological rules. To avoid this kind of arbitrariness, I assume the following theoretical meta-restriction:

(3) **No Explicit Floating:** No phonological constraint may refer specifically to floating structure (to phonological nodes not associated underlyingly to segments)

Mutation morphology in Western Nilotic (and more generally) raises three substantial empirical problems for the Concatenativist Hypothesis – especially from an optimality-theoretic point of view.

(4) **The 3 Big Problems**

- **The Overwriting Problem:** What does defective (floating) phonological material allow/force to "replace" corresponding phonological features which are preassociated to base segments (and protected by faithfulness constraints on association)?

- **The Inconsistency Problem:** Why does mutation morphology often show up in different forms in different contexts (e.g. as L-tones with H-tone bases and as H-tone with L-tone bases, cf. tonal polarity in Dinka discussed in chapter 5)?

- **The Divergence Problem:** Why do features involved in mutation morphology sometimes behave phonologically differently from features which are part of segmental affixes?

These problems will be the main topic of this book and will be introduced in more detail in the following four sections

1.1 The Overwriting Problem

Following the influential papers by Wolf (2005a, 2007), I will illustrate the Overwriting Problem with the classical case of featural consonant mutation from the Bantu language Aka (Akinlabi 1996), where the singular of class 5 nouns is expressed without a segmental affix by voicing the initial root:

(5) **Voicing Mutation in Aka** (Akinlabi 1996)

	Class 5 - singular	Class 6 Plural	
a.	**g**ɔ̀àlà	mà-**g**ɔ̀àlà	(game of imitation)
b.	**b**èlèlé	mà-**b**èlèlé	'sound of waterfall'
c.	**d**ʒámbà	mà-**d**ʒámbà	'mud'
d.	**d**èŋgé	ma-**t**èŋgé	'piercing tool'
e.	**g**ásá	ma-**k**ásá	'palm branch'
f.	**b**àpùlàkà	ma-**p**àpùlàkà	'lung'

Under the standard autosegmental analysis (see Lieber 1992, and references cited there), mutation is partially morphological and partially phonological. On the morphological side, it involves affixation of floating features, i.e. features which are not associated to root nodes. On the phonological side, there are processes which integrate the floating featural material into segments of the base by associating them to adjacent root nodes. This leads to delinking of underlying features for the involved segments and hence to overwriting. Thus for Aka, we might assume that the class 5 singular morpheme is a prefix which has the structure in (6):[2]

(6) [+voice] ↔ [+sing +class5]

If (6) is affixed to a noun such as *kásá*, phonological processes associate the [+voice] of the affix to the root node of the adjacent stop *k* and delink the segment of the underlying [–voice] feature, which results in surface *gásá*. If attached to bases with initial voiced segments, overwriting applies vacuously.

In its most generalized form, the Overwriting Problem is to identify independently motivated phonological mechanisms which execute phonological replacement of stem material by affix material (in the Aka case: association of floating [+voice], and deassociation of stem [±voice]). In subsection 1.1.1, I will discuss the concrete form the Overwriting Problem takes in Standard OT, and possible solutions which have been proposed. The following subsections address more specific subproblems of Overwriting.

1.1.1 The General Overwriting Problem in OT

Assuming Richness of the Base (Prince and Smolensky 1993), it is straightforward to transfer the morphological part of Lieber's original account for Aka into an optimality-theoretic analysis since incomplete segmental material cannot be excluded from the input anyway. However under the premise that phonological constraints are general (not morpheme-specific) and universal (not language-specific), it is a non-trivial task to account for the phonological side of mutation: As already noted by Zoll (1996), standard OT-faithfulness constraints conspire to

[2]In the following, I will write morphemes in the notation of the Vocabulary Items familiar from Distributed Morphology (Halle and Marantz 1993). See chapter 2 for more discussion.

erase floating features. This is illustrated in (7) for the input [+voice]+kásá in Aka. MAX and DEP are indifferent with respect to the floating feature, while IDENT prefers retention of the feature which is underlyingly associated to the root segment. Hence we expect deletion of the floating feature (subscripted features indicate association to the root node of the respective segment, ☞ marks the winning candidate under the given ranking, and ☛ the empirically correct output candidate):[3]

(7) **Input: [+vc]** + $k_{[-vc]}$asa

	MAX	DEP	IDENT
☛ a. $g_{[+vc]}$asa			*!
☞ b. $k_{[-vc]}$asa			

The OT-literature knows basically four possible approaches to guarantee the survival of floating input features, MAX constraints for features, markedness constraints, and the constraints MAXFLT and REALIZE MORPHEME:

MAX Constraints for Features:
Under the assumption of MAX constraints for feature-value pairs (Lombardi 1998, 2001, Zhang 2000, Kim and Pulleyblank 2009), specific mutation morphemes can be guaranteed preservation. Thus ranking MAX [+vc] above MAX [–vc] would derive the surfacing of the floating [+vc] morpheme in Aka:

(8) **Input: [+vc]** + $k_{[-vc]}$asa

	MAX [+vc]	MAX [–vc]
☞ a. $g_{[+vc]}$asa		*
b. $k_{[-vc]}$asa	*!	

Markedness Constraints:
Floating features might be saved by markedness constraints if reassociation leads to less marked structure. A possible example is manner mutation in Fula (Paradis 1992) where underlying root-initial consonants which are visible in class-2 forms are changed to stops in the realization of class-1 morphology.

(9) **Stopping Mutation in Fula** (Paradis 1992)

	'healthy'	'alive'	'stunted'	'small'	'white'
a. **Class 1**	**j**am**o**	**g**eet**o**	**g**udd**o**	**p**amar**o**	**d**annej**o**
b. **Class 2**	**y**amɓ**e**	**y**eetuɓ**e**	**w**udduɓ**e**	**f**amarɓ**e**	**r**anneɓ**e**

If we take the mutating feature to be [–continuant], overwriting can be derived from the constraint SONORITY-SEQUENCING (SON-SEQ) which prefers less sonorous (stop) onsets over more sonorous ones:

[3] To keep the candidate space small, I will assume that floating features cannot survive in the output without association to a root node. As far as I see, this decision does not have any impact on the following arguments.

(10) **Input:** [–cont] + $f_{[+cont]}$amar

	SON-SEQ	MAX	DEP	IDENT
☞ a. $p_{\mathbf{[-cont]}}$amar				*
b. $f_{[+cont]}$amar	*!			

However, this solution is not unproblematic. Since SON-SEQ is ranked above IDENT, we have to make sure in some independent way that SON-SEQ does not cause all continuant sounds in Fula to be plosivized in non-mutation contexts (a possibility would be to assume an additional constrain against inserting new features such as DEP [cont]). Moreover this approach does not carry over to Aka where mutation creates a more marked phonological structure: Voiced plosives are less sonorous than voiceless ones, hence SON-SEQ would prefer non-mutating *kásá* over mutating *gasa*. In addition, it is well known that voiced stops are more marked than voiceless stops in general (Kager 1999).

MAXFLT

The third possibility to save floating features despite a world of hostile faithfulness constraints is to stipulate a faithfulness constraint which is specific to floating material. A constraint of this type was already proposed by Zoll (1996) under the name MAX SUBSEGMENT and has been argued for recently in Wolf (2005a, 2007) who calls his version of this constraint MAXFLT:

(11) MAXFLT: All autosegments that are floating in the input have output correspondents. (Wolf 2007)

MAXFLT is well-suited to derive survival of the floating feature in the Aka case:

(12) **Input: [+vc]** $k_{[-vc]}$asa

	MAXFLT	MAX	DEP	IDENT
☞ a. $g_{\mathbf{[+vc]}}$asa				*
b. $k_{[-vc]}$asa	*!			

However, MAXFLT and similar constraints are an blatant violation of the No Explicit Floating principle formulated in (3), and is therefore highly problematic. In fact, I will show in chapter 2 that the essence of MAXFLT can be derived from more general principles in a containment-based version of Optimality Theory.

REALIZE-MORPHEME:
A further possible approach to ensure the survival of floating features is the constraint REALIZE-MORPHEME (van Oostendorp 2005a) which requires that every input morpheme is realized by some phonological output material:[4]

(13) REALIZE-MORPHEME: For every morpheme in the input, some phonological element should be present in the output (van Oostendorp 2005a)

For affixes consisting exclusively of a single phonological feature, this constraint will always favor survival and hence overwriting of base material because a feature is the smallest possible exponent of a morpheme, and there is hence no other way to realize it than to make it part of an existing segment.[5] This is illustrated for our Aka example in (14):

(14) **Input: [+vc]** $k_{[-vc]}$asa

	REAL-MORPH	MAX	DEP	IDENT
☞ a. $g_{[+vc]}$asa				*
b. $k_{[-vc]}$asa	*!			

1.1.2 The Incest Taboo Problem

In Anywa, specific prefixes with a phonetic L-tone have the effect that low-tone bases raise to H-tone (15-a). This process also extends to L-tone suffixes (Reh 1993, see chapter 5 for a detailed analysis). According to the autosegmental approach to mutation, this can be captured by the assumption that these prefixes have a floating H-tone which overwrites the L-tone of the base as shown in (15):

(15) **Anywa L-tone Raising** (Reh 1993:68)

a.	à^{H}-	dhyàŋ		→	à-dhyáŋ	‘durra bird’
b.	à^{H}-	càŋ	-Yì	→	à-cáŋ-Yí	‘you ate it’

That the floating H overwrites the L-tone of the base could in principle either be derived by MAX Feature constraints (i.e., the ranking MAX H ≫ MAX L) or by markedness constraints (e.g., the ranking *L, DEP T ≫ *H). However in contrast to the Aka case, the floating L in Anywa is accompanied by a segmental affix which would provide another perfect target for overwriting a preassociated L-tone by a H-tone. Thus the output *á-dhyà*ŋ for (15-a) (where the floating H has docked to the prefix) would equally well satisfy MAX H as the actual output,

[4]REALIZE-MORPHEME is called PARSE-MORPH in Akinlabi (1996). Kurisu (2001) assumes a REALIZE-MORPHEME constraint which is substantially different from the one used here because it requires phonological distinctivity between paradigmatically related forms, not realization of underlying phonological material. Kurisu’s use of this name is somewhat ironic since his constraint is intended to derive non-concatenative morphology without the assumption of a triggering morpheme. Gnanadesikan (1997) and de Lacy (2002b) argue for versions of REALIZE-MORPHEME (labeled MORPH REAL and MORPHDISF respectively) which combine the requirements of input preservation and distinctiveness in different ways.

[5]One possible alternative would be to create an epenthetic segment which is the host of the floating feature instead of overwriting an input segment. This possibility seems indeed to be attested in Yowlumne (Yawelmani) where the feature [constricted glottis] is realized in specific phonological contexts as part of a base segment causing glottalization, and in other phonological contexts as an independent segment (a glottal stop; Zoll 1996). Note that a floating feature which surfaces in all phonological contexts as an independent segment from the base would be indistinguishable from an underlying segment, and would simply not be analyzed as an underlying floating feature.

and *á-dhyáŋ* (where the floating H has displaced prefix and base L) outranks à-dhyáŋfor the markedness-based ranking *L, DEP T ≫ *H since it maximally minimizes the surface H-tones without inserting an epenthetic H.[6].

More generally, every floating feature which is accompanied by a segmental affix may in principle be expected to attach to segments of the affix instead of overwriting features of its morphological base (another example is 1PL and 3SG mutation in Nuer, as discussed in subsection 1.1.4). I will call this problem the *Incest Taboo Problem*. Wolf (2007:316) proposes to solve the Incest Taboo Problem by the constraint in (16), but obviously such a constraints violates the *No Explicit Floating* principle (3) assumed here.

(16) NOTAUMORDOC: Floating autosegments cannot dock onto bearing units that are exponents of the same morpheme.

Morphological categories which are expressed by floating features *and* segmental affixes also pose specific problems for REALIZE-MORPHEME-based approaches to Overwriting. These are the topic of subsection 1.1.4.

1.1.3 The Bidirectional Mutation Problem

I will say that a language has *Bidirectional Mutation* if it employs different mutation morphemes resulting in changes to opposite feature values (e.g. one morpheme inducing voicing and one inducing devoicing). Bidirectional Mutation is especially problematic for an an analysis of overwriting based on MAX constraints for segmental features. A case in point is the Western Nilotic language Nuer (Crazzolara 1933), where different non-finite categories of the verb are marked by mutation of the final root consonant.[7] In the negative present participle, all obstruents turn into voiceless stops, and in the past participle they get voiceless fricatives. The infinitive shows the underlying contrast:

(17) **Mutation in Nuer Non-Finite Forms** (Crazzolara 1933)

	'over-take'	'hit'	'pull out'	'scoop hastily'	
Infinitive	coβ	ja:ç	guð	kêp	
Negat. Pres. Ptc.	cò**p**	ja:**c**	gu**t̪**	ke**p**	[–voice –continuant]
Past Ptc.	co**f**	ja:**ç**	guθ	kɛ̀**f**	[–voice +continuant]

Assuming the morphemes in (18) for the participle forms (Wolf 2005a), a MAX Feature analysis might invoke the ranking MAX [–continuant] ≫ MAX [+continuant]. This correctly predicts the overwriting of stem [+continuant] by [–continuant] (stopping) in negative present participles, but makes the wrong prediction for the past participle that the stem fricatives should be maintained.

(18) **Nuer Mutation Morphemes in Wolf (2005a)**

a. [+Part +Neg –Past] ↔ [–voice –continuant]

b. [+Part+Past] ↔ [–voice +continuant]

[6]Note also that the floating H can in principle attach t two different syllables (and morphemes), as shown by ((15)-a).

[7]Another example is consonant mutation in Anywa, where plural forms of modified nouns stop root-final nasals, whereas the frequentative nasalizes root-final stops. See chapter 7 for detailed discussion.

Conversely, the ranking MAX [+continuant] ≫ MAX [–continuant] produces the correct output (fricativization) for the past participle, but also non-application of mutation for the negative present participle. Thus the MAX feature approach seems to be in principle incapable to account for Bidirectional Mutation.

1.1.4 The Multiple Exponence Problem

Multiple Feature Mutation: As shown convincingly by Wolf (2007), cases of multiple-feature mutation are problematic for approaches to mutation which bar explicit protection for floating features by specific constraints.

A simple case of multiple-feature mutation discussed by Wolf is nominative/ergative person agreement in Texistepec Popoluca (Wichmann 1994, Reilly 2002, 2004) where 1st person verb forms are marked by nasalizing the initial consonant, 2nd person forms by nasalizing and palatalizing the initial consonant, and 3rd person forms by denasalizing and palatalizing the initial consonant. This is illustrated in (19):

(19) **Mutation in Texistepec Popoluca** (Wichmann 1994, Reilly 2002)

Infin.	**1P**	**2P**	**3P**	
dastah	**n**astah	ɲastah	**d**ʲastah	'dig'
naj	—	—	**d**ʲaj	'sprout'

Wolf captures these patterns by positing the person markers in (20) (assuming that palatalized segments have the vocalic feature [–back], while non-palatal consonants are [+back]):[8]

(20) **Texistepec Popoluca Person Markers in Wolf (2007)**

a. [+1] ↔ [+nasal]

b. [+2] ↔ [+nasal–back]

c. [+3] ↔ [–nasal–back]

The 1st person marker consists of a single feature and can be analyzed exactly as mutation in Aka. However, the 2nd and 3rd person markers contain more than one floating feature which makes them special. MAXFLT also predicts the correct outputs for these cases as shown in (21). In principle, none (21-d), one (21-b,c), or two (21-a) features of the initial root consonant could be overwritten. Since MAXFLT outranks IDENT, realization of both floating features is achieved at the cost of the corresponding features of the stem-initial consonant.

[8]In the following, I adapt the semi-formal morphemic representations of floating material in Wolf (2005a, 2007) to the conventions used in this paper.

(21) **Input: [–nas–bk]** + $\text{n}_{[+\text{nas}+\text{bk}]}$aj

	MaxFlt	Ident
☞ a. $\text{d}^{\text{j}}_{\mathbf{[+nas+bk]}}$aj		**
b. $\text{d}_{[-\text{nas}\mathbf{+bk}]}$aj	*!	*
c. $\text{ɲ}_{[\mathbf{+nas}-\text{bk}]}$aj	*!	*
d. $\text{n}_{[+\text{nas}+\text{bk}]}$aj	*!*	

On the other hand, Realize-Morpheme appears to be unable to derive the same set of facts as shown in (22). The only candidate which is eliminated by Realize-Morpheme is (22-d) where none of the floating affix features is realized. All candidates which realize at least one affix features fare equally well for the constraint, and since Ident favors features which are underlyingly associated to segments, the candidates where only one floating feature overwrites (22-b,c) win and form a tie predicting variation between two unattested forms:

(22) **Input: [–nas–bk]** + $\text{n}_{[+\text{nas}+\text{bk}]}$aj

	Real-Mrph	Ident
☛ a. $\text{d}^{\text{j}}_{\mathbf{[-nas-bk]}}$aj		**!
☞ b. $\text{d}_{[-\text{nas}\mathbf{+bk}]}$aj		*
☞ c. $\text{ɲ}_{[\mathbf{+nas}-\text{bk}]}$aj		*
d. $\text{n}_{[+\text{nas}+\text{bk}]}$aj	*!	

Wolf's argument for MaxFlt and against Realize-Morpheme seems to be conclusive. MaxFlt is more powerful, but this power seems to be fully justified by the empirical facts of multiple-feature mutation.

The second set of data mentioned by Wolf, non-finite forms in Nuer (Crazzolara 1933), has already been have already been discussed in subsection 1.1.3. The data from (17) are repeated in (23).

(23) **Mutation in Nuer Non-Finite Forms** (Crazzolara 1933)

	'over-take'	'hit'	'pull out'	'scoop hastily'	
Infinitive	coβ	ja:ç	guð	kêp	
Negat. Pres. Ptc.	cò**p**	ja:**c**	gu**t̪**	ke**p**	[–voice –continuant]
Past Ptc.	co**f**	ja:**ç**	guθ	kɛ̀**f**	[–voice +continuant]

Again (assuming the morpheme entries in (18)) Realize-Morpheme can account for the overwriting by one of the specified features [–voice] and [±continuant], but not by two floating features which are part of the same morpheme.

Mutation + Affixation: As shown by Wolf (2005a, 2007), Nuer verbs pose a second related problem for a Realize-Morpheme based approach to the realization of floating features: Floating features cooccur with affixal morphology in the expression of morphological categories. Thus, as shown in (24), the 3SG of the indicative present active shows the suffix -ɛ and in addition mutation to a voiced stop. The corresponding 1PL form us marked by the suffix -*kɔ* and final consonant mutation to a voiceless fricative:

(24) **Multiple-Feature Mutation + Affixation** (Crazzolara 1933)

	'overtake'	'pull out'	'scoop hastily'	
Infinitive	coβ	guð	kêp	
3SG.ind.pres.act.	cóβ-ɛ́	gúð-ɛ́	kɛ́β-ɛ́	[+vc+cont]-ɛ
1PL.ind.pres.act.	còɔ**f**-kɔ̀	gwɔ̀θ-kɔ̀	kɛ̀a**f**-kɔ̀	[-vc+cont]-kɔ

(25) shows the affix entries Wolf assumes for these forms:

(25) **Mutation Morphemes for (25) in Wolf (2005a)**

a. [+3+Ind–Past+Act] ↔ [+voice+continuant]-ɛ

b. [+1+pl–Past+Act] ↔ [–voice+continuant]-kɔ

Crucially, Realize-Morpheme would not require surface realization for any of the floating features in (25) since the corresponding morphemes are already visible in the output through the segmental affixes.

1.1.5 The Erasure Problem

Modified nouns (i.e., nouns modified by possessors, demonstratives or other nominal modifiers) in Jumjum are marked by mutating the underlying tone of the noun to L. Crucially this mutation process overwrites not just the features for one segment (or rather for one tone-bearing unit, whether this is the mora or the syllable), but for the entire morphological base word:

(26) **Tonal Overwriting in Jumjum Modified Nouns** (Andersen 2004:161)

	Underlying Tone	**Absolutive**	**Modified Noun**		
a.	H	d̪ɛ́ːŋ	d̪ɛ̀ːŋ	'cow'	
b.	HL	jîːn	jìːn	'giraffe'	(giraffe:SG)
c.	L	kùːn	kùːn	'thorn'	(thorn:SG)
d.	HL	cícàm	cìcàm	'knife'	
e.	LH	cʌ̀w-nʌ́	cʌ̀w-nʌ̀	'arrow'	(arrow:SG)
f.	HH	díːr-gʌ́	dìːr-gʌ̀	'bird'	(bird:PL)
g.	HHH	líjʌ́ŋ-gʌ́	lìjʌ̀ŋ-gʌ̀	'feather'	(feather:PL)

This is markedly different from Aka class-5 mutation, where only the left-most (word-initial) obstruent of a noun is changed into its voiced counterpart, whereas all other voiceless stops of the base remain as they are (cf. underlying ***p**àpùlàkà*, 'lung', which gets ***b**àpùlàkà*, not ***b**à**b**ùlà**g**à*, cf. (5)). Crucially, in Jumjum, the overwriting of all base syllables by L-tone cannot be due to a general spreading process for L-tones because no such spreading obtains in the absolutive forms of (26-d,e). This results in a problem for virtually all approaches to Overwriting discussed in subsection 1.1.1. Realize-Morpheme, Max-Flt, and Max Feature (in this case: Max H) would all be satisfied by candidates such as *dìːr-gʌ́* for (26-f) where only the first syllable realizes the putative floating L-tone, whereas the second one remains faithful to its underlying association to H. Moreover, it is also difficult to see why a markedness constraint such as $*\sigma_H$ should lead to the extension a floating L to all syllables of a modified noun form, but should not do the same to the non-floating L of an absolutive form such as *cʌ̀w-nʌ́*. I will call mutational Overwriting which overwrites all phonologically appropriate targets of a base, *Erasure*, and the problem this poses for concatenative approaches to Overwriting the *Erasure Problem*.

The Erasure Problem has been noted at different points in the literature.[9] Thus Inkelas (1998), and Inkelas and Zoll (2007) provide in-depth discussions of Erasure in the tonology of Hausa which is reminiscent of the Jumjum pattern, but also shows some additional aspects of the problem. For example, the Hausa imperative is expressed by overwriting the underlying tone pattern of the verb by the pattern LH (27), which demonstrates that overwriting is not restricted to single tones, but may also involve contour melodies:

(27) **Tonal Overwriting in the Hausa Imperative** (Newman 2000:262-263)

	Underlying Form		**Imperative**		
a.	H	kwáːná	LH	kwàːná	'spend the night'
b.	HL	táːʃì	LH	tàːʃí	'get up'
c.	HLH	káràntáː	LH	kàràntáː	'read'

Just as simple Overwriting, Erasure may cooccur with overt segmental affixes as shown by the Hausa Ventive construction (28):

(28) **Tonal Overwriting in the Hausa Ventive** (Newman 2000:663)

	Underlying Form		**Ventive**		
a.	LH	fìtáː	H	fít-óː	'go out'
b.	HL	fáɗì	H	fáɗ-óː	'fall down'
c.	HLH	gángàráː	H	gángár-óː	'roll down'
d.	LHL	tàimákàː	H	táimák-óː	'help'

Verbal noun formation in the language proves that Erasure is not necessarily a grammar-wide restriction. Thus in contrast to imperative and ventive verbal-noun morphology adds a tonal melody to the underlying tone pattern of the base instead of overwriting it (29):

(29) **Tonal Non-Overwriting in Hausa Verbal-Noun Formation** (Newman 2000:705)

	Verb		**verbal Noun**		
a.	HL	búgàː	HL-H	búgàː-wáː	'beat'
b.	HLH	káràntáː	HLH͡L-H	káràntâː-wáː	'read'
c.	H	sánár̃	HH͡L-H	sánâr̃-wáː	'inform'
d.	H͡L	cêː	H͡L-H	cêwáː	'say'

In fact, Inkelas and Zoll (2007) argue that the contrast between "dominant" affixes such as the imperative and the ventive which trigger tonal overwriting and "recessive" affixes as verbal noun *-wă* which do not is evidence for Cophonologies, i.e. different constraint rankings, arbitrarily associated to morphological constructions. Thus Erasure is a major challenge to the Concatenativist Hypothesis.

[9] See also Flack (2007) on length Erasure in Dinka, which will be discussed at length in chapter 4, and Bye and Svenonius (2011) on a case of segmental quasi-Erasure in Tamashek Berber which is similar to the Mayak Vowel Quality Alternation I will analyze in chapter 6. In fact, Bye and Svenonius provide an analysis of the Tamashek data which is very much in the spirit of the Concatenativist Hypothesis.

1.2 The Inconsistency Problem ("Qirky Mutation")

An obvious prediction of the Concatenativist Hypothesis and of Generalized Nonlinear Affixation is that mutation should lead to consistent changes in morphological bases. This holds in fact for Aka where class 6 mutation always results in voicing. An example from Western Nilotic is breathiness mutation in Dinka benefactive forms which renders root vowels breathy for all verbs with creaky-voice vowels to which the morphological operation can be applied (30-a-d), whereas verbs with underlyingly breathy vowels do not change their laryngeal specifications (30-e):

(30) **Breathy Mutation in Dinka Benefactives** (Andersen 1995:28-29,38)

	Unmarked Nonfinite	**Benefactive Nonfinite**	
a.	lè:r	lê̤::r	'to roll'
b.	tè:m	té̤:m	'to cut'
c.	tèŋ	tê̤:ŋ	'to dust'
d.	wèc	wé̤:c	'to kick'
e.	bṳ̀:t̪	bṳ̂o:t̪	'to build'

Wolf (2007) identifies cases which taunt the consistency prediction: The same morphological construction induces different mutation patterns in different contexts. An extreme example he cites is the so-called "mixed mutation" in Breton which devoices [d], but spirantizes non-coronal stops and [m]:

(31) **Quirky Mutation in Breton** (Wolf 2007:350)

a.	d	⇒	t	**(Devoicing)**
b.	b	⇒	v	
c.	g	⇒	ɣ	**(Spirantization)**
d.	m	⇒	v	

I will use Wolf's term *Quirky Mutation* for this phenomenon, and call the problem it causes for the Concatenativist Hypothesis the *Inconsistency Problem*. In subsection 1.2.1 I will introduce simple cases of Quirky Mutation from Western Nilotic. Subsection 1.2.2 addresses a major pattern of non-phonological inconsistency in mutation morphology. The remaining subsections discuss two forms of inconsistent mutation which have a somewhat special status: chain-shifting mutation 1.2.3, and morphologically triggered phonological polarity 1.2.4.

1.2.1 Quirky Mutation in Western Nilotic

A simple example for inconsistent vowel mutation in Western Nilotic is the "Vowel Quality Alternation" (VQA) which is triggered by a number of affixes in Mayak (Andersen 1999b) and triggers the changes shown in (32). Crucially, the same morphological environment leads to shifting high and low vowels to their [+ATR] counterparts (32-a,b,e) whereas mid vowels are raised to high vowels (32-c,d):

(32) **Mayak Vowel Quality Alternation**

a. ɪ ⇒ i
b. ʊ ⇒ u
c. ɛ ⇒ ɪ
d. ɔ ⇒ ʊ
e. a ⇒ ʌ

The problem posed for the Concatenativist Hypothesis here, especially for an analysis in terms of floating features, is an obvious paradox: If there is a single floating feature which triggers VQA, why does it effect different changes for different vowels? Thus if the VQA exponent is [+ATR], how can it lead to raising [ɛ] to [ɪ] which have the same value for [±ATR], but differ in [±high]? On the other hand, under the assumption of two floating affix features [+high +ATR], it is hard to see how their appearance can be blocked in exactly the right contexts. Thus as is clear from (32), Mayak *has* the high [+ATR] vowels [i] and [u], and in fact has VQA alternations (applied to [ɪ] and [ʊ]) which result in just these sounds. Hence it is hard to see how affixing [+ATR +high] to [ɛ] and [ɔ] will *not* result in [i] and [u].

The Päri benefactive shows inconsistency in the domain of consonant mutation for final stem consonants. Apparently nasals are transformed into homorganic nasal+stop clusters (with concomitant nasalization of [l]), whereas glides and stops geminate, and [r] becomes a geminate palatal glide:

(33) **Consonant Mutation in the Päri Benefactive** (Andersen 1988:85ff)

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in Benefactive Stems	p	mb	jj	nd	jj	ww

What makes this alternation problematic for generalized Nonlinear Affixation (and inconsistent) is especially the difference between underlying nasals and [r]. Whereas the latter becomes as a whole [+continuant] (and remains [+sonorant]), the nasals become partially [–sonorant], and remain firmly [–continuant]. Again, it is hard to see which unitary set of phonological features could be the trigger for both processes.

1.2.2 Non-Phonological Inconsistency

A well-known case of extreme and polymorphous inconsistency is number marking in many Western Nilotic languages. The best-documented case in this respect is Dinka (Ladd et al. 2009), where singular and plural forms differ exclusively by a variety of mutation-like alternation patterns. Thus in (34-a,d), the singular has a L-tone, and the plural a H-tone, whereas the distribution of tone is reversed in (34-e,h). Other nouns alternate between SG-High and PL-Falling tone (34-c), SG-R and PL-L (34-f), and SG-H vs, PL-R (34-g), whereas (34-b) maintains a F-tone in bot numbers. There are changes in vowel length, thus the SG has a long and the plural a short vowel in (34-f) and the opposite length pattern is found in (34-c,g). (34-b) alternates between an extra-long V (in the PL) and a short one (SG), whereas (34-c) has an extra-long V in the SG , and a long one in the PL. Many nouns differ in the breathiness of the stem vowel (34-f,h) – again in both directions. Finally there is diphthongization (34-e), change of vowel quality (34-g), and changes in the stem-final consonants (34-h):

(34) **Plural Formation in Dinka** (Ladd et al. 2009:662)

	SG	PL	
a.	pì̤ːc	pí̤ːc	‘stirring stick’
b.	bî̤ɲ	bî̤ːːɲ	‘cup’
c.	bá̤ɲ	bâ̤ːɲ	‘chief’
d.	nòːːn	nóːn	‘grass’
e.	t̪íːl	t̪jɛ̀ːl	‘thistle’
f.	wă̤ːl	wàl	‘plant’
g.	lwák	lwɛ̤̌ːk	‘cattle byre’
h.	rɔ́ːw	rɔ̤̀ːt̪	‘hippo’

An important factor in understanding the complexity of number marking in Western Nilotic is certainly the tripartite nature of the system (Reh 1993, Dimmendaal 2000, Gilley 2000, Storch 2005) which becomes more obvious in languages where nominal number is predominantly expressed by means of affixes: Thus in Anywa, many nouns have an unmarked plural form, and a singular marked by an explicit suffix (35-b), whereas others show the crosslinguistically more common pattern where the plural form exhibits a number affix and the singular is unmarked (35-a). Finally, there are nouns which have a singular and a plural affix (35-c):

(35) **Threeway Number Marking in Anywa Nouns** (Reh 1993:96)

	SG	PL	
a.	dèːl	dèːtː-í	‘body’
b.	tɔ̀ŋ-ɔ̄	tɔ̀ŋ	‘eggs’
c.	wèːl-ō	wɛ́ːl-í	‘paper’

Dinka number mutation is clearly historically related to affixation patterns in Anywa, as shown by the pairs in (36):

(36) **Threeway Number Marking in Anywa and Dinka** (Ladd et al. 2009:661)

	Anywa		Dinka		
	SG	PL	SG	PL	
a.	cɛ̀n-ɔ	cɛ̀n	cǐːn	cìn	‘hand’
b.	ɛ̀c	íd̪-í	jɛ̤̀ːc	jɛ̤̀ːːc	‘belly’

Thus one might argue that the Dinka lexeme for "hand(s)" (36-a) ia marked for SG by an affix involving a floating mora, whereas the lexeme for "belly" uses a moraic plural affix, which would parallel the use of segmental affixes observed in Anywa. However, taken alone, this does not account for the fact that many Dinka nouns do not show any length contrast in number inflection (e.g. (34)-a,h) nor for the overall variation in different (non-)distinctions of tone, vowel and consonant quality exemplified in (34).

Although the Dinka number system is highly complex and probably problematic for learnability, it is probably completely unproblematic for phonological theory and the approach to the morphology-phonology interface proposed in this book. Thus in the most detailed study on the system up to date, Ladd et al. (2009) come to the conclusion that the type of mutation which is found in a given SG/PL-pair of Dinka is basically unpredictable:[10]

"Our dataset of 400 Dinka nouns yields eighty-two combinations of phonological differences that can be used to mark the distinction be-tween singular and plural. Some patterns appear with greater frequency than others: that is, patterns involving some combination of differences in tone, vowel length, and vowel height are more common than other combinations. However, though there are clearly some tendencies and probabilistic generalizations about how the phonological differences can be combined, it does not appear possible to identify any phonological or semantic motivation for the choice of number-marking pattern for a given noun." (Ladd et al. 2009:668)

Thus Dinka number marking is substantially different from Quirky mutation in Breton and the data discussed in subsection 1.2.1, which show an inconsistency of exponence, which is perfectly predictable from the phonological shape of the base to which the mutation process applies. Inconsistent mutation of the Dinka plural type seems rather to be a case of lexically conditioned suppletive allomorphy which is also found with strictly affixal number inflection as in the following cases from German where non-feminine nouns which are virtually identical grammatically and phonologically, but show different plural allomorphs:[11]

[10]Basically the same conclusion is reached for Nuer by Frank (1999:27):"This invokes the possibility that there are two forms (or principal parts) stored for all nouns, a singular and a plural stem from which all forms are derived."

[11]All noun pairs in (37) are matched for gender: The examples in ((37)-a,b,c) are neuter, and the ones in ((37)-d) masculine.

(37) **Lexically Conditioned Plural Allomorphs in German** (Wunderlich 1999:11)

	Plural in *-e*			**Plural in *-s***		
	SG	**PL**		**SG**	**PL**	
a.	Aquaréll	Aquaréll-e	‘water color’	Karuséll	Karuséll-s	‘carousel’
b.	Skelétt	Skelétt-e	‘skeleton’	Klosétt	Klosétt-s	‘toilet’
c.	Komplótt	Komplótt-e	‘complot’	Kompótt	Kompótt-s	‘compote’
d.	Fleck	Fleck-e	‘stain’	Scheck	Scheck-s	‘check’

In effect, the data in (34) are rather relevant for the purely morphological problem of lexically conditioned allomorphy than for inconsistent mutation. Of course, since they seem to involve changes of phonological features on their bases, they might also lead to valuable insights on overwriting (cf. section 1.1), but the methodological problem data exhibiting extreme amounts of allomorphy pose is that they are potentially suppletive and hence might not provide true evidence on the nature of productive mutation processes.

1.2.3 Chain-shifting Mutation

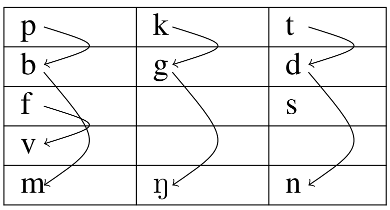
Chain-shifting mutation effects a change which is consistent in the sense that it mutates segments along the same phonological dimension, but rather along a continuous scale than in a way which can be captured by a simple set of binary features. Thus in the eclipsis mutation pattern of Irish, voiceless stops and fricatives change into voiced ones, whereas voiced stops are nasalized:

(38) **Irish Eclipsis** (Gnanadesikan 1997:97, Pullman 2004:13)

a.	**t**^{j}ax	ə	**d**^{j}ax	**[–vc] Stop**	⇒	**[+vc] Stop**
	house	their	house			
b.	**f**^{j}iə	ə	**v**^{j}iə	**[–vc] Fricative**	⇒	**[+vc] Fricative**
	deer	their	deer			
c.	**d**o:rəs	ə	**n**o:rəs	**[–son] Stop**	⇒	**[+son] Nasal**
	door	their	bag	[+vc]		[+vc]

The striking observation is that, although the general pattern is inconsistent (involves a [±vc] for some, and a [±son] change for other sounds), the change follows the same direction in what Gnanadesikan (1997) calls the “Inherent Voicing Scale” and makes the involved consonants consistently more sonorous, as shown schematically in (39):

(39) **Irish Eclipsis as a Chain Shift**



Many Western Nilotic languages show chain-shifting mutation involving vowels. A case in point is Thok Reel (Reid 2010) where specific agreement affixes trigger (among other changes) the following shifts, all comprising lowering but for different phonological features:

(40) **Chain-shifting Vowel Mutation in Thok Reel** (Reid 2010:75)

e̤		
↓		
ḛ	ḛ	
	↓	
	ɛ̰	ɛ̰
		↓
		a̰

1.2.4 Morphophonological Polarity

The classical case of morphologically triggered phonological polarity is found in Dholuo. Stem-final obstruents in Plural forms seem to have systematically the opposite value for [±voice] of what they exhibit in the singular (41):

(41) **Voicing exchange [–voice] → [+voice]**

	SG	**PL**		
a.	bat	bed-e	‘arm’	(Okoth-Okombo 1982:30)
b.	lut̪	lud̪-e	‘walking stick’	(Okoth-Okombo 1982:30)
c.	ɐri:p	ɐri:b-e	‘milky way’	(p. 128)
d.	guok	guog-i	‘dog’	(Okoth-Okombo 1982:30)

(42) **Voicing exchange [+voice] → [–voice]**

	SG	**PL**		
a.	ki:dí	kí:t-ê	‘stone’	(p. 128)
b.	ɔkɛ̂:bɛ	okɛ́:p-ɛ̂	‘tin can’	(p. 127)
c.	cogo	cok-e	‘bone’	(Okoth-Okombo 1982:30)

A straightforward brute-force attack to this phenomenon has been proposed in Gregersen (1974:106) who invokes the alpha-rule in (43) (slightly simplified here) triggered by the plural affix *-e* (cf. also Okoth-Okombo, 1982:61 for a similar rule):

(43) $$\begin{bmatrix} -\text{voc} \\ +\text{con} \\ \alpha\text{voiced} \end{bmatrix} \rightarrow [-\alpha\text{voice}] \,/\_\_\ [\text{Pl -e}]$$

In a constraint-based framework such as Optimality Theory, rules of this type cannot be formulated. In fact, the Dholuo data seem to be highly problematic for OT in general since the theory is basically restricted to faithfulness and markedness constraints (Moreton 2004): The change from *d* to *t* in (42-a) violates a faithfulness constraint (Ident [voice]) and while devoicing of a stop reduces markedness, this does not explain why devoicing only happens in the plural, and not in the phonologically crucially identical singular form. Even if markedness constraints forcing devoicing could be restricted to the plural forms, this seems to be at odds with the fact that forms which have unvoiced stops in the singular voice them in the plural forms.

Alderete (2001) (the same analysis can also be found in Alderete 1999) takes these problems as evidence that OT must be complemented by a new constraint type, so-called *trans-*

derivational antifaithfulness (TAF) constraints which require that the output of a derived form and the output of its morphological base differ for a specific property. More specifically, Alderete assumes that for every faithfulness constraint such as IDENT [voice] there is a corresponding antifaithfulness constraint (here: ¬IDENT [voice]):

(44) **Faithfulness and Anti-faithfulness for [voice]**

a. IDENT [voice]
Corresponding segments agree in the feature [voice].

b. ¬IDENT [voice]
It is not the case that corresponding segments agree in the feature [voice].

The tableau in (45) shows how (44-b) ranked above (44-a) allows to derive voicing exchange in Dholuo. ¬IDENT [voice] requires to change the voicing of at least one segment, which rules out the c.-candidates. However, additional voicing changes as in the b.–candidates are blocked by IDENT[voice]:

(45) **Voicing Exchange in Dholuo as Antifaithfulness**

Base	Derivative	¬IDENT [voice]	IDENT [voice]
i. /bat/	☞ a. bed-e		*
	b. ped-e		**!
	c. bet-e	*!	
ii. /cogo/	☞ a. cok-e		*
	b. ɟok-e		*!*
	c. cog-e	*!	

Other constraints not discussed in detail by Alderete are necessary to ensure that the voicing change occurs consistently in the last root consonant to block e.g. *pet-e*, which fares equally well as (8-i-a) since it differs from *bat* by a voicing change in the initial stop.

Alderete claims further that, in contrast to faithfulness constraints, TAF constraints are always morphologically triggered, i.e. every TAF constraint is restricted to specific morphological constructions which means in most cases particular affixes. Thus ¬IDENT [voice] is associated to the plural affixes *-i* and *-e*, but not to the third plural allomorph *-ni* which does not exhibit voicing exchange:

(46) **No Voicing Exchange with Plural *-ni***

	SG	**PL**		
a.	kó:mbé	ko:mb-ni	'hole in a tree'	(p. 126)
b.	pɔ́:kɔ̂	po:k-ni	'gourd'	(p. 127)

Naturally, Alderete's analysis is perfectly incompatible with the Concatenativist Hypothesis. But even abstracting away from the antifaithfulness approach, it is far from obvious how defective phonological material can have opposite effects in different contexts.

1.3 The Divergence Problem

Probably the first to identify the Divergence Problem to its full extent was Green (2006). Green observed that the Celtic language Manx had two types of lenition, one ("morphological") triggered by specific morphemes in word-initial consonants (47), and one ("phonological") applying regularly in intervocalic consonants throughout the language (48).

(47) **Morphological Lenition in Manx** (Green 2006)

f	Ø	
s	x ~ h (?)	s, t & k debuccalize (optionally)
t	x ~ h	
k	x ~ h	Coronal obstruents get velar
p	f	
d	ɣ	
g	ɣ	
b	v ~ w	Stops and m get [+continuant]
m	v ~ w	
n	no change	
l	no change	
r	no change	
vowel	no change	

(48) **Phonological (Intervocalic) Lenition in Manx** (Green 2006)

f	??	
s	z ~ ð	
t	d ~ ð	Voiceless stops get voiced stops or fricatives
k	g ~ ɣ	
p	b ~ v	
d	ð	
g	ɣ	Voiced stops get voiced fricatives
b	v	
m	no change	
n	no change	
l	no change	
r	no change	

Crucially both lenition types involve a change from [–continuant] to [+continuant] consonants, and for both we would intuitively expect [z] or [ð] as the output of specific input consonants: under morphological lenition for input [d] (because morphological lenition generally transforms oral stops into continuants), and under phonological lenition for input [s] (because phonological lenition has generally a voicing effect). In fact we get variation between [z] and[ð] in the latter case, however applying morphological lenition to [d] yields neither but the voiced velar fricative ɣinstead.

Green raises the problem to a more explicit level by giving working OT-analyses for these cases, which are illustrated in simplified form in (49) and (50). Phonological lenition is triggered by *V[-vc]V which penalizes intervocalic voiceless consonants. IDENT(coronal) is ranked above *ð and *z (which form a tie) to derive the free variation between both sounds as a result if this process:

(49) **Phonological Lenition in Manx** (Green 2006)

Input: pre:sən

	Id(cor)	*V[-vc]V	Id(vc)	*ð	*z
a. pre:sən		*!			
☞ b. pre:zən			*	*	
☞ c. pre:ðən			*		*
d. pre:hən	*!	*			

For morphological lenition, Green assumes a floating [+continuant] feature which is affixed to the word-initial consonant, and overwrites the [–continuant] of the base consonant due to high-ranked RealizeMorpheme (cf. the discussion of this constraint in subsection 1.1). *ð (and *z) dominates Ident(coronal) to ensure that the resulting sound is not coronal

(50) **Morphological Lenition in Manx** (Green 2006)

Input: $[+cont]_1$+$d_2$ulis

	RealMorph	*ð	Id(cor)
a. $d_{1,2}$ulis	*!		
b. $ð_{1,2}$ulis		*!	
☞ c. $ɣ_{1,2}$ulis			*

Now crucially, the analysis of phonological lenition requires the ranking Ident(cor) ≫ *ð/*z whereas morphological lenition can only be captured by the ranking *ð/*z ≫ Ident(cor), and we face a ranking paradox. Green concludes that only phonological lenition is derived in phonology whereas morphological lenition is a purely morphological phenomenon.

A typical example for the Divergence Problem in Western Nilotic is found in the morphophonology of the feature [⊢⊣] in Päri. The benefactive triggers mutation of verb vowels to their [⊣] counterparts (stem vowels which are already [⊣] remain unaffected):

(51) **[⊣]-Mutation in the Päri Benefactive** (Andersen 1988:92)

	Underived	**BEN**	
a.	á-jàp	á-jʌ́p-ì	‘open’
b.	á-kʌ̀t	á-kʌ́t-ì	‘plait’
c.	á-gɛ̀:r	á-gé:j:-ì	‘build’
d.	á-jík	á-jík-ì	‘make’
e.	á-lʊ̀:p	á-lúp:-ì	‘speak’

On the other hand, Päri has root-dominant vowel harmony for [ATR]: Suffixes (52) and prefixes (53) systematically adjust to the [⊢⊣]-value of the root morpheme:

(52) **Päri [ATR] Harmony in Possessive Suffixes** (Andersen 1989:10)

	[⊢]	[⊣]
	‘bird’	‘meat’
2SG	wìɲɟ-ɪ́	rìŋg-í
3SG	wìɲɟ-ɛ̀	rìŋg-è
1SG	wìɲɟ-á	rìŋg-á
1PI	wìɲɟ-ɔ̌	rìŋg-ǒ
2PL	wìɲɟ-ʊ́	rìŋg-ú

(53) **Päri [ATR] Harmony in Agreement Prefixes** (Andersen 1989:11)

	[⊢]	[⊣]
	‘return’	‘beat’ (AP)
2SG	ɪ́-dɔ̀ːk	í-pòːd-ô
1SG	á-dɔ̀ːk	á-pòːd-ô
2PL	ʊ́-dɔ̀ːk	ú-pòːd-ô

The crucial problem here is that analyzing [ATR]-mutation by affixing a floating [⊣], the obvious expectation – based on the vowel harmony facts – is that affixal [⊣] is suppressed in favor of the [ATR]-value of the root. Put the other way around, the overwriting of the vowel quality in (51) by the constraint ranking in (54), would ceteris paribus predict that vowel harmony should show dominance of [⊣], not of roots.

(54) MAX [⊣] $\gg$ MAX [⊢]

Chapter 2

Theoretical Assumptions

The approach to phonology I assume in this book is radically conservative, and combines the classical concepts of mainstream phonological theory: autosegmental representations (Goldsmith 1976, McCarthy 1979), phonological strata (Kiparsky 1982), and containment-based Optimality Theory (Prince and Smolensky 1993). Although this framework contains only small-scale technical adjustments to phonological standard assumptions and achieves interesting new results mainly by their specific combination, I will call it "Extended Stratal Containment" (abbreviated as `esc`) whenever it is convenient to refer to the entire set of assumptions proposed in this book.

This chapter introduces the technical details of the proposed approach to phonology and its interaction with morphology.

2.1 Phonological Representations

2.1.1 Colored Containment

The version of OT I propose here is a variant of the Colored Containment version of Optimality Theory developed in van Oostendorp (2006b) and Revithiadou (2007). The central assumption of all versions of Containment Theory is that segments and features are never literally deleted, and are hence "contained" in the output, which has important consequences for the analysis of incomplete neutralization (van Oostendorp 2008) and opacity (see the discussion of Luganda and of Dutch dialects below).

Colored Containment crucially departs from the classical implementation of containment in Prince and Smolensky (1993) in the representation of epenthesis. Whereas Prince and Smolensky equate epenthesis with unfilled prosodic positions, which causes serious problems for the interaction of empty segments with their phonological context (van Oostendorp 2006b:6), Colored Containment exploits the widely held assumption that underlying phonological material is morphologically affiliated and – following Consistency of Exponence (McCarthy and Prince 1993) – maintains this affiliation throughout the phonology. This assumption is made concrete by morphological coloring: Each morpheme has a unique color different from the colors of all other morphemes, and each non-epenthetic element in phonological structure wears the specific color of its morpheme throughout the grammar. This makes underlying (morphemic) material representationally distinct from epenthetic elements which are colorless.

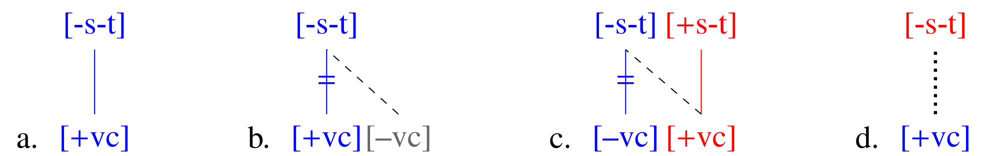
A second major difference between different versions of Containment Theory is the treatment of deletion. Whereas Revithiadou and van Oostendorp capture the distinction between deleted and phonetically realized material by an adaptation of Goldrick's (2000) turbidity model, I will implement this difference in a more traditional autosegmental system where association lines in addition to potentially bearing morphological color may also be marked for being phonetically visible or not. Interpreting morphological color as morphological visibility on a par with phonetic visibility, this leads to the following typology for association lines:

(1) **Typology of Phonological Visibility for Association Lines**

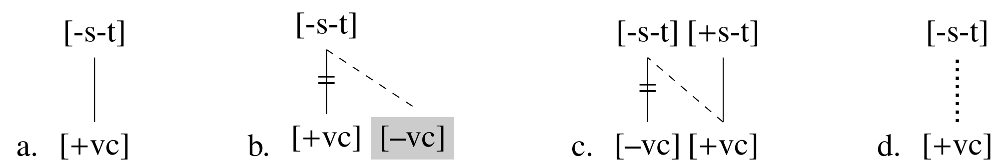
		morphologically visible	
		+	**–**
phonetically visible	**+**	realized underlying association	realized epenthetic association
	–	unrealized underlying association	unrealized epenthetic association

In this system, an epenthetic association line is morphologically invisible, but phonetically visible, while a "deleted" association line is morphologically visible and phonetically invisible. An underlying association line which is realized in the output is visible both to morphology and phonology.[1] From the perspective of the primordial containment-based system in Prince and Smolensky (1993), where deletion of segments was implemented by retaining the segments itself but literally deleting the association lines integrating them into higher prosodic structure, the resulting system of esc is "extended" because it abandons literal deletion of association lines.

(2) illustrates the notation I will use for autosegmental representations. (2-a) shows an underlyingly voiced stop which is realized faithfully, (2-b) is an underlyingly voiced stop under overt devoicing; [–vc] and its link are epenthetic, hence colorless. That the association line is epenthetic is also indicated by dashing. The "=" symbol marks the underlying association line as phonetically invisible. (2-c) shows a case where a stop assimilates in voicing to a following nasal:[2] (2-d) is an obstruent which is associated by a non-phonetic epenthetic association mine to a floating heteromorphemic [+vc] node.

(2)


(3) shows the same structures in colorless notation, where the epenthetic node is marked by including it in a shaded box. This marking convention will also be maintained throughout this book:

(3)


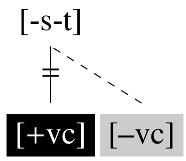
Phonological nodes (root nodes, prosodic nodes, and feature nodes) are not locally marked as phonetically (in-)visible. Instead their visibility follows from their inclusion in P-structure, a

[1] See the analysis of Luganda in subsection 2.3 and the treatment of overwriting in chapter 3 for discussion on the role of association lines which are neither visible morphologically nor phonetically.

[2] I assume that [+/–sonorant] and [+/–continuant] are not part of the root-node, but use the more standard root node representation here for the exposition of the formalism.

substructure of candidates which corresponds conceptually roughly to the result of Stray Erasure (Steriade 1982, Itô 1988) in pre-OT and early OT-phonology. Thus the [+vc] node in (3-b) and the [–vc] node in (3-c) would both not be included in the P-structure of these representations because they are not dominated by higher phonological nodes (segmental root nodes) and hence not be interpreted by phonetics (see subsection 2.1.4 for detailed discussion). To indicate that nodes are not included in P-Structure, I will print them in white and include them in black boxes as shown in (4) which corresponds to (3-b). However it is important to keep in mind that this notation (in contrast to the marking devices for epenthetic nodes/association lines and the phonetic visibility of association lines) does not correspond directly to any formal property of the marked objects.

(4)



I will also use the gray and black background notation in contexts where it is convenient to simplify autosegmental representations to a segmental format as in (5): All three strings in (5) are phonetically interpreted as [bete]. In (5-a) this corresponds to underlying /bete/, while the input for (5-b) is /bet/ (with epenthetic [e]), and (5-c) shows underlying /betep/ with deleted /p/:[3]

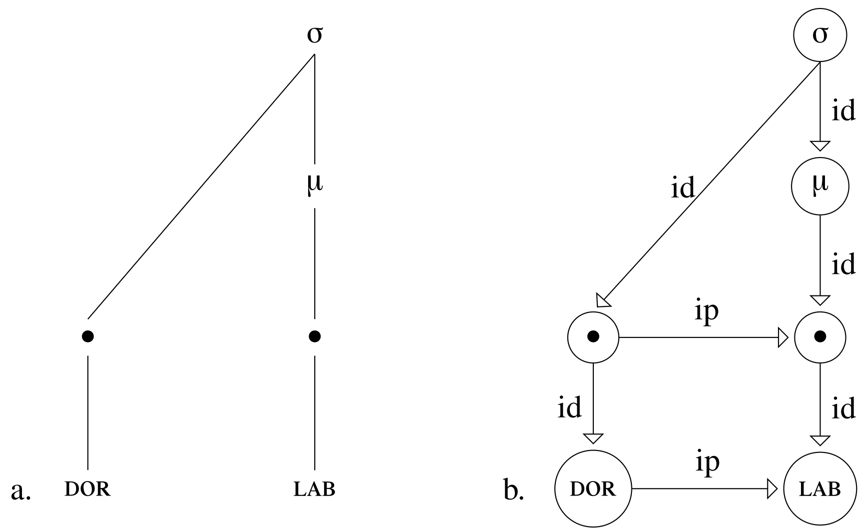
(5) a. b e t e   b. b e t e   c. b e t e p

[3]The advantage of this notation is that it does not require any diacritics and can be combined with coloring wherever representation of morphological coloring is relevant and possible.

2.1.2 Autosegmental Representations

Autosegmental Representations: Formally, an autosegmental representation is a directed labelled acyclic graph (http://en.wikipedia.org/wiki/Directed_graph), i.e., an ordered pair $G = (N, E)$ where N is a set of nodes, and E a set of directed edges connecting the nodes in N.[4] Thus the standard autosegmental diagram in (6-a) is a simplified representation of the graph in (6-b)

(6) **Autosegmental Representations as Graphs**



Nodes and Edges: In the simplest case, nodes are conceived as atomic objects, and an edge is formally an ordered pair of nodes. Thus the edge • → LAB would formally be the ordered pair (•, LAB). Here I assume a slightly more complex structure to accommodate Colored containment Theory. Crucially a node is a triple (I, L, C) where I is a unique identifier, L a label, and C a morphological color. An edge is a quintuple (N_1, N_2, T, C, P) where N_1 and N_2 are nodes (the origin and the destination of the edge), T is the type of the edge (i.e. either id: immediate dominance, or ip: immediate precedence), C is a morphological color, and P is a phonetic visibility parameter (either "0" for invisible or "1" for visible). However, for simplifying the discussion, I will in the following often disregard color, phonetic visibility, and types of nodes and edges whenever they are irrelevant, and represent nodes as atomic, and edges as ordered pairs.

Graph Terminology and Notation: $N(G) = N$ and $E(G) = E$, for $G = (E, N)$. A node n *dominates* a node n' iff there is a directed path of immediate dominance transitions from n to n' of length $l \geq 0$. A node *n precedes* a node n' if there is a directed path of immediate precedence transitions from n to n' of length $l \geq 0$. A node *n reflexively precedes* a node n' if there is a directed path of immediate precedence transitions from n to n'. A node *n reflexively dominates* a node n' if there is a directed path of immediate dominance transitions from n to n'. Every node reflexively precedes itself and reflexively dominates itself. Two nodes n_1, n_2 are *linearly ordered* iff either n_1 precedes n_2, or n_1 precedes n_2. Two nodes n_1, n_2 are hierarchically ordered or *linked* iff either n_1 dominates n_2, or n_1 dominates n_2. Two nodes n_1, n_2 are *associated* iff either n_1 immediately dominates n_2 or n_1 immediately dominates n_2. Note especially the

[4] See Kornai (1995), Coleman (1998) for more discussion of the formal aspects of autosegmental representations.

following definition which is non-standard:

(7) **Definition *Ancestor Node*:**
A node is an *ancestor node* in G if it is not
immediately dominated by any other node in $N(G)$.

The notion defined in (7) roughly corresponds to the definition of *root node* in tree theory. I use the newly coined term *ancestor node* here to avoid the confusion with segmental root nodes and lexical roots.

Autosegmental Representations: Every directed acyclic graph with the internal structure of node and edges described above is an *autosegmental representation*. Thus in the following, I will use the terms 'graph' and 'autosegmental representation' as interchangeable.

Well-formed Autosegmental Representations: An autosegmental representation G is *well-formed* if it satisfies the three conditions in

(8) **Conditions on Wellformed Autosegmental Representations**

a. There is a single ancestor node A which dominates all nodes in G
b. For every two nodes $n_1, n_2 \in N(G)$:
n_1 and n_2 are linearly ordered if and only if their labels are of the same node type
c. For every two nodes $n_1, n_2 \in N(G)$:
If n_1 immediately dominates n_2 then
node type(Label(n_1)) → node type((Label(n_2))
is a possible dominance pattern

The node types mentioned in (8) are specified in (9). (8-b) requires for examples that in a graph all nodes labeled with one of the tone features L, H, M For example either precede or follow each other, an d that they may not precede or follow nodes with other labels (say • o rμ).(9):[5]

(9) **Node Types**

(i)	Prosodic Word	{ω}
(ii)	Syllable	{σ }
(iii)	Mora	{μ }
(iv)	Tone	{L,H,M}
(v)	Root Node	{•}
(vi)	Place	{DORSAL, LABIAL,CORONAL}
(vii)	ATR	{ ⊣, ⊢}
(viii)	Every binary segmental feature is a separate node type: ([±sonorant], [±consonant], [±high], [±voice], . . .)	

(10) lists the possible dominance patterns referred to in (8-b). Thus, (8-b) licenses a σ-node which immediately dominates a •-node, but not a σ-node immediately dominating a PL-feature node.

[5]Thus (8)-b implies that there is no tier separation, i.e. two nodes of the same node type cannot be on different tiers.

(10) **Possible Dominance Patterns**

(i)	Prosodic Word	→	{Syllable}
(ii)	σ	→	{Mora,Root Node, Tone}
(iii)	Syllable	→	{Root Node,Tone}
(iv)	Tone	→	{ }
(v)	Root Node	→	{Place, ATR, [±sonorant], [±consonant], [±voice], ...}

The hierarchical feature structure encoded in (10), and employed in the remainder of this book is very simplistic: The only possible TBUs are syllables and moras. Tones are atomic units, not decomposed into more basic features – neglecting the ground-breaking insights of Yip (1980) – and there is no internal structure of segmental features as convincingly argued for in Clements and Hume (1995). Note also that [±consonant] and [±sonorant] do not have any special status as inherent part of segmental root nodes. I see these simplifications with due reluctance and regret, but adopt them because they are not crucial for any of the data and analyses presented here, and make the parallels between different domains of mutation morphology (moras, segmental, features, etc.) much more conspicuous.

2.1.3 The Structure of Candidates and GEN

A candidate is an ordered pair (A, R), where A is a designated ancestor node, and R is an autosegmental representation (but not necessarily a wellformed autosegmental representation). The designated ancestor node is the node the candidate selects as the ancestor node for the subpart of the autosegmental representation which is phonetically interpretable. See subsection 2.1.4 for discussion.

Intuitively, and derivationally speaking, GEN is allowed to perform any combination of the basic operations in (11) to produce output candidates, and optionally the operation in (12) which may be applied maximally once:

(11) **Potentially Iterative Operations of GEN**

a. Insert a colorless node (feature, root node or prosodic node)
b. Insert a colorless (phonetic or non-phonetic) association line between two unassociated nodes
c. Mark a colored association line as phonetically invisible

(12) **Non-Iterative Optional Operation of GEN**
Mark one of the nodes as the designated ancestor node

More formally and declaratively speaking, GEN is a function which takes as input a graph $R = (N, E)$, and generates the set of output candidates of the form $C = (R', A)$, where $(R' = (N', E'))$ such that the conditions in (13) hold:

(13) **Conditions on Candidates Generated by GEN**

a. $A \in$ N'
b. $N \subseteq N'$
c. $\forall (N_1, N_2, T, C, P) \in E : \exists (N_1, N_2, T, C, P') \in E'$
d. $\forall e \in E' :$ If $e \notin E \rightarrow$ color(e) in $E' = \emptyset$
e. $\forall n \in N' :$ If $e \notin E \rightarrow$ color(e) in $E' = \emptyset$

(13-b) states the simple Containment Condition for nodes: Nodes of the input are inherited without modification to candidates. The situation for edges is slightly more complex (13-c): The candidate must contain a corresponding edge for every input edge. The edge in the candidate may have a different phonetic visibility value, but must be the same as the input edge in all other respects (most notably its color must be the same). (13-d,e) state that all epenthetic material must be colorless (has the zero color).

2.1.4 Sub-Representations

Although candidates in Containment are unitary objects and fully contain the structure of the corresponding inputs, constraints and strata may make make differential reference to specific substructures which I will define here.

The most obvious substructure of a given candidate C is of course the input representation contained in it. I will call this the M-Structure of C (or simply M(C)). It is defined as follows (where $C = (A, G)$, $G = (N, E)$, and $G' = (N', E')$) :

(14) **Definition M-Structure**

M(C) is the candidate (A, G') where G' is the minimal subgraph of G such that:

a. All colored nodes of N are in N'
b. All colored id-edges of E are in E'
c. All ip-edges of E which connect nodes of $N \cap N'$ in E are in E'

The only non-obvious part of (14) is (14-c) which takes account of the immediate-precedence edges inserted by morphological concatenation. These don't have morphological colors, but are still integrated into M-structure to render it a coherent graph.

Where M-Structure corresponds to the input of phonological evaluation. P-Structure is the part of a candidate which is either delivered to phonetic interpretation, or to a subsequent stratum (see section 2.4 for discussion). Thus it is a rough declarative equivalent of the operation Stray Erasure of in pre-OT and early OT-phonology (Steriade 1982, Itô 1988, Prince and Smolensky 1993).

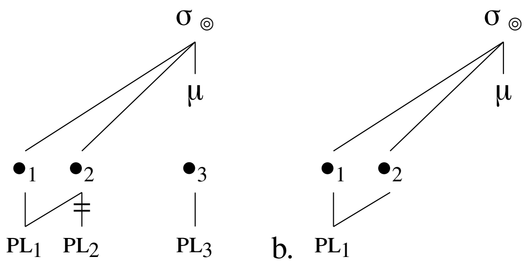
(15) **Definition P-Structure**

P(C) is the candidate (A, G') where G' is the minimal subgraph of G such that:

a. All nodes of N which are dominated through an uninterrupted path of phonetic association lines by A in G are in N'
b. All phonetic id-edges of E which connect nodes of $N \cap N'$ in E are in E'
c. All ip-edges of E which connect nodes of $N \cap N'$ in E are in E'

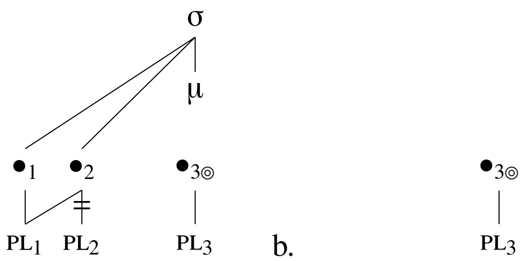
(16) provides a simple example – (16-b) is the P-structure corresponding to the candidate (16-a). The subscript numbers are not part of the representation, but only added here to enease reference to specific nodes, whereas "◎" here and in the rest of the book marks the designated ancestor node A. $\bullet_3$ and PL_3 are not in (16-b) because they are not dominated by $\sigma_{◎}$. PL_2 is dominated by $\sigma_{◎}$, but since the last id-edge of the association path is non-phonetic, this isn't sufficient to establish inclusion in (16-b) by (15-a). The association line between $\bullet_2$ and PL_2 itself is not in (16-b) because (15-b) only includes phonetic id-edges in P-structure:

(16) a. b.



Note crucially the role of the ◎ for computing P-Structure. Thus (17-a) which differs from (16-a) only in its ◎ has the dramatically different P-structure (17-b)

(17) a. b.



Intuitively, I-structure is a subrepresentation which neutralizes the difference between phonetic visible and invisible association lines. Put another way, it is the graph generated by replacing the phonetic visibility value of every edge in a graph by '1'. (18) defines this intuition more formally Suppose again that $C = (A, G)$, $G = (N, E)$, and $G' = (N', E')$

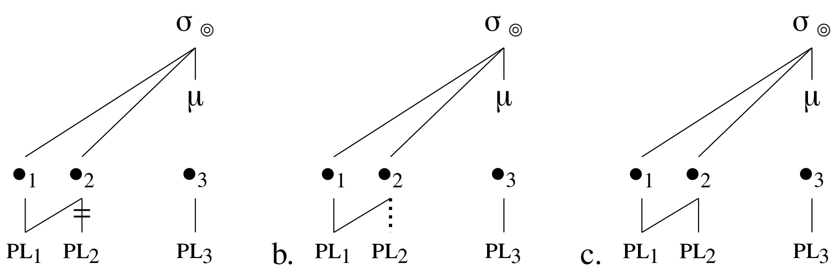
(18) **Definition I-Structure**

I(C) is the candidate (A, G') such that:

a. $N = N'$
b. $\forall$ ip-edges $e \in E, E' : e \in E \leftrightarrow e \in E'$
c. $\forall$ i-edges $e \in E, E' : (N_1, N_2, T, C, P) \in E \leftrightarrow (N_1, N_2, T, C, 1) \in E'$

Thus both (19-a) (= (16)-a) and (19-b) have the I-Structure in (19-c):

(19) a. b. c.



Finally I will often refer to the S-Structure of a candidate to refer redundantly but more explicitly to the entire candidate as generated by Gen:

(20) **Definition S-Structure**

S(C) $=_{\text{def}} C$

2.2 Morphological Exponence

I adopt a late-insertion (i.e. postsyntactic) approach to morphological spellout (Halle and Marantz 1993, Trommer 2003, Wolf 2008) which works in two phases, where roughly speaking, Vocabulary Insertion selects the morphological exponents for specific morphosyntactic structures, whereas Exponent Insertion combines (concatenates) these exponents phonologically:

(21) **Morphological Spellout**

As in Trommer (2003) I assume that syntax provides word-like units without phonological content to the morphology component. each such unit takes the form of an ordered list of abstract syntactic heads (with the lexical root in initial position). Thus the Dinka 3SG verb form *wɛ̀ːc*, '(s)he kicks' (corresponding to underlying *wέc*, Andersen 1995:28) is delivered by the syntax to morphological spellout as (22):

(22) < [+V], [+3 +SG] >

Vocabulary Insertion realizes the heads of these head lists by inserting into every head a vocabulary item which matches the features of the head (where matching is potentially only partial, i,e. the VI is underspecified w.r.t. the head). Concretely, insertion here means replacing the relevant head by the exponents specified in the VI, resulting in a list of exponents. *Exponent Insertion* is the process which actually attaches exponents to the base, i.e. attaches the other exponents to the first exponent of the list, and governs linear order. (Note that the term "base" in the following simply refers to the phonological representation to which an exponent is affixed at a specific point of the morphological derivation).

2.2.1 The Structure of Vocabulary Items and Exponents

Vocabulary Items are triples consisting of a feature structure specifying morphosyntactic features, a list of exponents with independent conditions on linearization (prefix suffix, infix, etc. see subsection 2.2.4 below for discussion, and contexts), and a (potentially empty) set of further context restrictions (see below for discussion) written as in (23) (I use the symbol "⊕" to separate the elements of exponent lists to highlight the difference to other list objects employed in `esc`):

(23) **Structure of a Vocabulary Item**

$$[Feature_1, \ldots, Feature_n] \leftrightarrow\ < Exponent_1 \oplus Exponent_2 \oplus \ldots Exponent_m >$$
$$(/ \{ Context_1, Context_2, \ldots Context_i, \})$$

The morphological lexicon of a given language is itself a disjunctive list of Vocabulary Items ordered according to specificity and other general criteria (cf. Müller 2005 for discussion). If more than one VI matches a given syntactic head, the first matching VI in the lexicon (the list

of VIs is inserted). A VI matches a syntactic head if all of its morphosyntactic features are contained in the head and its context specifications are met.
Exponents may either be *simple* or *complex*. Complex exponents are of the two types listed in (24).

(24) **Types of Complex Exponents**

a. **Exponents Sets:** Sets of simple exponents delivered for selection to phonological evaluation

b. **Exponent Hierarchies (Lists):** Ordered Lists of simple exponents selected by the Elsewhere Principle at Vocabulary Insertion

Exponents Sets (marked by enclosing them in curly brackets: “{,}”) implement phonologically optimizing suppletive allomorphy which is carried out in phonological evaluation (see subsection 2.2.3 for discussion), whereas *exponent hierarchies* provide allomorphs which undergo selection at Vocabulary Insertion proper, due to the same principles as selection of the VIs themselves. In this subsection I will restrict my discussion to simple exponents.

Splitting vocabulary items into different exponents is motivated by cases where different parts of a VI target different linear positions of the base as in circumfixes such as the Tagalog “requirement” marker *ma- . . . -an* (Lieber 1992:155) (Schachter and Otanes 1972:226):

(25) **The Tagalog “Requirement” Circumfix** (Schachter and Otanes 1972:226)

a.	bilis	‘speed’	ma-bilis-an	‘requiring speed’
b.	tagal	‘slowness’	ma-tagal-an	‘requiring slowness’

This might be represented by the VI in (27) (where ‘+R’ stands for the morphosyntactic feature encoding “requirement”). The linearization specification “$\_\_\bullet_l$” indicates that *ma* is prefixed to the first –l(eftmost) – segmental root node of the base, whereas “$\bullet_r\_\_$” designates the position of *an* after the last – r(ightmost) – segment of the base.

(26) [+R] $\leftrightarrow$ $< (\mathrm{ma}, \_\_\bullet_l) \oplus (\mathrm{an}, \bullet_r\_\_) >$

Thus exponents are hybrids: On the one hand, they are independent from each other for phonological purposes: each forms a wellformed autosegmental representation on its own; in particular different exponents are not dominated by a common ancestor node, and they have independent phonological linearization requirements. On the other hand exponents of a single Vocabulary Item realize exactly the same morphosyntactic features, implying that they should be indistinguishable for modules and processes outside of morphology. I encode this assumption by the explicit statement in (27):

(27) **Unified Color Exponence Hypothesis:**
Exponents of the same vocabulary item bear the same morphological color.

For phonological evaluation, Unified Color Exponence has the important consequence that constraints which make reference to colors cannot distinguish exponents of a single Vocabulary Item. In fact, this is crucial for the effects of constraints such as □Contiguity (cf. section 2.3.5).
Vocabulary Items with multiple exponents often involve non-segmental entities. Thus, the Atlantic language Fula apparently has circumfixes which comprise segmental suffixes and prefixal floating features such as [+nasal] and [–continuant] (cf. Trommer 2008c). Similarly, the Wakashan language Kwak’wala has a morphological pattern which combines suffixation of

segments and prefixal reduplication (Kirchner 2010). The `esc`-representation of segmental affixes bearing floating features is also of the same type (cf. subsection 2.2.5).
The Dinka 3SG affix discussed above also involves multiple exponents, but without any of them being segmental. It corresponds to the VI in (28), where the first exponent is a L tone prefixing to the first tone of the base, and the second exponent a mora which is suffixed to the right-most mora of the base (the L-tone prefix accounts for the change in tone quality, and the mora for the lengthening in *wéc* ⇒ *wèːc*, see chapters 4 and 5 for detailed discussion on the morphophonology of these markers):

(28) [+3 +SG] ↔ < (L, $\_\_T_l$) ⊕ (μ, $\mu_r\_\_$) >

More generally, a simple exponent is a triple (P, L, C), where P is a well-formed autosegmental representation (the phonological content of the marker), L a linearization specification (see subsection 2.2.4) , and C a set of context specifications (see subsection 2.2.3). Thus Dinka verbs have the 2SG exponent *-é* which occurs only in forms that have undergone some valency changing (or directional) derivation with exception of the centripetal derivation (cf. *wèc*, 'you (SG) kick' (underived) vs. *wɛ̀ːc-é*, 'you (SG) kick' (AP) and *wéːc*, 'you (SG) kick' (CP), , Andersen 1995:20,28). This exponent has the structure in (29), where I assume that (little) "v" is the privative feature which is common to all verbal derivational heads, and [–CP] designates all non-centripetal categories of this type:

(29) (é, $\bullet_r\_\_$, {[v –CP] __})

In contrast to affixes, exponents of lexical roots do have empty linearization specifications and an empty set of context restrictions. Thus the VI for the Dinka verb *wéc*, 'to kick' is properly represented as in (30):

(30) [+V] ↔ < (wéc, Ø, { }) >

In the following, I will often abbreviate exponents in obvious ways by omitting empty structures and lists, brackets of singleton lists or sets, or by indicating linearization specifications of standard prefixes and suffixes in the standard way by dashes. Thus (29) might be written as "(-é, [v –CP] __)" or "-é, [v –CP] __", and the exponent in (30) as "(wéc)" or just "wéc".

2.2.2 Vocabulary Insertion

Vocabulary Insertion basically replaces a morphosyntactic word (a list of abstract heads) by a list of exponents as shown in (31) (I'm abstracting away here from the effects of exponent sets which require a slight complication of the insertion algorithm, see subsection 2.2.3 for discussion):

(31) **Vocabulary Insertion**
Given a morphosyntactic word M = < $H_1 \ldots H_n$ >,
and a lexicon of vocabulary items L,

For heads H_i, $1 \leq i \leq n$**:**
Let V be the first VI in L which matches H_i
and E = < $E_1 \ldots E_m$ > the exponent list of V
For exponents E_j, $1 \leq j \leq m$**:**
If E_j is an ordered list:
Replace E_j in E by the first element of E_j which matches H_i and its context

Replace H_i by the elements of E

Crucially there are two selection loops in the algorithm. On the one hand, for each head, the first matching VI is selected, and at this point also the first matching exponent of exponent lists is chosen.

Take as an example again the Dinka 2SG form of non-derived verbs ((22), (28)). Recall from (22) that the head list delivered by the syntax component (M in (31)) is < [+V], [+3 +SG] >. The relevant VIs from the VI-lexicon L are the entries in (28) and (30). Now the algorithm in (31) will go through (22) and first replace [+V] by (wḗc, Ø, { }), then turn to [+3 +SG], and replace it by the sequence (L, $\_\_\mathrm{T}_l$) ⊕ (μ, μ_r__), resulting in the exponent list in (32), which becomes later subject to Exponent Insertion.

(32) < (wḗc, Ø{ }) ⊕ (L, $\_\_\mathrm{T}_l$) ⊕ (μ, μ_r__) >

2.2.3 Exponent Sets and Allomorphy

An exponent set is an (unordered) disjunction of simple exponents written as in (33):

(33) **Notation for Exponent Sets**

$$\left\{ \begin{array}{c} SimpleExponent_1 \\ \ldots \\ SimpleExponent_n \\ \end{array} \right\}$$

Exponent sets (or *disjunctive exponents*) capture cases, where allomorphy is optimizing with respect to the phonological ranking of the language implementing the standard approach to phonologically conditioned suppletion in OT (Kager 1996, Rubach and Booij 2001, Wolf 2008). A classical example is the allomorphy of the definite article clitic in the analysis of (Mascaró 1996, Mascaró 2007) (data from Harrell (1962)) which surfaces as [u] after consonant-final, and as [h] after vowel-final stems:

(34) **Allomorphy of the Definite-Article Clitic in Moroccan Arabic**

a. xtˤa	'error'	xtˤa-h	'his error'
b. ktab	'book'	ktab-u	'his book'

This can be captured by the exponent set {h, u}. For exponent sets, candidates generated by GEN from affixing either of the simple exponents of the disjunction are evaluated in the same phonological evaluation cycle. In other words, Exponent Insertion applies not to a single exponent list, but to the set of all possible exponent lists which result from replacing every exponent set by one of its members. This results in a set of phonological graphs which are the basis for GEN generating candidates on the basis of all generated alternatives, which are in turn evaluated by the very same process of constraint evaluation.

Thus in Moroccan Arabic case for the vowel-final base *xta*, *xta-h* is evaluated against *xta-u* and surfaces because it avoids a violation of Onset which is ranked above NoCoda (35). Similarly for the consonant-final noun *ktab*, *ktab*-u wins over *ktab-h* since Onset is violated by neither candidate, and *ktabu* fares better for NoCoda (36) (Mascaró 2007):

(35) **Allomorphy of the Definite-Article Clitic in Moroccan Arabic**

Input: xtˤa-{h,u}

	MAX	DEP	ONSET	NOCODA
☞ a. xtˤa-h				*
b. xtˤa-u			*!	

(36) **Allomorphy of the Definite-Article Clitic in Moroccan Arabic**

Input: ktab-{h,u}

	MAX	DEP	ONSET	NOCODA
a. ktab-h				*!
☞ b. ktab-u				

Phonologically non-optimizing suppletion is captured by context restrictions on simple exponents (see Paster, Bye 2006, 2006 and Bye (2006) for arguments that such cases exist). Following the Extended Indirect Reference Hypothesis in (111), I advocate here the position that context restrictions may only refer to prosodic properties of the base to which an exponent is affixed (see Paster 2005 for a crosslinguistic study on such cases). Thus a number of tonal exponents in Dinka is sensitive to the vowel length of the base to which they attach (see chapter 5 for details). Crucially, this sensitivity is to the prosody of the base at the point where morphological insertion takes place, not when phonological evaluation is carried out. For example there is a low tone BAP exponent which occurs only (and systematically) with underlying-short-vowel verb stems which is captured by the exponent entry -L / V_{μ}. Crucially, on the surface there is no consistent length distinction of verb roots which could motivate the distribution of the tonal suffix: Underlyingly short-V roots and long H-tone roots are lengthened whereas underlyingly long L-tone roots maintain their length, hence underlyingly L/long verbs are extra-long in BAP surface forms, whereas all underlyingly short and H/long verbs are extra long.

More generally context restrictions of exponents and vocabulary items may refer to any property of atomic elements to which they are adjacent. Besides prosodic properties of the base these are also morphosyntactic properties of adjacent syntactic heads. Again some examples for this are to be found in the tonal exponents of Dinka where there is a 2SG H-tone prefix exponent which is restricted to the context of an AP head (cf. the entries in (51)).

2.2.4 Exponent Insertion and Linearization of Simple Exponents

Recall that a simple exponent is a triple (P,C,L) where P is a well-formed autosegmental representation (cf. section 2.1.2), C a set of context restrictions, and L a linearization specification which specifies in which linear position of the base an affix is inserted. Following (Yu 2003, Fitzpatrick 2004), I assume that linearization of an affix as a prefix, suffix or infix is basically idiosyncratic, and is generally speaking either prefixation or suffixation to a member from a restricted set of phonological nodes (“pivots” or “anchor points”) selected on the basis of the linearization specification of the involved exponent.

(37) **Possible Anchor Points for Affixation** (Fitzpatrick 2004:13-14)

a. Initial X
   - (i) First Consonant ($\bullet^{c}_{l}$)
   - (ii) First Vowel ($\bullet^{c}_{v}$) .
   - (iii) First Segment ($\bullet_{l}$)

b. Final X
   - (i) Final Consonant ($\bullet^{c}_{r}$)
   - (ii) Final Vowel ($\bullet^{v}_{r}$)
   - (iii) Final Segment ($\bullet_{r}$)
   - (iii) Final Syllable ($\sigma_{)}$

c. Prominence Points
   - (i) Stressed Syllable (σ_{s})
   - (ii) Stressed Vowel ($\bullet^{v}_{s}$)
   - (iii) Stressed Foot (Ft_{s})

In contrast to Yu and Fitzpatrick, I assume that not only root nodes, but also peripheral elements of other autosegmental tiers can serve as the pivots for affixation (Exponent Insertion). In particular, tonal affixes may be inserted before or after the first tone of a base, and moraic affixes following or preceding the first/final mora of their base.

In fact there is ample evidence that infixation is not restricted to segmental affixes. (see also Zoll 1996 2003 for detailed arguments that non-segmental affixation exhibits standard properties of suffixation and prefixation). Thus adopting the classical assumption that morphological reduplication is triggered by the affixation of prosodic material (especially of syllables and feet) not dominating segmental root nodes (Kirchner 2010, Bermúdez-Otero 2011, Bye and Svenonius 2011), infixal reduplication (see Broselow and McCarthy 1983 for a classical survey, and Yu 2003 for more recent discussion) is technically the infixation of syllable and foot nodes.[6]

Consider for example the case of mora infixation in Shizuoka-Japanese discussed in Davis and Ueda (2002) which is manifested either by insertion of a nasal, gemination of the medial syllable, or lengthening the first vowel of the base:[7]

(38) **Mora Affixation in Shizuoka Japanese** (Davis and Ueda 2002)

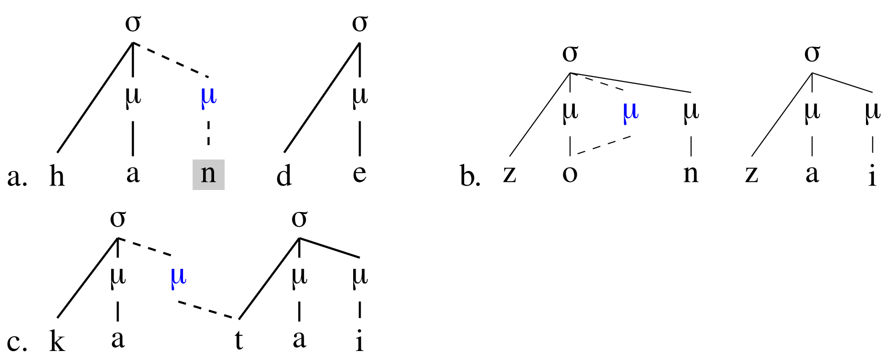
	Adjective	**Emphatic Form**	
a.	hade	ha**n**de	'showy'
	ozoi	o**n**zoi	'terrible'
	nagai	naŋgai	'long'
b.	katai	ka**tt**ai	'har'
	osoi	o**ss**oi	'slow'
	takai	ta**kk**ai	'high'
c.	zonzai	z**o:**nzai	'impolite'
	suppai	s**u:**ppai	'sour'
	okkanai	**o:**kanai	'scary'

[6]See Hyman and Leben (2000) for the claim that there are no cases of tonal infixation.

[7]More evidence for mora infixation from Nilotic is provided in chapter 4.

Crucially, as shown in (39), the additional mora expressing emphasis appears after the first mora of the base, which becomes especially obvious from the nasal insertion case (39-a) where the vocalic stem mora clearly intervenes between the additional affix mora and the left edge of the base .[8] (39) shows this with autosegmental representations:

(39)



In `esc`, the emphatic exponent can be represented as in (40), a μ which is suffixed to the leftmost μ of its base:

(40) $(\mu, \mu_1 \_\_)$

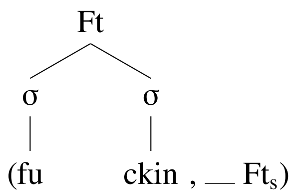
Affixation of an entire foot to the foot tier is instantiated by expletive infixation in American English (McCarthy 1982, Yu 2003) where a foot (*fuckin* or *bloody*) constituent attaches to the head foot of the base.[9]

(41) **English Expletive Infixation** (McCarthy 1982)

a.	togéther	to-**bloody**-gether
b.	advánce	ad-**bloody**-vance
c.	impórtant	im-**fuckin**-portant
d.	Winnipesáukee	Winnipe-**fuckin**-saukee

In `esc`, this can be captured by the marker in (42) specifying a foot which prefixes to the main-stressed foot of the base. See below for discussion of how the concomitant infixation of the syllables and segments of *fuckin* is accomplished.

(42)



[8]The emphatic cannot be infixation before the final mora of the base since the second syllable sometimes contains one (*hade*) and sometimes 2 moras (*nagai*). There is one more potential analysis: the mora might be a prefix, attach to the base-initial vowel whose mora in turn deassociates and triggers nasal insertion etc.

[9]See McCarthy (1982), Yu (2003) for discussion of cases where expletive infixation targets secondarily stressed feet. This might be evidence for also assuming targets such as Ft_1.

Consider finally a case of σ-affixation. As shown in Yu (2003:41), Ulwa marks distributive forms of adjectives by a CV-reduplicant which appears consistently before the main-stressed syllable of the base. If stress is on the first syllable, this results in a prefix (43-a). If the stressed syllable is non-initial, it becomes an infix.

(43) **Ulwa Adjective Distributive Reduplication** (Green 1999:51)

a.	jám-ka	'good-ADJ'	**ja-**jám-ka
	píː-ka	'extinguished-ADJ'	**pi-**piː-ka
a.	ihír-ka	'erect-ADJ'	i-**hi-**hír-ka
	barás-ka	'black-ADJ'	ba-**ra-**rás-ka

Adopting the assumption that templatic reduplication is the consequence of affixing prosodic nodes which are floating in the sense that they do not dominate segmental material (Kirchner 2010, Bermúdez-Otero 2011, Bye and Svenonius 2011), the Ulwa distributive affix must be represented as a σ-node. In `esc`, it can be captured by the exponent in (44) which specifies the affix as a syllable which is prefixed to the stressed syllable of the base:

(44) $(\sigma, \_\_\ \sigma_s)$

In general, anchor points/pivots for affixation in `esc` take the form of linearization specifications (LP) of simple exponents. A LP has one of the two forms in (45)

(45) **Types of LPs**

a. **Prefix:** __ *NodeDescriptor*
b. **Suffix:** *NodeDescriptor* __

A *NodeDescriptor* consists minimally of a node name (e.g. "•" or "µ"), or the name of a node type (e.g. "Tone") and one of the subscripts "*l*" (for the leftmost element matching the *NodeDescriptor*), "*r*" (for the rightmost element matching the *NodeDescriptor*), or "*s*" (for the main-stressed element matching the *NodeDescriptor*)'. Segmental root nodes may additionally bear the superscripts "c" or "v" restricting them to •s dominating [+cons] and [-cons] respectively. The LPs corresponding to the anchor points in (37) are specified in brackets there.

Let us now turn to the phonological details of Exponent Insertion. In the most basic case, an exponent may be thought of consisting only of a single tier. Then prefixation of the exponent (the tier) T to the base (the graph) G would result in the minimal graph G' which is a tier prefixation of T to a specified pivot in G as defined in (46) ((47) gives the parallel definition for suffixation):

(46) **Definition Tier Prefixation**
(for tier $T = t_1 \to t_2 \to \ldots \to t_n$ and graph $G = (E, N)$)

A graph $G' = (E', N')$ is a *tier prefixation* of T to node D in G iff:

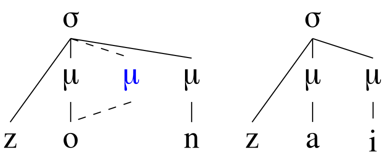
(i) all nodes which are in N or T are in N'
(ii) all id-edges which are in E are in E'
(iii) all ip-edges which are in T are in E'
(iv) all ip-edges which are in E and are not of the form $X \to D$ are in E'
(v) E' contains an ip-edge from the rightmost node of T to D
(vi) If D is immediately preceded in G by another node M then E' contains an ip-edge from M to the leftmost node of T

(47) **Definition Tier Suffixation**
(for tier $T = t_1 \to t_2 \to \ldots \to t_n$ and graph $G = (E, N)$)

A graph $G' = (E', N')$ is a *tier suffixation* of T to node D in G iff:

(i) all nodes which are in N or T are in N'
(ii) all id-edges which are in E are in E'
(iii) all ip-edges which are in T are in E'
(iv) all ip-edges which are in E and are not of the form $D \to$ X are in E'
(v) E' contains an ip-edge from D to the leftmost node of T
(vi) If D immediately precedes in G another node M then E' contains an ip-edge from to the rightmost node of T to M

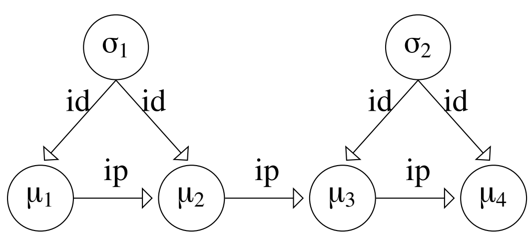
Let us see how this works with Japanese μ-infixation, concretely the derivation of *zonzai* ⇒ *zo:nzai*, the structure repeated in (48):

(48)


Recall that the emphatic exponent has the form in (49), i.e. it is a suffix which attaches to the leftmost mora of its base

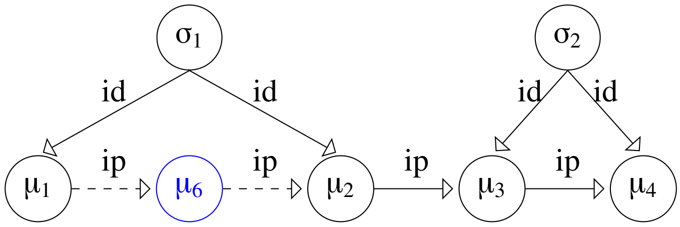
(49) $(\mu, \mu_{1}\,\_\_)$

Considering only σ-tier and μ-tier, the base *zonzai* has the structure in (50), and the emphatic exponent corresponds to the rudimentary graph in (51)

(50)


(51) 

The minimal *tier suffixation* according to (47) is (52). Obviously it contains all nodes from (50) and (51) (cf. condition (47)-i) and the four id-edges leading from syllables to μ-nodes in (50) (cf. condition (47)-ii). Trivially, (52) also contains all ip-edges from (51) (cf. condition (47)-iii) since (51) has no edges. Turning to condition (47)-iv, the only id-edge of (50) of the form $D \rightarrow$ X is μs1 → μs2 (since μs1 is the target of suffixation), which is not in (52) whereas all other id-eges from (50) are. (52) also contains an additional ip-edge from μs1 (*D*) to μs6 (the leftmost node of *T*) (cf. condition (47)-v), and from μs6 (the rightmost node of *T*) to μs1 (*M*/the node immediately preceded by *D*/μs1 in (50)) (condition (47)-vi). (52) is *minimal* because it does not contain any other nodes or edges apart from those explicitly required by (47).

(52) 

Note that the affix mora in (52) is fully integrated w.r.t. immediate precedence, but not w.r.t. immediate dominance. Thus there is no id-edge from σ_1 to μ_6 (nor from μ_6 to any segment). The ip-edges to syllables and segments in (48) are inserted by the phonological evaluation, not by Exponent Insertion.

This implies also an other important property of Exponent Insertion: The structures it generates are not necessarily wellformed autosegmental representations because these require that all nodes of graphs are dominated by a unique ancestor node which obviously doesn't hold for μ_6 in (52). In fact, phonological optimization might be in part understood as an attempt to restore formal well-formedness and interpretability to phonological structure which has been distorted in the course of affixation.

In the general case, an exponent graph may consist of different tiers, and all these tiers must be affixed simultaneously to the corresponding tiers of the base graph at the appropriate nodes. The following ancillary definition is useful to pick out exactly these nodes for every tier:[10]

(53) **Definition of *Simultaneous*:** Two nodes N_1 and N_2 are *simultaneous* in a graph G if there is a connected subgraph G' of G such that (i) G' contains N_1 and N_2 (ii) G' does not contain any ip-edges and (iii) G' contains maximally one node of each node type (cf. (9))

Graph prefixation is now defined as in (54), where (54-i) takes care for extending tier prefixation to all involved tiers, and (54-ii) ensures inheritance of the exponent's dominance relations (id-edges). (55) is again the mirror-image definition for suffixation:

[10]The relevant relation here cannot be simply the relation of two nodes N_1, N_2 such that either N_1 dominates N_2 or vice versa. This wouldn't capture the case of an affix of the form • – μ– L which is affixed at the •-tier: the L-tone in this case neither dominates •, nor is it dominated by •. Rather it is in a c-command-like relation to •: it is dominated by a node which dominates •.

(54) **Definition Graph Prefixation**
(for the graphs $G_1 = (E_1, N_1)$ and $G_2 = (E_2, N_2)$)

The *Graph Prefixation* of G_2 to node D in G_1
is the minimal graph $G = (E, N)$ such that:

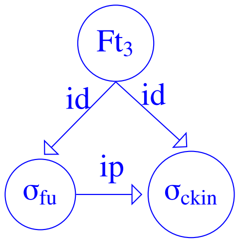
(i) For every node type T for which there is a non-empty set of nodes in N_1 and N_2:
G is a tier prefixation of Tier(T, G_2) to node L in G_1
where L is the leftmost type-T-node in G_1 which is simultaneous with D
(ii) All id-edges which are in E_2 are in E

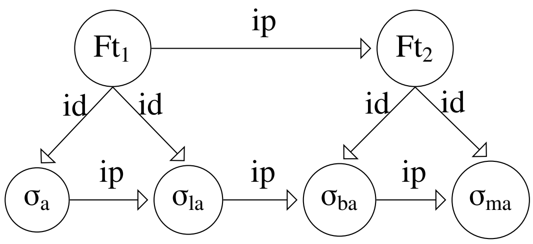
(55) **Definition Graph Suffixation**
(for the graphs $G_1 = (E_1, N_1)$ and $G_2 = (E_2, N_2)$)

The *Graph Suffixation* of G_2 to node D in G_1
is the minimal graph $G = (E, N)$ such that:

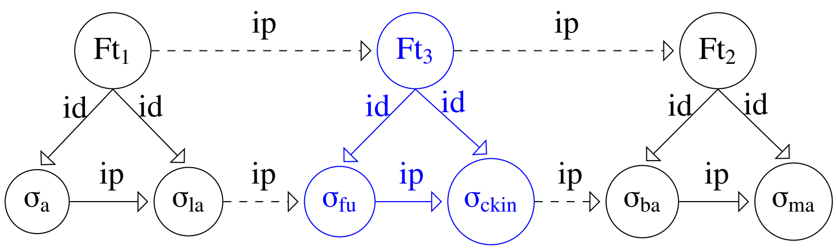
(i) For every node type T for which there is a non-empty set of nodes in N_1 and N_2:
G is a tier suffixation of Tier(T, G_2) to node R in G_1
where R is the rightmost type-T-node in G_1 which is simultaneous with D
(ii) All id-edges which are in E_2 are in E

Here is again a simple illustrative example, English expletive infixation of *fuckin* (56) to the base *Alabama* (57). For convenience, segments (and the PWord of *Alabama*) are omitted and syllables are indexed by the segment strings of the root nodes they dominate:

(56)


(57)


(58) is the graph prefixation of (56) to node FT_2 in (57). The definition in (54) requires by clause (i) that there is tier prefixation of the foot tier of (56) to the leftmost node of (57) which is simultaneous to Ft_2. Since the only foot node which is simultaneous to FT_2 is FT_2 itself, this requires tier prefixation of Ft_3 (again a trivial one-element tier to Ft_2). On the syllable tier of (57), there are two σ's which are simultaneous to Ft_2, σ_{ba} and σ_{ma}. Since σ_{ba} is the leftmost simultaneous element, (54) demands tier prefixation of the syllable tier of (56) to σ_{ba}. Clause (ii) of (54) is fulfilled because all id-edges from (56) are transferred to (58). Note also that the id-edges inherited from (57) satisfy ((46)-ii) simultaneously for both instances of tier prefixation (at Ft- and σ-tier).

(58)


Note finally one important prediction of the approach to affixation developed here: An exponent of a specific node type may not be affixed to an anchor point of an other node type. Thus a foot-sized exponent such as *fuckin* could not target a syllable or a segment as its anchor point.

2.2.5 The Representation of Floating Features

The architecture of `esc` enforces a very specific implementation of floating features. Thus the floating H-tone exhibited by many L-tone roots in Anywa which only shows up in affixed forms (cf. gàth^{H}-ὲ ⇒ gáth-'ε, trade-PL, 'types of trade', Reh 1993:69) cannot form a single exponent together with segmental and prosodic material such as *gath* because the phonological specification of an exponent in `esc` is by assumption a wellformed autosegmental representation. According to the conditions in (8) this implies that integrating *gath* and H would require domination by a single prosodic node (the ancestor node of the graph). However if H were dominated by a higher node, it wouldn't be floating, but just a fully integrated tone which is expected to be realized phonetically also in non-derived forms.[11] Thus gàth^{H} must be represented by the exponent list in (59):

(59) < (gàth) ⊕ (H, T_r __) >

Assuming that (59) is part of an appropriate VI, The algorithm in (31) would map the input for gáth-ɛ́, (< [+N], [+PL] >) into (60):

(60) < (gàth) ⊕ (H, T_r __) ⊕ (ɛ́, • $_r$ __) >

At this point, Exponent Insertion treats the floating H just as it would treat any affixal exponent. It first realizes gàth, then suffixes the H-tone to the L-tone of gàth, and finally suffixes ɛ́ to *th* at the segmental root-node tier (and concomitantly its H-tone to the formerly floating H tone).

[11] A conceivable escape hatch would be to attach H to a higher prosodic head say the PWord, where it might be exempted from phonetic realization. Note also that floating moras might be represented as dominated by syllables but not dominating segments, see also chapter 4 for discussion of such structures.

2.3 Constraints

I assume two general types of constraints, markedness constraints and interface constraints, where I understand markedness constraints as constraints which do not refer in any respect to morphological affiliation and only in a highly restricted way to the phonetic realization of phonological material, whereas interface constraints (most notably faithfulness constraints) make crucial reference to both kinds of information. Thus the restrictiveness of the overall system with respect to the morphology-phonology interface depends crucially on the possible types of interface constraints invoked.

2.3.1 Markedness Constraints and The Cloning Hypothesis

I assume that markedness constraints are subject to the Cloning Hypothesis formulated in (61):[12]

(61) **The Cloning Hypothesis:**
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.

I illustrate the Cloning Hypothesis with a constraint playing a central role in the autosegmental literature, NoSkipping, penalizing autosegmental spans which skip intervening elements.[13] Besides the more familiar constraint in (62) which only counts skipping of phonetically realized elements,[14] it is natural in a containment model of phonological representations that intervention effects of this type generalize to phonetically invisible elements. This intuition is captured by the constraint in (63). The P-clone is marked here, as throughout this book by underlining,[15] whereas the I-clone does not have any explicit marking.

(62)	**<u>NoSkipping</u>**	Assign $*$ to every segmental root node, which is skipped by an association span connecting segments in I
(63)	**NoSkipping**	Assign $*$ to every segmental root node, which is skipped by an association span connecting segments in P

Note a crucial convention for the formulation of constraints to which I will adhere in the rest of the book. The final restriction to P in (62) and to I in (63) are interpreted as having scope over the entire constraint. Thus the I-Structure configuration in (64) violates both, (62) and (63), but the I-Structures in (65) violate only (63) because (62) accesses not the I-structures in (65), but the corresponding P-structures in (66) which do not involve any skipping of root nodes (I assume that the segmental root nodes in (64) and (65) which are not marked as deleted

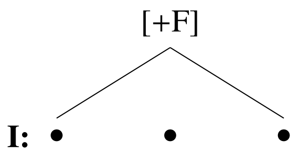
[12]The relation of clones proposed here is parallel to the relation of different types of faithfulness constraints in Correspondence Theory, e.g. Max_{IO} (for the input-output relation), and Max_{BR} (for the base-reduplicant relation). Whereas these constraints are structurally identical they refer to different sub-representations of candidates (or more exactly of input-candidate mappings), but can be ranked independently in individual grammars. This is also true for the markedness clones developed here.

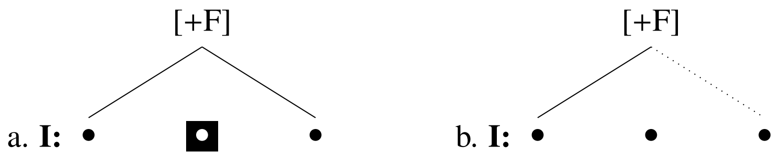
[13]See subsection 2.3.2 for a more explicit formalization.

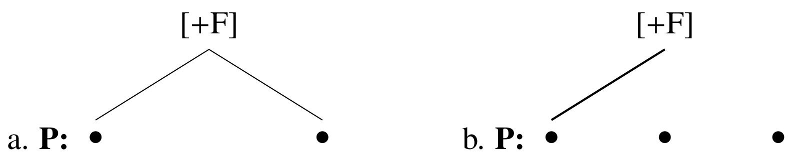
[14]This constraint is often claimed to be inviolable (see e.g. Gafos 1999; Walker 1999), a point which is not crucial for the argumentation here.

[15]In a slight departure from this convention, P-constraints on autosegmental association are marked by double arrows. See subsection 2.3.2 for discussion.

are dominated by higher-order prosodic structure not depicted here, which guarantees their presence in the corresponding P-structures):

(64) 

(65) 

(66) 

Evidence for the generalized NoSkipping constraint in (63) comes from assimilation data in different varieties of Dutch. Thus van Oostendorp (2004) observes that in Hellendoorn Dutch, nasal suffixes assimilate in PLACE to preceding stops (67-a,c). However, in past tense forms, where an intervening underlying stop (the past tense suffix) is deleted, no assimilation takes place (67-b,d):

(67) **Blocking of Place Assimilation in Hellendoorn Dutch** (van Oostendorp 2004:2-3)

		Underlying	**Surface**
a.	'to work'	wɛrk-n	wɛrkŋ̩
b.	'we worked'	wɛrk-t-n	wɛrkn̩
c.	'to hope'	hop-n	hopm̩
d.	'we hoped'	hop-t-n	hopn̩

Similarly, in Aalst Dutch, nasals regularly assimilate to *following* obstruents in place across word boundaries (68-a), but fail to assimilate if the underlying representation contains an intervening schwa (the gender marker) (68-b):

(68) **Blocking of Place Assimilation in Aalst Dutch** (van Oostendorp 2004:17)

		Underlying	**Surface**
a.	'handsome guy'	schoo/n/ ventje	schoo/ɱ/ ventje
b	'beautiful woman'	schoo/nə/ vrouw	schoo/n/ vrouw

Assuming that nasal assimilation is triggered by a constraint which requires that nasals are associated to the same place features as phonetically preceding stops, written here simply as PA ('Place Assimilation'), the contrasts in (67) follow from higher ranked NoSkipping (abbreviated in the following as NoSkip) as shown in (69) and (70). The brackets in (69-b) and (70-b) indicate that the included segments are linked to the same place feature.

(69) **Input:** wɛrk-n, 'to work'

	NoSkip	PA
a. wɛrk-n		*!
☞ b. wɛr(k-ŋ)		

(70) **Input:** wɛrk-t-n, 'we worked'

	NoSkip	PA
☞ a.wɛrkt-n		*
b. wɛr(kt-ŋ)	*!	

The Aalst Dutch data can be obviously captured by the same type of analysis.

Cloning can also account for cases of opacity which are the central motivation for the turbid version of Colored Containment. An often cited case in point is the deletion of vowels under hiatus before another vowel in Luganda which leads to compensatory lengthening of the surviving vowel (Goldrick 2000:2):

(71) **Compensatory Lengthening in Luganda**

a. /ka + tiko/ → katiko 'mushroom'
b. /ka + oto/ → ko:to 'fireplace (dim.)'
c. /ka + ezi/ → ke:zi 'moon (dim.)'

These data lead to an opacity problem for Correspondence Theory because the mora associated to the first vowel (*a* in (71-b)) seems to reassociate to the second vowel (*o* in (71-b)), but under Richness of the Base (Prince and Smolensky 1993) nothing forces *a* to project a mora in the first place since constraints requiring vowels to associate to moras apply – like any other OT-constraint – to outputs, not to inputs.

(73) sketches a solution to this problem based on the I- and P-constraints in (72) (note that the restriction of (72-c) to P is indicated by a double arrow, see subsection 2.3.2 for discussion of this convention) for the case of two adjacent vowels which are not underlyingly dominated by μs.

(72) **Constraints for Luganda**

a. *$\underline{VV}$	Assign ∗ to every ordered pair of adjacent Vs in P
b. $\mu \uparrow V$	Assign ∗ to every vowel which is not dominated by a mora in I
c. $\mu \Uparrow V$	Assign ∗ to every vowel which is not dominated by a mora in P
d. *$[V\ V]_{\mu}$	Assign ∗ to every μ which exhaustively parses more than 1 segmental root node in I

(73) shows how these constraints derive compensatory lengthening of [o] in (71-b) if [a] is deleted. V → μ directly excludes the possibility of vowels which are not dominated (at least in I) by a mora (73-e), which requires the insertion of at least one epenthetic mora (73-a,b,c,d,e). However under the plausible assumption that μs (and especially epenthetic μs) must be phonetically realized in Luganda, phonetic domination of the vowels by μs, as in (73-d) automatically

implies that both vowels are in P, and violate *<u>VV</u> (73-d). Inserting a separate mora for every vowel, where one of the moras dominates the vowels non-phonetically solves this dilemma, but violates $\mu \Rightarrow \bullet$ that prohibits moras which are floating in the sense that they do not dominate a segmental root node in P (73-c). $*[\mathrm{V\ V}]_\mu$ captures the intuition that there must be a mora for every segment, i.e., that one mora cannot be the only prosodic dominating element for two independent segments, which excludes (73-b). This leaves us with (73-a) as the only viable option: One of the epenthetic moras dominates one of the vowels, and the other epenthetic mora dominates the first vowel non-phonetically, and the second one by a phonetic association line leading thus to lengthening of the second vowel (of course, as in any analysis of the Luganda data, independent constraints have to ensure that the first vowel is deleted under hiatus, not the second one).

(73) **Compensatory Lengthening in Luganda in** `esc`

Input: a o

	$\overset{\mu}{\underset{\mathrm{V}}{\uparrow}}$	*<u>VV</u>	$\overset{\mu}{\underset{\bullet}{\Downarrow}}$	$*[\mathrm{V\ V}]_\mu$	DEP $\overset{\mu}{\underset{\bullet}{\uparrow}}$
☞ a. μ μ / a o					***
b. μ / a o				*!	**
c. μ μ / a o			*!		**
d. μ μ / a o		*!			**
e. a o	*!*				

2.3.2 Markedness Constraints on Autosegmental Association

Constraints on Minimal Association: I employ two kinds of constraints on minimal association , ASSOCIATE (74-a) which requires that a node of a specific type is dominated by at least one appropriate higher-order node, and SPECIFY (74-b), which requires that a node of a given type dominates at least one specific lower-order node. In the following, I will usually write these constraints in the arrow notation also depicted in (74) (in running text: $T_2 \leftarrow T_1$ and $T_1 \rightarrow T_2$ respectively).

(74) **I-Constraints on Minimal Association**

a. ASSOCIATE(T_1, T_2)	T_2 ↑ T_1	Assign $*$ to every type-T_1 node which is not immediately dominated by a type-T_2 node in I
b. SPECIFY(T_1, T_2)	T_1 ↓ T_2	Assign $*$ to every type-T_1 which does not immediately dominate a type-T_2 node in I

T_1 and T_2 might either be possible node labels (e.g. DORSAL) or one of the node types listed in (9) above. (75) illustrates both constraint schemata with the I-constraints on segmental root nodes and PL(ACE) features.

(75) **I-Constraints on Minimal Association** (Examples)

a. ASSOCIATE(PL,•)	• ↑ PL	Assign $*$ to every PL-node which is not immediately dominated by a •-node in I
b. SPECIFY(•,PL)	• ↓ PL	Assign $*$ to every •-node which does not immediately dominate a PL-node in I

The short versions for the P-Structure versions of these constraints are marked by double arrows (⇒ and ⇐):

(76) **P-Constraints on Minimal Association**

a. <u>ASSOCIATE</u>(T_1, T_2)	T_2 ⇑ T_1	Assign $*$ to every type-T_1 node which is not immediately dominated by a type-T_2 node in P
b. <u>SPECIFY</u>(T_1, T_2)	T_1 ⇓ T_2	Assign $*$ to every type-T_1 node which does not immediately dominate a type-T_2 node in P

(77) **P-Constraints on Minimal Association** (Examples)

a. <u>ASSOCIATE</u>(PL,•)	• ⇑ PL	Assign $*$ to every PL-node which is not immediately dominated by a •-node in P
b. <u>SPECIFY</u>(•,PL)	• ⇓ PL	Assign $*$ to every •-node which does not immediately dominate a PL-node in P

The P-Structure version of ASSOCIATE is mostly ineffective for lower-level categories which in principle can only be dominated by one specific higher-order node because P by definition only contains nodes which are already dominated by a higher-order node, apart from the possibility that the lower-order node itself is the ◎. Thus a reasonable effect of (77-a) might be to block floating PLACE node at the root level.

(78) shows the violations which specific phonological structures incur for the constraints on association of PL and segmental root nodes.

(78) **Constraint Violations for Constraints on Minimal Association**

	S	**I**	• ↑ PL	• ↓ PL	• ⇑ PL	• ⇓ PL	**M**	**P**
a.	σ◎ │ • │ PL	σ◎ │ • │ PL	✓	✓	✓	✓	σ◎ │ • │ PL	σ◎ │ • │ PL
b.	σ◎ │ • ǂ PL	σ◎ │ • │ PL	✓	✓	✓	*	σ◎ │ • │ PL	σ◎ │ •
c.	σ◎ │ • PL	σ◎ │ • PL	*	*	✓	*	σ◎ │ • PL	σ◎ │ •
d.	σ◎ ǂ • │ PL	σ◎ │ • │ PL	✓	✓	✓	✓	σ◎ │ • │ PL	σ◎
e.	σ◎ ǂ • ǂ PL	σ◎ │ • │ PL	✓	✓	✓	✓	σ◎ │ • │ PL	σ◎
f.	σ◎ │ • PL	σ◎ │ • PL	*	*	✓	*	σ◎ │ •	σ◎ │ •
g.	σ◎ │ • ⋮ PL	σ◎ │ • │ PL	✓	✓	✓	*	σ◎ │ •	σ◎ │ •
h.	σ◎ │ • ¦ PL	σ◎ │ • │ PL	✓	✓	✓	✓	σ◎ │ •	σ◎ │ • │ PL

Constraints on Maximal Association: In general, every markedness constraint in `esc` is of the form in (79) (where λ is the locus of the constraint violation (McCarthy 2003a:6) and McCarthy (2003b:77):

(79) *C Assign $*$ to every λ in P
for which the conditions R hold in P

In constraints on maximal association, the constraint locus is a specific node type, and the conditions R is the local association context of other node types. (80) gives representative examples of the notation I will use for such constraints. The constraint locus forms the body of the constraint, and the association context is indicated by superscripted and subscripted node descriptors (subscripted nodes are implied to be dominated by the focus node of the constraint and superscripted nodes to dominate it):

(80) **Constraints on Maximal Association**

a. $\bullet_{\text{DORS}}$	Assign $*$ to every $\bullet$-node which dominates a DORS-node in I
b. $\underline{\text{L}}^{\mu}$	Assign $*$ to every L-node which is dominated by a μ-node in P
c. ${}^{*}_{\text{PL}}\bullet_{\text{PL}}$	Assign $*$ to every $\bullet$-node which immediately dominates more than one PL-node in I
d. ${}^{\bullet}_{*}\underline{\text{PL}}^{\bullet}$	Assign $*$ to every PL-node which is immediately dominated by more than one $\bullet$-node in P

I-Structure constraints of the type exemplified by (80-c) may actually have effects which are usually attributed to faithfulness constraints in Correspondence Theory. For example the constraint ${}^{*}_{g}V_{g}$ (where g is a variable over the glottal features spread glottis and constricted glottis) which plays a crucial role in deriving possible mutation patterns (cf. chapter 6) penalizes a phonetic vowel which is breathy and creaky at the same time, a highly maybe crosslinguistically unattested option, but it also penalizes vowels which are morphological breathy and phonetically creaky, and thus potentially blocks non-identity of featural specification for a given segment. However this effect is generally achieved by faithfulness constraints of the IDENT-type in Correspondence Theory.

Note finally that the constraints on maximal as well as on minimal association introduced here have straightforward counterparts in the correspondence-theoretic literature on autosegmental representations. Thus $\bullet \rightarrow$ PL is equivalent to the constraint HAVEPLACE in McCarthy (2008), and more generally the central constraints on tone association proposed by Yip (2002) correspond closely to these constraint types, as shown in (81) (where "τ" stands for "TBU") :

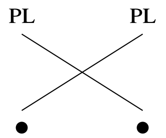
(81) **Constraints on Autosegmental Association of Tone** (Yip 2002)

*FLOAT	Each tone should be associated with at least one TBU	$T \uparrow \tau$
*SPECIFY	Each TBU should be associated with at least one tone	$\tau \uparrow T$
*CONTOUR	Each TBU should be associated with at most one tone	${}_{T}\overset{*}{\tau}_{T}$
NOLONG-T	Each tone should be associated with at most one TBU	${}^{\tau}_{*}T^{\tau}$

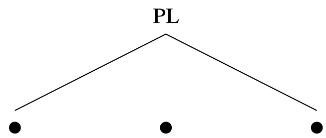
Constraints on Locality of Association and Intervention: As classical Autosegmental Phonology, esc restricts association by constraints on crossing association lines and on skipping nodes in association, or in other words on intervening association lines (82-a) or intervening nodes (82-b) in association:

(82) **Violations of Locality of Association**

a. **Intervention of Association Lines (Line Crossing)**



b. **Intervention of Nodes** (Node Skipping)



(83) and (84) exemplify the constraint schemata I will use for marking these configurations:

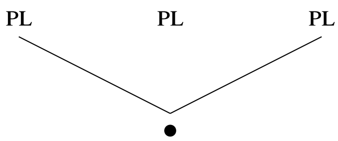
(83) $*\times\overset{\bullet}{\downarrow}_{PL}$ Assign * to every ordered pair of •-nodes (R_1, R_2) in I such that:
(i) R_1 dominates the PL-node P_1 and R_2 dominates the PL-node P_2
(ii) $R_1 \prec R_2$ and $P_2 \prec P_1$

(84) $*\vee\overset{\bullet}{\downarrow}_{PL}$: Assign $*$ to every triple of •-nodes (R_1, R_2, R_3) in I such that:
(i) $R_1 \prec R_2 \prec R_3$
(ii) R_1 and R_3 are associated to the PL-node *P*, but
(iii) R_2 is not associated to *P*

Note that the formulation of (84) doesn't explicitly mention crossing which is highly dependent on the correct graphical representation of tiers, whereas (83) is more independent of the spatial imagination of the observer, but captures the same intuition.

The source points of arrows in the constraint schemata in (84) and (83) indicates the constraint locus. Thus $*\vee\overset{\bullet}{\downarrow}_{PL}$ would be violated by triples of PL-nodes where the two outermost ones are associated to a PL-node not associated to the middle one as in (85), but not by (84). Conversely, (85) does not incur violations of (84).

(85)



As all markedness constraints, anti-intervention constraints exist in I-Structure and P-Structure version. See subsection 2.3.1 on the different clones of NOSKIPPING constraints.

2.3.3 Interface Constraints: Faithfulness

The most basic faithfulness constraints in `esc` penalize the phonetic non-realization of morphological nodes and the epenthesis of nodes (i.e. phonetic non-morphological nodes), and are labelled MAX and DEP following their counterparts in Correspondence Theory (McCarthy and Prince 1994, 1995). In contrast to McCarthy and Prince (1995) and following Lombardi (1998), I take it for granted that MAX and DEP constraints may refer to any phonological node type, not only to segmental root nodes. (86) exemplifies the schema with PLACE. (89), (90), and (91) show the constraint violations these (and the other faithfulness constraints introduced in this section) incur for representative input-output mappings. Note that DEP refers to I not to P because an epenthetic PL-node might only present in I, but not in P (cf. ((90)-c,d)):

(86) **Faithfulness Constraints on Nodes**

a. MAX PL	Assign $*$ to every PL-node in M which is not in P
b. DEP PL	Assign $*$ to every PL-node in I which is not in M

In close analogy to the basic markedness constraints on association lines (cf. subsection 2.3.2), I assume that faithfulness constraints on association lines exist in two versions, a downward-oriented one (87), and an upward-oriented one (88):

(87) **Downward Faithfulness Constraints on Association Lines**

a. MAX$\overset{\bullet}{\downarrow}_{\text{PL}}$	Assign $*$ to every ordered pair (R,N) in M such that: (i) R is in P (ii) R is a $\bullet$-node, N is a PL-node (iii) R immediately dominates N in M (iv) R does not immediately dominate N in P
b. DEP$\overset{\bullet}{\downarrow}_{\text{PL}}$	Assign $*$ to every ordered pair (R,N) in M such that: (i) R is in P (ii) R is a $\bullet$-node, N is a PL-node (iii) R immediately dominates N in I (iv) R does not immediately dominate N in M

(88) **Upward Faithfulness Constraints on Association Lines**

a. MAX$\overset{\bullet}{\uparrow}_{\text{PL}}$	Assign $*$ to every ordered pair (R,N) in M such that: (i) N is in P (ii) R is a $\bullet$-node, N is a PL-node (iii) R immediately dominates N in M (iv) R does not immediately dominate N in P
b. DEP$\overset{\bullet}{\uparrow}_{\text{PL}}$	Assign $*$ to every ordered pair (R,N) in M such that: (i) N is in P (ii) R is a $\bullet$-node, N is a PL-node (iii) R immediately dominates N in I (iv) R does not immediately dominate N in M

Crucially both constraint schemata can only be violated if both targeted node types are present underlyingly (morphologically). Thus none of the constraints in (87) and (88) is violated by the structures in ((90)-c,d,e) where the PL-node is epenthetic. To see the essential difference between upward- and downward versions of constraints, consider ((89)-b) which violates MAX$\overset{\bullet}{\downarrow}_{\text{PL}}$, but not MAX$\overset{\bullet}{\uparrow}_{\text{PL}}$ because the P-structure of ((89)-b) doesn't contain a PL-node (not fulfilling condition (i) of (88-b)). For similar reasons, ((90)-b) violates DEP$\overset{\bullet}{\downarrow}_{\text{PL}}$, but not DEP$\overset{\bullet}{\uparrow}_{\text{PL}}$:

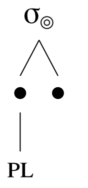
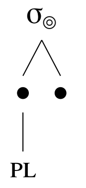
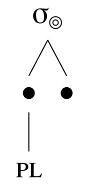
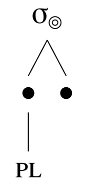
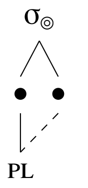
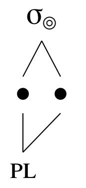
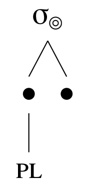
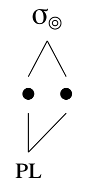
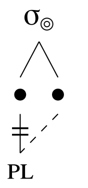
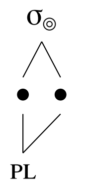
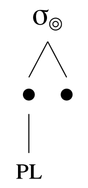
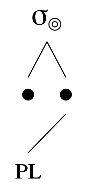
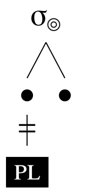
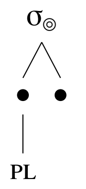
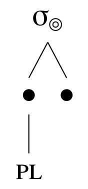
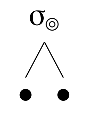
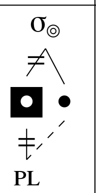
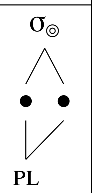
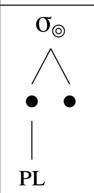
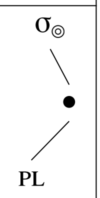
(89) **Constraint Violations for Different Faithfulness Types: Deletion**

	S	I	MAX PL	DEP PL	MAX$\overset{\bullet}{\downarrow}_{\text{PL}}$	DEP$\overset{\bullet}{\downarrow}_{\text{PL}}$	MAX$\overset{\bullet}{\uparrow}_{\text{PL}}$	DEP$\overset{\bullet}{\uparrow}_{\text{PL}}$	M	P
a.	σ◎ | • | PL	σ◎ | • | PL	✓	✓	✓	✓	✓	✓	σ◎ | • | PL	σ◎ | • | PL
b.	σ◎ | • ǂ PL	σ◎ | • | PL	*	✓	*	✓	✓	✓	σ◎ | • | PL	σ◎ | •
c.	σ◎ | • PL	σ◎ | • PL	*	✓	✓	✓	✓	✓	σ◎ | • PL	σ◎ | •
d.	σ◎ ǂ • | PL	σ◎ | • | PL	*	✓	✓	✓	✓	✓	σ◎ | • | PL	σ◎
e.	σ◎ ǂ • ǂ PL	σ◎ | • | PL	*	✓	✓	✓	✓	✓	σ◎ | • | PL	σ◎

(90) **Constraint Violations for Different Faithfulness Types: Epenthesis**

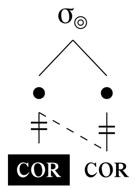
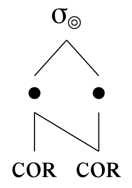
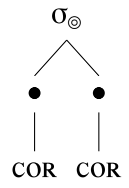
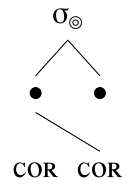
	S	I	MAX PL	DEP PL	MAX$\overset{\bullet}{\downarrow}_{PL}$	DEP$\overset{\bullet}{\downarrow}_{PL}$	MAX$\overset{\bullet}{\uparrow}_{PL}$	DEP$\overset{\bullet}{\uparrow}_{PL}$	M	P
a.	σ◎ | ● ¦ PL	σ◎ | ● | PL	✓	✓	✓	*	✓	*	σ◎ | ● PL	σ◎ | ● | PL
b.	σ◎ | ● ⋮ PL	σ◎ | ● | PL	*	✓	✓	*	✓	✓	σ◎ | ● PL	σ◎ | ●
c.	σ◎ | ● PL	σ◎ | ● PL	✓	*	✓	✓	✓	✓	σ◎ | ●	σ◎ | ●
d.	σ◎ | ● ⋮ PL	σ◎ | ● | PL	✓	*	✓	✓	✓	✓	σ◎ | ●	σ◎ | ●
e.	σ◎ | ● ¦ PL	σ◎ | ● | PL	✓	*	✓	✓	✓	✓	σ◎ | ●	σ◎ | ● | PL

(91) **More Constraint Violations for Different Constraint Types**

	S	I	MAX PL	DEP PL	MAX$\overset{\bullet}{\downarrow}_{\text{PL}}$	DEP$\overset{\bullet}{\downarrow}_{\text{PL}}$	MAX$\overset{\bullet}{\uparrow}_{\text{PL}}$	DEP$\overset{\bullet}{\uparrow}_{\text{PL}}$	M	P
a.			✓	✓	✓	✓	✓	✓		
b.			✓	✓	✓	*	✓	*		
c.			✓	✓	*	✓	*	*		
d.			*	✓	*	✓	✓	✓		
e.			✓	✓	*	*	*	*		

Note finally two non-obvious differences of upwards and downwards faithfulness constraints to IDENT constraints in Correspondence Theory: *First*, the realization of a segmental feature node might enforce realization of the segmental root node to which it is underlyingly associated. Thus MAX$\overset{\bullet}{\uparrow}_{\text{PL}}$ might block a candidate (91-e) in favor of (91-b) or (91-e). *Second*, a candidate such as (92), where the first •-node is associated to a feature node in M, and to a different feature node with the same label in P violate MAX$\overset{\bullet}{\downarrow}_{\text{PL}}$ (and similar cases could be constructed for upwards faithfulness constraints). This holds because faithfulness constraints over association lines are defined with respect to node tokens not with respect to label types. This kind of distinction is not well-defined in (non-autosegmental) versions of Correspondence Theory where segmental features are conceptualized as properties of segments, not as entities on their own.

(92) **Types vs. Tokens in Faithfulness Violations**

S	I	MAX PL	DEP PL	MAX$\downarrow^{\bullet}_{PL}$	DEP$\downarrow^{\bullet}_{PL}$	MAX$\uparrow^{\bullet}_{PL}$	DEP$\uparrow^{\bullet}_{PL}$	M	P
		*	✓	*	*	*	*		

2.3.4 Interface Constraints: Derived-Environment Constraints

The constraint schema DERIVEDENVIRONMENT (abbreviated DE), a generalized version of the constraint ALTERNATION proposed in van Oostendorp (2007), captures the intuition that phonological material which is part to a given morpheme is more reluctant to associate to phonological material of the same morpheme than to heteromorphemic material. (93) shows the general schema. A typical example which will be important later on in this book is DE$\uparrow^{\bullet}_{\dashv}$ which is defined in (93)

(93) DE$^{T1}_{T2}$ Assign $*$ to every node of type T1 which is associated by an epenthetic association line to a tautomorphemic node of type T2 but not to a heteromorphemic node of type T2

(94) DE$\uparrow^{\bullet}_{\dashv}$ Assign $*$ to every [$\dashv$] node which is associated by an epenthetic association line to a tautomorphemic • but not to a heteromorphemic •

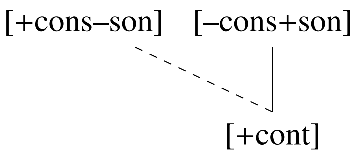
I will briefly discuss the type of data which has originally inspired van Oostendorp's ALTERNATE and then turn to evidence which motivates the extended version I propose here. As the name DERIVEDENVIRONMENT suggests the core phenomenon are derived environment effects (also called nonderived environment blocking in part of the literature, e.g. Wolf (2008)) phonological processes which apply in (phonologically or morphologically) derived environments. A typical example is assibilation in Finnish, where [t] becomes [s] if it immediately precedes [i]. Crucially this process applies completely regularly but only if [t] and [i] are heteromorphemic, i.e. in a morphologically derived environment:[16]

[16] See van Oostendorp's paper for an extension of his analysis to cases where the derived environment is apparently purely phonological.

(95) **Assibilation in Finnish** (Kiparsky 1993)

a.	/halut-i/	⇒	[halusi]	'want-PAST'
	/halut-a/	⇒	[haluta]	'want-INF'
	/koti/	⇒	[koti], *[kosi]	'home'
b.	/va:ti-vat/	⇒	[va:tivat]	'demand-3PL'
	/tilat-i/	⇒	[tilasi], *[silasi]	'order-PAST'

van Oostendorp's crucial observation is that most cases of DEEs involve feature spreading, and as pointed out by Wolf (2008:329) this holds also for Finnish assibilation which might be interpreted as spreading of [+continuant] from a high front vowel to a left-adjacent [t]:

(96)


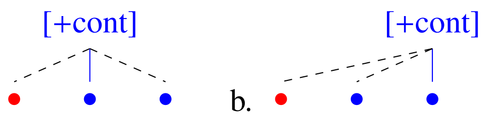
High-ranked Alternation as defined in (97) would block this process morpheme-internally (e.g. in [koti]) since the [+cont] feature of [i] and the root node of [t] have the same morphological color, and spreading would mean that an epenthetic association line links them.

(97) Alternation: If an association line links two elements of color α, the line should also have color α. (van Oostendorp 2007:16)

The DE schema slightly generalizes Alternation by penalizing tautomorphemic epenthetic association only if there is no parallel heteromorphemic association. Thus the Finnish assibilation case might be captured by the following instantiation of the scheme in (93)

(98) $DE_{\bullet}^{[+cont]}$ Assign $*$ to every [+cont] node which is associated by an epenthetic association line to a tautomorphemic •-node but not to a heteromorphemic •-node

For the Finnish data and comparable DEE cases, $DE_{\bullet}^{[+cont]}$ actually does not make different predictions than Alternation. Crucially $DE_{\bullet}^{[+cont]}$ penalizes a subset of the configurations which incur violation s of Alternation, but the only possibility how a spreading candidate could escape violation of DE, but not of Alternation is a [+cont] node which is associated epenthetically to a heteromorphemic and a tautomorphemic segment, hence one of the configuration s in (99):

(99) a. b.


But since Finnish doesn't have [+cont]-spreading of vowels to the right ([it] *⇒ [is]), and assibilation is strictly local, i.e. does also not extend to stops which are not adjacent to the triggering [i], these escape hatches are independently excluded.[17]

[17] van Oostendorp also derives from Alternation that Turkish vowel-harmony does not apply root-internally. This could not be captured by a DE constraint because vowel harmony is iterative hence, a vocalic feature could easily be associated epenthetically (spread to) to tauto- and a hetero-morphemic vowel. In chapter 6, I propose a more general account of root-dominant vowel harmony which doesn't invoke the concept of heteromorphemicity.

The empirical motivation for replacing Alternation by DE-constraints comes from mutation cases and, more generally, from floating features. Thus, as I will show more in detail in chapter 5 many Anywa prefixes with an overt L tone also carry a floating H which shows up on L-tone lexical roots (e.g. à$^{\mathrm{H}}$- dhyàŋ ⇒ à-dhyáŋ‘durra bird’ (Reh 1993:68). The fact that the floating H associates to the base of the prefix, not to the prefix itself could be derived from Alternation since docking on the prefix would again link epenthetically two tautomorphemic nodes. But again, the same result follows from high-ranked $\mathrm{DE}^{\sigma}_{\uparrow\mathrm{T}}$, which allows docking of the H to the prefix only if it is also associated to the root. Since the prefixes in Anywa arguably form independent PWords and the language doesn’t allow H-tones which are linked to TBUs of different PWords (blocking for example the otherwise expected spread of H from H-tone prefixes to L-tone bases), the option of associating the floating H to both, prefix and lexical root is independently excluded, and hence $\mathrm{DE}^{\sigma}_{\uparrow\mathrm{T}}$ enforces association to the base only. Now suffixes do not form independent PWords in Anywa (and H-tone roots spread their tone to L-tone suffixes). At this point, Alternation and $\mathrm{DE}^{\sigma}_{\uparrow\mathrm{T}}$ make different predictions: Alternation predicts that the floating H should *only* associate to the suffix since every association to the lexical root would incur a violation of the constraint. On the other hand, $\mathrm{DE}^{\sigma}_{\uparrow\mathrm{T}}$ predicts that the floating H should attach to both morphemes, root and suffix because Anywa H-tones always overwrite L-tones if this is not excluded by independent constraints. In fact this is exactly what happens (cf. gàth$^{\mathrm{H}}$ -ɛ̀ ⇒ gáth-ɛ́, trade-PL, ‘types of trade’, Reh 1993:69). Thus tautomorphemic association is parasitic on heteromorphemic association just as predicted by the generalized approach to DEE implemented by DE, but not by the original Alternation. A similar pattern is found with the feature [ATR] in Anywa. Generally the language has root-dominant [ATR]-harmony with segmental affixes, as shown for the plural suffix *-I* in (100), where it appears as *-i* after [⊣] bases and as -ɪ after [⊢] bases:

(100) **[ATR]-Harmony with PL *-I*** (Reh 1993:106)

	SG	PL	
a.	ōtìːt	ōtìːd-ì	‘firefly’
b.	ōkūom	ōkūom-í	‘ibis’
c.	tɛ̀ːŋ	tɛ̀ːŋ-ì	‘type,kind’
d.	cwìːr	cwìːr-í	‘rainy season, year’
e.	jɛ̄ːj	jɛ́ː-í	‘(kind of) basket’

In a line with the analysis for the [ATR]-system of closely related Päri (see chapter 5 for details), I assume that the Root-level ranking of Anywa ensures that vowels of lexical roots are specified for [ATR] whereas affix vowels are not specified for these features. Harmony is then derived by spreading at the stem-level triggered by the ranking Dep [⊢⊣] ≫ V → [⊢⊣].

With floating [⊣]-affixes there is overwriting of stem-[⊢⊣], illustrated in (101) with AP forms, which I attribute to undominated V← [⊣] (cf. again the parallel analysis for Päri in chapter 5):

(101) **[˧]-Overwriting in the Anywa Antipassive** (Reh 1993:222)

	Underived	**Antipassive**	
a.	càm	cʌ̀m	'eat'
b.	gɛ̀ːr	gèːt	'build'
c.	kán	kʌ̀n	'hide'
d.	d̪ìːŋ	d̪ɪ̄ːŋ	'filter'
e.	bìl	bɪ̀t	'soak'

Now returning to plural *-I*, an idiosyncratic subset of nouns behaves systematically different. Whereas the unaffixed base (singular) forms are [˧], affixation of plural *-I* renders both morphemes, stem and suffix [˧]:

(102) **Nouns with Irregular [˧] in PL-Forms** (Reh 1993:109)

	SG	**PL**	
a.	pàːp	pʌ́b-í	'savannah'
b.	dɛ̀ːk	dèː-ì	'fish soup'
c.	bʊ̀ːr	búr-í	'hole (in ground)'
d.	t̪ʊ̀ɔj	t̪úo-í	'fishing basket'

The [˧] which shows up in plural forms cannot be part of the affix because then we would also expect to find it in the nouns in (101), but it can also not be associated to the vowel of the lexical root because then it would also show up in the singular forms of (102).[18] The most straightforward account is that the [˧] showing up in the plural forms of (102) is a floating exponent of the lexical root which due to the constraint Dᴇ˧̣ may only associate to the tautomorphemic stem vowel if it also associates to an affix V. Again this would not follow from the original version of Aʟᴛᴇʀɴᴀᴛɪᴏɴ which would either (if high-ranked) block association of [˧] to the tautomorphemic root vowel or (if low-ranked) allow it – independently from association of [˧] to the affix.

[18]Even if [˧] were an affixal exponent, it would be unclear why it should overwrite [˦] of lexical roots which doesn't happen with segmental affixes and cannot be due to V ← [˧] because associating to the affix vowel *I* would satisfy this constraint at a lesser cost for faithfulness constraints since the suffix is not specified for [˦˧]

2.3.5 Other Interface Constraints

• Constraints on Morphological Colors as Phonological Objects

Treating morphological colors explicitly as grammatical phonologically relevant objects – one of the core assumptions of Colored Containment Theory implies that they might be subject to similar constraints as other objects such as nodes and association line. In fact, the constraint REALIZEMORPHEME employed e.g. in van Oostendorp (2005a) might be understood as a version of MAX defined as in (103), which is completely analogous to the MAX schema for morphological nodes ((86)) (in the following I use the symbol "□" to refer to morphological color):[19]

(103) MAX □ Assign ∗ to every □ in M
which is not in P

Of course, a color "is" not in the same way in a representation as a node or association line "is". Colors are properties (or under the representation proposed in subsection 2.1.2 parts) of objects which are in turn parts of representations. But the consequence of this is simply that constraint formulations on colors such as (103) imply obvious equivalent statements as the one in (104):

(104) **Equivalence Statement on Colors**
The statement $S(C, O)$ is true in the autosegmental representation R iff
there is some node or association line X of color C such that $S(C, O)$ is true in R.

Similarly colors might be expected to be subject to contiguity constraints. Thus the dispreference for discontinuous exponents crosslinguistically is a well-documented observation. In fact, I will argue in chapter 4 that moras in Dinka are subject to the constraint in (105):

(105) □CONTIGUITY$_{\mu}$ Assign ∗ to every μ M_1 intervening
between two moras M_2, M_3 such that
Color(M_2) = Color(M_3) ≠ Color(M_1) in P

Finally I will argue that there are substantial constraints limiting the complexity of associating colors with multiple instances of the same type of phonological material (or vice versa). Just as Anywa is subject to the constraint in (106), Dinka shows evidence for the constraint in (107) (cf. chapter 4):

(106) $*V^{3\mu}$ Assign ∗ to every V which is
dominated by more than two moras

(107) $*V^{3□}$ Assign ∗ to every V which is
dominated by (moras of) more than two colors

Conversely Anywa tonology seems to be governed by the constraint in (108) which restricts morphemes to "contain" maximally one H-tone either by morphemic affiliation or by association to a morphologically affiliated element which is parallel to the purely phonological ban

[19]For morphological reasons, Western Nilotic is not a good testing ground for REALIZEMORPHEME since the abundance of exponents for most morphemes hardly ever results in a situation where the constraint could become effective. See Wolf (2005b), Wolf and McCarthy (2008) for detailed discussion of this point.

on syllables associated to more than one H-tone, which can be observed in Dinka (109) (cf. chapter 5):

(108) $\overset{*}{{}_{\text{H}}\square_{\text{H}}}$ Assign $*$ to every color which immediately dominates more than one H tone

(109) $\overset{*}{{}_{\text{H}}\sigma_{\text{H}}}$ Assign $*$ to every syllable which dominates more than one H-tone

• Constraints on Roots and Affixes

Following McCarthy and Prince (1994) (see also Downing 2006 and Urbanczyk 2006) I assume that there are substantive universal constraints on the possible phonological shapes of morphosyntactic categories such as Rt ≈ PW and Aff < Ft (cf. chapter 6 on Päri for a concrete application). In contrast to non-stratal CT, in `esc` such constraints can only be effectively evaluated for roots and Stem-Level affixes at the Root Level, and for Word-Level affixes at the Stem Level due to the Atomic Interface Condition (cf.subsection 2.4.2). Moreover, I follow Bermúdez-Otero (2011) in further restricting the phonological access of phonological constraints to morphological features to alignment constraints which align morphological and prosodic units, as in (110). Conversely, I restrict the access of morphological selection (i.e., context restrictions of Vocabulary Items and single Exponents) in a mirror fashion by the clause in (111):

(110) **Indirect Reference Hypothesis**
A phonological constraint may not refer to syntactic, morphological, or lexical information unless to require alignment between designated prosodic units and the exponents of designated syntactic (word-syntactic or phrase-syntactic) nodes (slightly adapted from Bermúdez-Otero (2011:74))

(111) **Extended Indirect Reference Hypothesis**
Morphological selection may not refer to phonological information apart from prosodic features of the base

It is obvious that Rt ≈ PW can be reduced to such alignment constraints as in (112):

(112) **Rt ≈ PW by Alignment Constraints**

a. Align (Rt,L,PW,L) Assign $*$ to every lexical root whose left edge does not coincide with the left edge of a PW

b. Align (Rt,R,PW,R) Assign $*$ to every lexical root whose right edge does not coincide with the right edge of a PW

Taken for granted that independent constraints guarantee that exponents in WN are always maximally monosyllabic, also Aff < Ft follows directly from the alignment constraints in (113):

(113) **Aff < Ft by Alignment Constraints**

a. Align (Ft,L,Rt,L) Assign $*$ to every Ft whose left edge does not coincide with the left edge of a lexical root

b. Align (Ft,R,Rt,R) Assign $*$ to every Ft whose right edge does not coincide with the right edge of a lexical root

Why does this follow? Suppose that (113-a) and (113-b) are undominated at the Root Level. Now a hypothetical affix *wa* which projects foot structure ($[\mathrm{wa}]_{\mathrm{Ft}}$) would violate both (113-a) and (113-b) since the foot boundaries of *wa* do not coincide with the boundaries of a lexical root. Due to *Consistency of Exponence* and the *Morph Integrity Hypothesis*, ("Morphological operations do not alter the syntactic specifications or phonological content of morphs" (Bermúdez-Otero 2011)46), the affix cannot be transformed into a root morpheme, and therefore the only way for *wa* not to violate (113) is to refrain from projecting a foot. Under the standard assumption that PWs may only immediately dominate feet, but not syllables (Selkirk 1995), *wa* will necessarily be restricted to the maximal size of a syllable.[20]

Note also that the Indirect Reference Hypothesis in (110) directly excludes Positional Faithfulness Constraints (Beckman 1998) which are sensitive to the root-affix distinction. This seems to pose empirical problems for harmony systems which are sensitive to this distinction. See chapter 6 (for Päri) on a constructive proof that the `esc`-system has natural means to capture such systems.

• Comparative Markedness

Comparative Markedness constraints (McCarthy 2003a) are parametrized markedness constraints which restrict the violations they incur to "old" or "new" constraint violations. Thus consider the standard OT-constraint *D in (114) (Kager 1999):

(114) *D Assign $*$ to every • which dominates [+vc] and [–son]

For an input *da*, the output *da* violates the constraint ${}^{*}_{\mathrm{O}}\mathrm{D}$ (which is restricted to "old" voiced obstruents, but not ${}^{*}_{\mathrm{N}}\mathrm{D}$ (restricted to "new " voiced obstruents). In `esc`, ${}^{*}_{\mathrm{N}}\mathrm{D}$ and ${}^{*}_{\mathrm{O}}\mathrm{D}$ are formalized as (115) (see also van Oostendorp 2005b for discussion of Comparative Markedness constraints in Colored Containment):[21]

(115) **Comparative Markedness Versions of (114)**

a. ${}^{*}_{\mathrm{O}}\mathrm{D}$ Assign $*$ to every • in P which dominates [+vc] and [–son] in P and in M

b. ${}^{*}_{\mathrm{N}}\mathrm{D}$ Assign $*$ to every • in P which dominates [+vc] and [–son] in P, but not in M

More generally, every markedness constraint in `esc` is of the form in (116) (where λ is the locus of the constraint violation (McCarthy 2003a:6) and McCarthy (2003b:77), i.e. a single node or an ordered pair of nodes which are connected by immediate dominance or precedence) and corresponds to the Comparative Markedness constraints in (117):

(116) *C Assign $*$ to every λ in P for which the conditions R hold in P

[20] Under this constraint ranking, an affix could also not be a simple juxtaposition of syllables (which are not dominated by a Ft node) because outputs of phonological computation in `esc` are necessarily unitary objects dominated by a single designated ancestor node.

[21] I am abstracting away here from the potential problems for the direct comparison of input- and output representations with fully predictable structure, which lead McCarthy (2003a:9-10) to implement Comparative Markedness not by comparison to inputs, but to "fully faithful candidates"

(117) **Comparative Markedness Versions of (116)**

a. $^{*}_{O}C$ Assign ∗ to every λ in P
for which the conditions *R* hold in P and in M

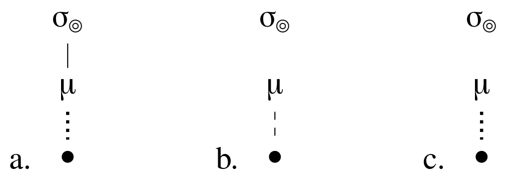
b. $^{*}_{N}C$ Assign ∗ to every λ in P
for which the conditions *R* hold in P, but not in M

• Constraints on Epenthetic Structure (*JUNK)

Constraints on epenthetic lines characterize the highly marked status of association lines which are neither interpretable morphologically nor phonetically. They follow the general schema in (118). Obviously, the formulation of this constraint type requires reference to all three substructures of a candidate and makes this a true interface constraint.

(118) $*T_1 \vdots T_2$ Assign ∗ to every ordered pair of nodes (*R*,*N*) in I such that:
(i) *R* is of type T_1, *N* is of type T_2
(ii) *R* immediately dominates *N* in I
(iii) *R* does not immediately dominate *N* in P or in M

There are three relevant configurations which incur violations of this constraint type illustrated for *μ . . . • in (119) with the syllable as the ◎. In all three cases, *R* (μ) does not immediately dominate *N* in M (the association line is epenthetic). In (119-b), the association line is also not in P because it has the phonetic value 0, and in (119-b) because it is not dominated by $\sigma_{◎}$. (119-c) combines both scenarios:

(119)


See section 3.2.1 where the role of this constraint type for overwriting phenomena is discussed.

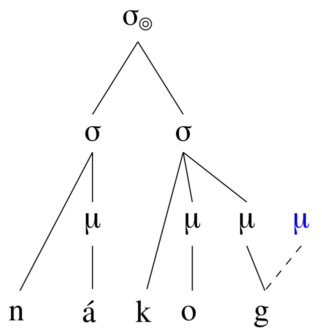
A second constraint type penalizes epenthetic nodes which are not phonetically interpreted. (120-a) shows the general schema, and (120-b) a concrete instantiation which will play an important role in the account of tonal epenthesis of Anywa in section 5.4.3

a. *Ⓣ Assign ∗ to every node of type *T*
which is neither in M nor in P

b. *Ⓣ Assign ∗ to every tone
which is neither in M nor in P

• Constraints on Ancestor Nodes

An assumption made almost universally, but implicitly in the autosegmental and feature-geometric literature is that a structure such as (120) is impossible, not because the mora is floating, but because the final [f] is partially integrated into the overall structure, and partially dominated by a floating element outside of the main structure:

(120) 

Configurations such as (120) are quirky, but are easily generated by standard constraints on autosegmental representation. Thus (120) could result from undominated $\text{MAX}^{\mu}_{\bullet}$ and $\text{DEP}^{\mu}_{\sigma}$. I assume that they are marked by constraints of the type in (121) (a *phonetic ancestor node* is a node which is not dominated through any phonetically visible association line in I):

(121) ${}^{\odot}_{*}T^{\odot}$ Assign $*$ to every node of type T which is dominated by more than one phonetic ancestor node through an uninterrupted path of phonetic association lines in I

Recall from subsection 2.1.2 that an ancestor node (not to be confused with the designated ancestor node ◎, only instantiated by $\sigma_{\circledcirc}$ in (120)) is by definition a node which is not dominated by any other node. Thus the constraint ${}^{\odot}_{*}\bullet^{\odot}$ would correctly identify (120) as marked because it is dominated by $\sigma_{\circledcirc}$ and the affixal μ, which are both not dominated by any other node on the representation. Note also crucially that ${}^{\odot}_{*}T^{\odot}$ is not a markedness constraint because it is not restricted to P-Structure (the affix μ is not in P), but also not to I because it makes crucial reference to phonetic visibility.

The empirical motivation behind making ${}^{\odot}_{*}T^{\odot}$ a violable constraint is that it gives rise to a simple concatenative account of subtractive morphology. Thus in a language where a suffix mora deletes the coda consonant of the base this can be derived from ${}^{\odot}_{*}\bullet^{\odot}$ such as in Tohono Tohono O'odham, an Uto-Aztecan language (Hill and Zepeda 1992, Fitzgerald and Fountain 1995, Fitzgerald 1997, Yu 2000, Horwood 2001, Kosa 2006, Gagnon and Piche 2007). As can be seen in (122), the final consonant is subtracted to form the perfective from the imperfective base.[22]

(122) **Perfective in Tohono O'odham** (Fitzgerald and Fountain 1995:5+6)

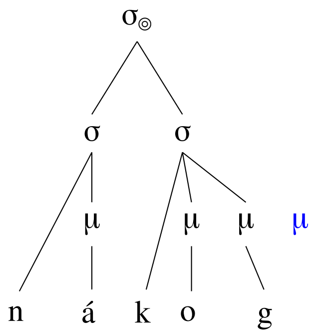
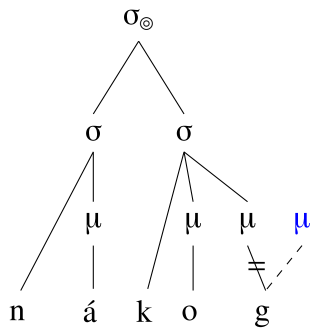
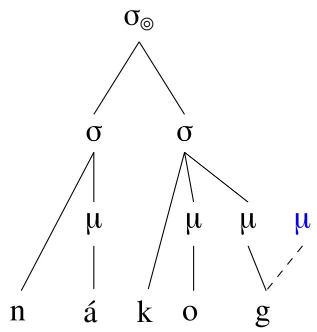
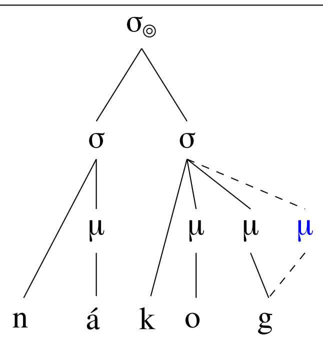
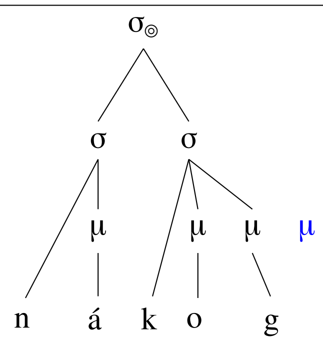
	Imperfect	**Perfect**	
a.	má:**k**	má:	'giving'
b.	hí:n**k**	hí:n	'barking'
c.	híhi**m**	híhi	'walking' (pl)
d.	gátwi**d**	gátwi	'to shoot object'
e.	híkč**k**	híkč	'cutting'
f.	čɨʔɨwi**d**	čɨʔɨwi	'covering'
g.	náko**g**	náko	'enduring'

This pattern can be derived by ${}^{\odot}_{*}\bullet^{\odot}$, as shown in (124). $\mu \rightarrow \bullet$ enforces the affix mora to

[22]The subtraction pattern actually varies, and rhyme deletion instead of coda deletion takes place in some cases. But this deletion of the final VC sequence can only be found in bases that would otherwise end in a [COR][+high] sequence and is regarded as an additional phonologically-triggered deletion process that repairs a marked configuration which would otherwise emerge after coda deletion by Horwood (2002).

associate to a segmental root node excluding a completely floating affix mora as in the input (123-d), whereas association of the μ to higher prosodic structure is blocked by $\text{D}{\small\text{EP}}^{\sigma}_{\mu}{\uparrow}$. $\underset{*}{\odot}\bullet^{\odot}$ is now crucial in enforcing deassociation of the base-final segment to the mora by which it is underlyingly dominated (123-b). Consequently In the winning candidate, [f] is not realized phonetically because it is not dominated by the ⊚ ($\sigma_{⊚}$):

(123) **Subtractive Morphology in Tohono O'odham**

Input: 	$\mu \downarrow \bullet$	$\textsc{Dep}^{\sigma}_{\mu}$ ↑	${}^{\odot}_{*}\bullet^{\odot}$	$\pi \uparrow \mu$
☞ a. 				*
b. 			*!	
c. 		*!		
d. 	*!			*

In section 3.2, I will show that ${}^{\odot}_{*}T^{\odot}$ is also crucial in capturing specific cases of mutation morphology in Western Nilotic. See also section 4.1.1 for the role of the constraint in vowel-lengthening μ-integration.

• A Constraint against Ineffability

I assume that candidates where no node is marked as ◎ correspond to the Ø-output, hence absolute ineffability for a given input. I will write the (violable) constraint which militates against candidates of this type simply by the ◎-symbol itself:

(124) ◎ Assign $*$ to every candidate without a designated ancestor node

This corresponds in function roughly to the MPARSE constraint of Prince and Smolensky (1993) (see also Wolf and McCarthy 2008 and van Oostendorp 2006a for discussion), although the implementation here is much more direct.

2.4 Strata

I adopt Stratal Optimality Kiparsky (2000), Bermúdez-Otero (2011), i.e., the hypothesis that languages have different phonological levels (strata) $L_1 \ldots L_n$ of evaluation which are ordered in a feed-forward architecture. The output of stratum L_n provides the input for stratum L_{i+1}. Strata correspond to parts of morphological constituency and may (potentially) employ different rankings of OT-constraints. Thus in Albanian, derivational affixes have quite different consequences for stress than inflectional ones. Consonant-final derivational affixes lead to stress shift, following the pattern holding also in monomorphemic words, where words ending with a closed syllable have systematically final stress (cf. e.g. *a**det***, 'habit' vs. ***ho**le*, 'swing', Trommer 2005, stressed syllables are marked by boldface).

(125) **Stress Shift in Derived Nouns**

a. **pu**.nə	'work'	a'. **mend**	'mind'
b. pu.nə.-**tor**	'worker'	b'. men.**d-im**	'thought'
c. pu.nə.-to.**r-i**	'working class'	c'. men.d-im-**tar**	'thinker'

On the other hand, the addition of inflectional affixes does not affect the stress pattern of the base: Thus ***ho**le-n*, the accusative form of *hole* has penultimate stress even though the final syllable is closed and expected to attract stress. Note also that the definite accusative form of *a.**det***, *a**de**t-in*, has stress on the penultimate syllable (corresponding to the final syllable of *a.**det***) even though the penultimate syllable is not closed in this form (but only in the base form). In Stratal Optimality Theory, this can be taken as evidence that derivational affixes in Albanian are part of the Stem Level and inflectional affixes of the Word Level with different rankings of phonological constraints. In a nutshell, the Stem Level ranks stress attraction to stem-final heavy syllables above faithfulness for underlying stress (thus excluding the possibility that a lexical item prespecified for prosodic structure overwrites the general stress pattern) whereas the ranking is reversed for the Word Level (for showing the Stem Level explicitly in action I assume here that *adet* is underlyingly marked for initial stress, the output would obviously be identical if the root were already specified for final stress) (see Trommer 2005, 2008d for a worked out analysis using standard prosodic constraints):

(126) **Albanian Stress Assignment (Stem Level)**

Input: (**a**.det)

	StressHeavyFinal	FaithStress
a. (**a**.det)	*!	
☞ b. (a.**det**)		*

(127) **Albanian Stress Assignment (Word Level)**

Input: (**a**.det)-in

	FaithStress	StressHeavyFinal
☞ a. a.(**de**tin)		*
b. a.de(**tin**)	*!	

In most languages, Stem Level and Word Level do not correspond as cleanly to the intuitive dichotomy between derivation and inflection. Thus, as is well known, in English a substantial part of the derivational affixes ("class 1 affixes") constitute the Stem Level whereas another subset of derivational affixes together with all inflectional ones ("class 2 affixes") constitute the Word Level.

2.4.1 The Root Level and Stratal Preprocessing

A standard assumption in Stratal OT (as in late Lexical Phonology) is that there are exactly three levels of evaluation: the Stem Level, the Word Level, and the Phrase Level. Moreover an important tenet of the theory is that there is a crucial asymmetry between roots and affixes which partially follows from the choice of levels: whereas non-bound roots might undergo cycles of evaluation on their own, affixes (and bound elements more generally, e.g. bound roots) never do. This follows because there might be monomorphemic stems (and words) composed of single roots undergoing the appropriate cycles, but no stems or words composed exclusively of affixes[23] Bermúdez-Otero (2008) (see also Baker 2005) departs from the dogma that only roots and stems in the morphological sense may undergo independent phonological evaluation. Under the assumption that the morphological and phonological derivation of word (form)s is based on a set of morphemes (e.g. {stupid, -ity, -s} for the word form *stupidities*), which are successively added to the morphological object under construction at the appropriate level of evaluation.[24]

I will call this theory "Egalitarian Stratal OT" since it may be characterized as in (128) without any differential treatment of affixes and lexical roots. (129) shows how this applies to the English word *stupidities*:

(128) **Egalitarian Stratal OT** (Bermúdez-Otero 2008)

- A derivation of a word is based on a lexical array (the set of all roots and affixes to be part of the word) which are successively combined

- At every stratum, all independent morphological objects undergo phonological evaluation (i.e. all morphological objects which are not part of other morphological objects)

(129) **Derivation of *stupidities* in Egalitarian Stratal OT**

	Evaluation of
Stem Level:	Stems and Word-Level affixes
Stem Level:	Words

	Evaluation of
Lexical Array:	stupid, -ity, -s
Stem Level:	stupidity, -s
Word Level:	stupidities

Evidence for the Egalitarian architecture comes from cases where Stem-Level affixes behave partially like independent grammatical words. For example in Ngalakan, bisyllabic affixes seem to behave like independent PWords with respect to stress assignment Baker (2005). Thus in monomorphemic words, the language exhibits exceptionless alternating stress corresponding to syllabic trochees assigned from left to right:

[23] See however the fascinating case of Hungarian where two elements otherwise functioning as suffixes seem to be able to constitute a morphosyntactic and prosodic word on their own when they cooccur (Trommer 2008b, Spencer 2009)

[24] This is reminiscent of standard assumptions in Minimalist syntax where derivations of syntactic structures are based on enumerations – arbitrary choices of material from the lexicon with no or minimal internal structure (Chomsky 2000, Müller 2010).

(130) **Ngalakan: Alternating Stress in Monomorphemic Words** (Baker 2005)

a.	(pólo)	'old person'
b.	(káma)la	'sky'
c.	(káɳa)(mùru)	'long-nose' (native honeybee)
d.	(káɹaŋ)(kàna)(ɳìni)	'wallaby sp.'

However with bisyllabic suffixes, this pattern is disrupted in a predictable way, as shown in (131):

(131) **Ngalakan: Morphologically Disrupted Stress** (Baker 2005)

a. (ʈótoyʔ)-ki	'aunt-your'
b. (ʈótoyʔ)-(kí-kkaʔ)	'aunt-your-LOC'
c. (ʈótoyʔ)-ki-p(púlu)	'aunt-your-PL'
d. (ʈótoyʔ)-ki-p(púlu-k)kaʔ	'aunt-your-PL-LOC'

The crucial generalization is that "Polysyllabic suffixes and clitics are inherently footed, but the footing of monosyllabic suffixes and clitics is contingent on their surrounding environment." (Baker 2005:5). In Egalitarian Stratal OT, this can be derived as follows: At the Stem Level, foot structure is built on stems and bisyllabic Word-Level affixes, but not on monosyllabic affixes. At the Word Level, Stem-Level foot structure must be maintained. New feet can only be built on hitherto unfooted syllables. A concrete implementation of this may be built on the constraints in (132):

(132) **Prosodic Constraints for Ngalakan Stress**

a. **Al-Ft**	Assign $*$ to every ordered pair of a foot node and a syllable (F, S) such that S intervenes between F and the left edge of the lowest PWord which dominates F in P
b. **Ft-Bin**	Assign $*$ to every foot which is not binary in P
c. **Ps-σ**	Assign $*$ to every syllable node which is not dominated by a foot node in P
d. **Ps-Seg**	Assign $*$ to every segment node which is not dominated by a syllable node in P
e. **Fth-Ft**	Assign $*$ to every syllable which is dominated by foot F in M, but not dominated by F in P

At the Stem Level, Stem-Level affixes and roots are evaluated in exactly the same way as shown in the following three tableaux. Crucially, monosyllabic affixes are not assigned foot structure, whereas bisyllabic affixes and lexical roots (there are no monosyllabic lexical roots in the language) are subject to the pressure of FootBin.

(133) **Stem Level: Evaluation of Roots**

Input: kaɭamuru

	Ps-Seg	Ft-Bin	Ps-σ	Al-Ft	Fth-Ft
☞ (káɭa)(mùru)				**	
(káɭa)mùru			*!*		
(ká)(ɭa)(mù)(ru)		*!		******	
kaɭamuru	*!*******				

(134) **Ngalakan Stem Level: Evaluation of a Bisyllabic Affix**

Input: -ppulu

	Ps-Seg	Ft-Bin	Ps-σ	Al-Ft	Fth-Ft
☞ (ppulu)					
ppulu			*!*		
ppulu	*!****				

(135) **Ngalakan Stem Level: Evaluation of a Monosyllabic Affix**

Input: -ŋki

	Ps-Seg	Ft-Bin	Ps-σ	Al-Ft	Fth-Ft
(ŋki)		*!			
☞ ŋki			*		
ŋki	*!**				

As in Albanian, faithfulness to prosodic structure is dominated by all relevant prosodic constraints at the Stem Level, but exerts its effect through high ranking at the Word Level. Instead of the expected creation of left-aligned feet as in (136-c) the prosody of the bisyllabic affix is maintained:

(136) **Word Level: Evaluation of Complex Forms**

Input: (ṭótoyʔ)-ki-p(púlu)

	Fth-Ft	Ps-Seg	Ft-Bin	Ps-σ	Al-Ft
☞ a. (ṭótoyʔ)-ki-p(púlu)				*	**
b. (ṭótoyʔ)-(ki-p)(púlu)			*!		**
c. (ṭótoyʔ)-(ki-ppu)lu	*!			*	

A systematic asymmetry that the Ngalakan analysis so far does not predict is the fact that lexical roots are always at least bisyllabic in the language, whereas affixes may be smaller. This cannot effectively be derived at the Stem Level since this stratum treats affixes and monomorphemic stems (hence roots) in exactly the same way. Moreover the basic insight of the analysis crucially depends on the assumption that the asymmetry between monosyllabic affixes on the one side and roots/polysyllabic affixes on the other side can be derived in a purely phonological way. What I propose here is that the two lexical strata (Stem Level and Word Level) of Bermúdez-Otero are augmented with a third one, the *Root Level*, resulting in the architecture in (137) illustrated again with *stupidities*

(137) **Derivation of *stupidities* in** `esc`

a.	**Evaluation of**
Root Level:	Roots and Stem-Level affixes
Stem Level:	Stems and Word-Level affixes
Word Level:	Words

b.	**Evaluation of**
Root Level:	stupid, -ity
Stem Level:	stupidity, -s
Word Level:	stupidities

The basic idea here is that from the point of view of Phonology, the words and stems which undergo evaluation at the Stem and Word Level (let us call these 'Stratal Stems' and 'Stratal Words') are complex units[25] of the stratal levels 1 and 2, whereas Stem-Level affixes and lexical root morphemes are atomic level-0 elements, and Word-Level affixes atomic level-1 elements. Hence (137-a) has the fine structure in (138):

(138) **Stratal Objects in** `esc`

	Atomic	**Complex**	
Level 0	Roots and Stem-Level affixes	—	(Root Level)
Level 1	Word-Level affixes	Stratal Stems	(Stem Level)
Level 2	—	Stratal Words	(Word Level)

This allows to state the organizing principle implicit in (137) as in (139):

(139) **Stratal Preprocessing Hypothesis:**
Every level-n object which is part of a complex constituent at level-$n + 1$
is evaluated independently by level-n phonology
(and by no other evaluation process)

Crucially, from (139) it follows that all affixes are evaluated on their own only once: Stem-Level (Level-0) affixes at the Root level, and Word-Level (Level-1) affixes at the Stem level.

In this architecture, the fact that all lexical roots in Ngalakan are at least bisyllabic can be derived by the constraint RT ≈ PW which requires that roots correspond to prosodic words (cf. (112) for a decomposition of this constraint into more basic alignment constraints and further discussion). Suppose now that the lexicon of Ngalakan contains monosyllabic roots such as *pol*. If RT ≈ PW, and FT-BIN are ranked above DEP, this will result in epenthesis of a vowel to guarantee word (root) minimality:

(140) **Ngalakan Root Level: Upgrading of a Monosyllabic Root**

Input: pol

	RT ≈ PW	HEADEDNESS	FT-BIN	DEP
☞ a. [(pol o)]				*
b. [(pol)]			*!	
c. [pol]		*!		
d. pol	*!			

According to (137) and (139), Word-Level affixes do not undergo Root-Level evaluation and are hence not subject to any restrictions on their prosodic size, which seems to correspond well

[25] Even if they do not contain more than one morpheme as in the case of the Stratal Word *stupid* which consists of the Stratal Stem *stupid*, which in turns dominates the root *stupid*.

to the empirical facts.[26]

Whereas the addition of the Root Level means a substantial extension of the overall architecture of SOT, I suggest that it is accompanied by a substantial restriction on the interface between morphology and phonology stated explicitly in (141):[27]

2.4.2 The Atomic Interface Condition

(141) **The Atomic Interface Condition:**
Stratally complex objects do not incur violations
of constraints which refer to morphosyntactic features.

From (141) it follows that morphosyntactic features of lexical roots and Stem-Level affixes (the atomic level-0 objects) can only be accessed at the Root Level, and morphosyntactic features of Word-Level affixes only at the Stem Level. Constraint violation at the Word Level is completely blind to morphosyntactic features since the Word Level does not evaluate atomic elements

This implies i.a. that any difference between lexical morphemes and functional morphemes/affixes is only directly relevant at the Root Level (or for Word-Level affixes at the Word Level). For example, Rt ≈ PW does not have any effect (incurs no constraint violations) at Stem and Word Level because the only atomic elements which undergo evaluation in one of these are Word-Level affixes at the Stem Level which vacuously fulfill Rt ≈ PW.

This does not mean that there are no systematic differences between roots and affixes in Stem and Word Level phonology, but that these substantially restricted since they must be triggered by phonological differences which are derived in a previous cycle at the Root Level. See Trommer (2008a) for an extensive case study of Hungarian vowel harmony based on these assumptions.

2.4.3 Rebirthing

A stratum is an encapsulated unit of computation whose internal structure is opaque to the rest of the grammar. In particular, the input of a stratum *S* is not visible to the strata or modules which process the output of *S*. This kind of stratal encapsulation, which is potentially undermined by Containment, is guaranteed in esc by an operation which I call *Rebirthing*.[28] Rebirthing involves two purifying operations:

(142) **Rebirthing:**
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')

[26] It is not clear to me whether Ngalakan has affixes with Stem-Level properties. The prediction made by the analysis here is that these would also not be necessarily bisyllabic because they satisfy Rt ≈ PW vacuously.

[27] This might be seen as a special kind of bracket erasure: the features, i.e. the internal structure of morphemes is only visible at the lowest level of computation and becomes invisible to later levels.

[28] Cycle-final Cleanup has the effect that the interaction of levels is maximally analogous to the correspondence-theoretic implementation of SOT in Bermúdez-Otero (2008), where the invisibility of the Stem-Level input to Word-Level constraints follows from more implicit reasons: By their very nature, markedness constraints in Correspondence Theory do not have access to input forms of any kind (Orgun 1996), and Word-Level faithfulness constraints are restricted to the Word-Level IO-correspondence which does not include the Stem-Level inputs.

I will illustrate the application of these operations with a classical case of opacity, dentalization in Belfast English (Harris 1985, Bermúdez-Otero 2011). In Belfast English, the coronal [–continuant] sounds /t, d, n, l/ are generally alveolar ([–anterior]) except when preceding /(ə)ɹ/, in which case they become dental ([+anterior]):

(143) **Dentalization of Coronals in Belfast English** (Bermúdez-Otero 2011:5)

a.	**t**rain	[t̪ɾɪən]	**d**rain	[d̪ɾ̪ɪən]
b.	Pe**t**er	[pit̪əʴ]	la**dd**er	[lad̪əʴ]
c.	di**nn**er	[dɛ̈n̪əʴ]	pi**ll**ar	[pɛ̈l̪əʴ]

However, there is no dentalization before the agentive or comparative *-er* suffixes, apart from the case where the latter attaches to bound roots as in *better* (144-c):

(144) **Underapplication of Dentalization in Belfast English** (Bermúdez-Otero 2011:5)

a.	hea[t]er	loa[d]er	ru[n]er	ki[l]er
b.	fa[t]er	lou[d]er	fi[n]er	coo[l]er
c.	be**tt**er	[bætəʴ]	be**tt**er	[bæt̪əʴ]
	‘one who bets’		‘good:CMP’	

Following Bermúdez-Otero (2008), I assume that *-er* is attached to *bett* at the Stem Level whereas all other cases of *-er*-affixation are Word-Level morphology. Allophony is captured by the ranking of the four constraints in (145). At the Stem Level, the markedness constraints are undominated, enforcing insertion of [+ant] and deassociation of [–ant] on a pre-liquid noncontinuant coronal (145-i), and the converse operations in other contexts (145-b) (note that I again use inputs which differ from the outputs to show how the system works, even though the stems do not alternate):

(145) **Belfast Dentalization – Stem Level**

(i). **Input:** [–ant] | • r (Peter)

	*[–ant] R	*[+ant]	Max [ant]	Dep [ant]
☞ a. [+ant] [–ant] ╪ • r			*	*
b. [–ant] | • r	*!			

(ii) . **Input:** [+ant] | • # (bet)

	*[–ant] R	*[+ant]	Max [ant]	Dep [ant]
☞ a. [–ant] [+ant] (• linked to [–ant], delinked from [+ant]) • #			*	*
b. [+ant] | • #		*!		

Before getting shipped to the Word Level, the forms undergo Rebirthing. Thus the output of (145-i) repeated below as (146-a) loses the association line between • and [–ant], and [–ant] is removed, generating the P-structure representation of (145-i). At this point, r, [+ant], •, and the association line connecting the latter two are assigned a new common morphological color by Morpheme Merger resulting in (146-c):

(146) **Cycle-Final Cleanup**

a. [+ant] [–ant] (• linked to [+ant], delinked from [–ant]) • r	**Phonetization** ⇒	b. [+ant] (linked) • r
b. [+ant] (linked) • r	**Morpheme Merger** ⇒	c. [+ant] (linked) • r

(147) shows the derivations at the Word Level. The original inputs to the Stem Level have become unaccessible, and high-ranked Max/Dep [ant] ensure that Word-Level affixation does not lead to dentalization:

(147) **Belfast Dentalization – Word Level**

(i). **Input:** [+ant] • r (Peter)

	Max [ant]	Dep [ant]	*[–ant] R	*[+ant]
a. [+ant] [–ant] • r	*!	*!	*	
☞ b. [+ant] • r				*

(ii). **Input:** [–ant] • r (bet-er)

	Max [ant]	Dep [ant]	*[–ant] R	*[+ant]
a. [–ant] [+ant] • r	*!	*!		*
☞ b. [–ant] • r			*	

Chapter 3

Solutions

3.1 Introduction

This chapter contains short pointers to the detailed solutions the analyses of Western Nilotic in the following chapters provide for the problems identified in chapter 1. Note that the theory proposed here does by no means predict that a notionally homogenous phenomenon (say morphophonological polarity) should receive a unified theoretical analysis. On the contrary, the central claim of this book is that the emergence of such phenomena is an epiphenomenon of independent phonological processes. Thus the case studies on tonal and voicing polarity show that calling the relevant phenomena 'polarity' is at best a strong idealization, and that the relevant processes differ substantially from each other in detail.

3.2 The Overwriting Problem

3.2.1 The General Overwriting Problem

Solution 1 – Simple Upward Maraudage: Simple overwriting in `esc` follows a mechanism which I will call "maraudage": A floating feature F associates to a higher node N to satisfy an association constraint $F \rightarrow N$. This implies de-association of a feature F' (also of type F) which is underlyingly (morphologically) associated to N due to independent constraints (e.g. the combination of F and F' might violate a markedness constraint). F "wins" over F' because deassociating F' will not lead to a violation of $F \rightarrow N$ (since deassociation in `esc` is actually only phonetic invisibility, and the association line is still visible for $F \rightarrow N$ which is an I-structure constraint).

I will illustrate the maraudage mechanism with Aka (cf. chapter 1 for details) and assume the following constraints (see chapter 1 for the definition of $\text{M}{\small\text{AX}}_{\bullet \leftarrow [vc]}$):

(1) **Constraints Governing Overwriting in Aka**

a. $\begin{array}{c}\bullet\\ \uparrow\\ [vc]\end{array}$ Asssign $*$ to every [±voice] node which is not dominated by at least 1 $\bullet$ in I

b. ${}_{[vc]}\overset{*}{\bullet}{}_{[vc]}$ Asssign $*$ to every $\bullet$ which dominates more than 1 [±vc] node in P

c. $\begin{array}{c}*\bullet\\ \vdots\\ [vc]\end{array}$ Asssign $*$ to every association line linking a root node and a [±vc] node which is neither in P nor in M

d. $\text{M}{\small\text{AX}}_{\overset{\bullet}{\downarrow}\,[vc]}$

Undominated $\bullet \leftarrow$ [vc] means that the floating [+vc] must associate to the stem segment [t], but ${}_{[vc]}\overset{*}{\bullet}{}_{[vc]}$ correctly rules out the possibility of an obstruent with contour voicing (2-c). Inserting a non-phonetic association line (2-b) would solve this dilemma, but is excluded by *[vc] $\cdots$ $\bullet$. Since $\text{M}{\small\text{AX}}_{[vc] \leftarrow \bullet}$ is ranked relatively low, its violation is tolerated leading to straightforward overwriting, i.e. voicing of [t] (2-a):

(2) **Overwriting of [vc] in Aka**

Input: [+vc] [–vc] | t

	• ↑ [vc]	*[vc]•[vc]	*• : [vc]	$\textsc{Max}_{[vc]\leftarrow\bullet}$	Max [vc]
☞ a. [+vc] [–vc] ⋱ ǂ d				*	*
b. [+vc] [–vc] ⋱ | t			*!		*
c. [+vc] [–vc] ⋱ | t		*!			
d. [+vc] [–vc] | t	*!				*

Note that the constraint system invoked here also allows to model a language ("Anti-Aka") which systematically excludes the kind of overwriting for [vc] which we observe in Aka. Thus ranking $\textsc{Max}_{[vc]\leftarrow\bullet}$ above • → [vc] will lead to non-parsing of floating voicing features, as shown in (3):

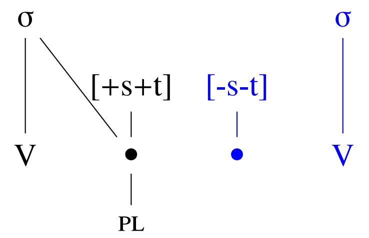
(3) **Non-Overwriting of Floating [vc] in Anti-Aka**

Input: [+vc] [–vc] | t

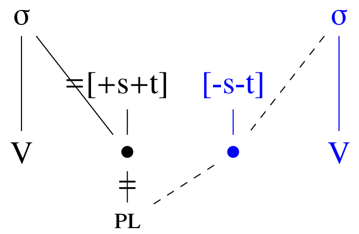
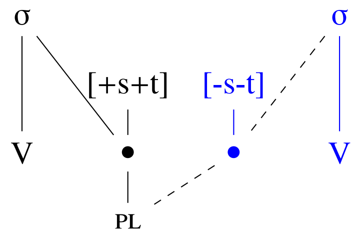
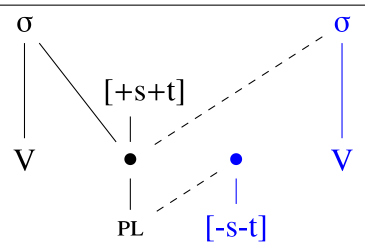
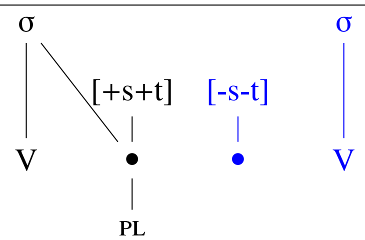
	$\textsc{Max}_{[vc]\leftarrow\bullet}$	*[vc]•[vc]	*• : [vc]	• ↑ [vc]	Max [vc]
a. [+vc] [–vc] ⋱ ǂ d	*!				*
b. [+vc] [–vc] ⋱ | t			*!		*
c. [+vc] [–vc] ⋱ | t		*!			
☞ d. [+vc] [–vc] | t				*	*

Solution 2 – Downward Maraudage: Maraudage in Aka (and most cases of maraudage discussed in this book) work(s) upward in the sense that the node N which marauds another node does so by virtue of a $N \rightarrow N'$ constraint on upward association. If this constraint is satisfied in the output, the marauding node is automatically realized because it is dominated into the overall prosodic structure. However, maraudage may also be triggered by affixal material which is required to dominate specific phonological material by virtue of a $N' \leftarrow N$ constraint. Downward maraudage of this type is mediated by other constraints, typically constraints against multiple ancestor nodes (cf. section 2.3.5) and phonotactic constraints. A case in point is stopping in Dholuo (e.g. *bʊ:r* ⇒ *bʊ:c*-ɛ, 'ulcer', Tucker 1994:128) which is analyzed as maraudage of a PL-node of a base consonant by an underspecified [–son–cont] root node in chapter 7 ([r] is phonologically palatal in Dholuo). PL ← • enforces association of the affixal stop (cf. (4-d)), but that the latter is phonetically realized is due to $\underline{\text{(N.T)}}_{\text{PL}}$ (eliminating (4-c)), and cooccurrence with the original owner is blocked by the wellformedness constraint $\overline{\text{(N.T)}}_{\text{PL}}$ which excludes the syllable contact *r.c* from Dholuo phonotactics (4-b) (see section 7.3.1 for details).

(4) **Stopping under •-Affixation to r**



Input:

			• ↓ PL	$*^{\odot}PL^{\odot}$	$\underline{(N.T)}_{PL}$	MAX •
☞ a.		(c)				*
b.		(rc)			*!	
c.		(r)		*!		*
d.		(r)	*!			*

3.2.2 The Bidirectional Mutation Problem

Digression: Unidirectional Mutation: The analysis in (2) predicts that Aka could also have a floating [–vc] affix, which would overwrite [+vc] stem segments in a mirror fashion. Given our limited knowledge of Aka, this possibility cannot be excluded, but there are languages for which we might want to assume that overwriting is unidirectional. For example, in Dinka which has a whole battery of morphological processes which render stems breathy (see chapter 1), but no morphological constructions which render stems breathy, this asymmetry is probably not accidental, but due to the phonological constraint ranking of the language. This can be captured by the differential ranking of sub-constraints for breathy ([··]) and creaky ([~]). Crucially if [··] → • is ranked above $\text{MAX}_{[lar]\leftarrow\bullet}$ and • ← [~] below it, floating [··] leads to overwriting (5), whereas floating [~] remains unparsed (6) ([lar] covers both, [~] and [··]):

(5) **Overwriting of [··] over [~] in Dinka**

Input: a linked to [~]; floating [··]

	• ↑ [··]	MAX [lar] ↑ •	• ↑ [~]
☞ a. a ([~] unparsed, delinked ╪; [··] linked)		*	
b. a ([~] linked; [··] unparsed)	*!		

(6) **Non-Overwriting of [~] over [··] in Dinka**

Input: a linked to [··]; floating [~]

	• ↑ [··]	MAX [lar] ↑ •	• ↑ [~]
a. a ([··] unparsed, delinked ╪; [~] linked)		*!	
☞ b. a ([··] linked; [~] unparsed)			*

Solution – Maraudage: Remember now that there are cases where overwriting *is* bidirectional in the sense that floating [+*F*] overwrites preassociated [–*F*], and floating [–*F*] overwrites preassociated [+*F*]. In fact this was one of the potential problems identified for floating feature analyses in OT in chapter 1 on the basis of Nuer consonant mutation. Since Nuer not only provides a more complex case, but also shows a number of theoretically relevant points, I will sketch a short analysis close to the one for Aka. (7) repeats the relevant data from chapter 1. Recall that the language derives negative present participles by rendering a root-final obstruent voiceless and plosivizing it in case it is a fricative:

(7) **Mutation in Nuer Non-Finite Forms** (Crazzolara 1933)

	‘over-take’	‘hit’	‘pull out’	‘scoop hastily’	
Infinitive	coβ	ja:ç	guð	kêp	
Negat. Pres. Ptc.	cò**p**	ja:**c**	gu**t̪**	ke**p**	[–voice –continuant]
Past Ptc.	co**f**	ja:**ç**	guθ	kɛ̀**f**	[–voice +continuant]

(8) shows the relevant constraints for capturing continuancy mutation which are fully parallel to the respective constraints for [voice]:

(8) **Constraints on [cont]**

a. $\overset{\bullet}{\underset{[ct]}{\uparrow}}$ Asssign $*$ to every [±cont] node which does not dominate at least 1 root node in I

b. $\overset{*}{{}_{ct}\underline{\bullet}_{ct}}$ Asssign $*$ to every root node which is associated to more than 1 [±cont] node in P

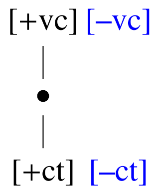
c. $\overset{*\bullet}{\underset{[ct]}{\vdots}}$ Asssign $*$ to every association line in I linking a root node and a [±cont] node which is neither in P nor in M

d. $\textsc{Max}_{\overset{\bullet}{\underset{[ct]}{\uparrow}}}$

In the evaluation, the candidates (9-a-e) are analogous to (7-a-e). (9-e,f) show that also partial mutation (overwriting only for [cont] or [voice]) is excluded:

(9) **Overwriting of [vc] and [cont]** ([β] ⇒ [p])

Input:



	•→[vc]	•→[ct]	[vc]*•[vc]	ct*•ct	*• : [vc]	*• : [ct]	MAX •↓[vc]	MAX •↑[ct]
☞ a. [+vc] [–vc] • [+ct] [–ct]							*	*
b. [+vc] [–vc] • [+ct] [–ct]					*!	*!		
c. [+vc] [–vc] • [+ct] [–ct]			*!	*!				
d. [+vc] [–vc] • [+ct] [–ct]	*!	*!						
e. [+vc] [–vc] • [+ct] [–ct]		*!						*
f. [+vc] [–vc] • [+ct] [–ct]	*!						*	

3.2.3 The Multiple Exponence Problem

Maraudage also already implies the solution for the Multiple Exponence Problem. In contrast to an account in terms of REALIZE-MORPHEME, the maraudage mechanism for a given floating node *N* realizing the Vocabulary Item *V* is completely independent from the presence of other exponents realizing *V*. This is illustrated by the analysis of Nuer in subsection 3.2.2.

3.2.4 The Incest Taboo Problem

Solution – Derived Environment Constraints: Nuer exhibits a second interesting pattern already discussed in chapter 1: Floating features cooccur with affixal morphology in the expression of morphological categories. Thus, as shown in (10), the 3SG of the indicative present active shows the suffix -ɛ and, in addition, mutation to a voiced stop. The corresponding 1Pl form us marked by the suffix -*kɔ* and final consonant mutation to a voiceless fricative:

(10) **Multiple-Feature Mutation + Affixation** (Crazzolara 1933)

	'overtake'	'pull out'	'scoop hastily'	
Infinitive	coβ	guð	kêp	
3SG:IND:PRES:ACT	cóβ-έ	gúð-έ	kέβ-έ	[+vc+cont]-ɛ
1PL:IND:PRES:ACT	còɔ**f**-kɔ̀	gwɔ̀θ-kɔ̀	kɛ̀a**f**-kɔ̀	[-vc+cont]-kɔ

Recall that this raises the question why the floating features of the affix do not link to a segment of the affix itself, which would predict for example that we get *kɛ̀**ap**-xɔ̀* instead of *kɛ̀**af**-kɔ̀*.

In the following, I interpret the non-association of floating material to tautomorphemic segments as a Derived Environment effect along the lines developed in chapter 2. Thus the constraint in (11) penalizes overwriting of a [–cont] affix segment by a affixal floating [+cont] when this is not accompanied by concomitant association of [+cont] to a base segment.

(11) **Derived-Environment Constraint**

DERIVED-ENVIRONMENT$^{ct}_{\bullet}$ Assign ∗ to every morphological [±cont] node which is associated by an epenthetic association line to a homomorphemic root node and is not associated to a heteromorphemic root in P.

High ranking of (11) now excludes correctly (12-e) (corresponding to *kɛ̀**ap**-xɔ̀*). Associating the floating [+cont] to both the stem and the affix stop, might seem an escape hatch to avoid violation of DE$^{ct}_{\bullet}$, but this leads to an additional violation of MAX$_{\bullet\leftarrow[ct]}$ and is therefore also suboptimal:

(12) **Non-Overwriting of Affix [–cont]**

Input: [–ct] [+ct] [–ct]

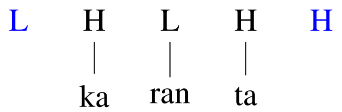
	$DE^{ct}_{\bullet}$	$\bullet \uparrow$ [ct]	$^{*}_{ct}\underline{\bullet}_{ct}$	$^{*}\bullet$: [ct]	$MAX_{\bullet \uparrow [ct]}$
☞ a. [–ct] [+ct] [–ct]					*
b. [–ct] [+ct] [–ct]				*!	
c. [–ct] [+ct] [–ct]			*!		
d. [–ct] [+ct] [–ct]		*!			
e. [–ct] [+ct] [–ct]	*!				*
f. [–ct] [+ct] [–ct]					**!

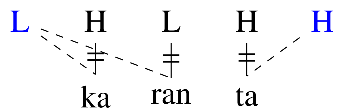
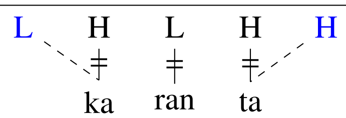
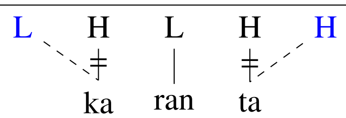
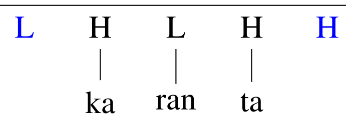
3.2.5 The Erasure Problem

Complete erasure will be derived in this book as the conspiracy of non-concatenative circumfixation and Color Contiguity. Thus, as illustrated in (13), I assume that the Hausa imperative discussed in section 1.1.5 involves a L-tone prefix , and a H-tone suffix. In this constellation, the color contiguity constraint basically enforces deletion of stem tones which is accompanied by reassociation to the affix tones to provide the base syllables with phonetic tone. See chapter 5 for detailed analyses of Hausa and Jumjum. A similar case of metric (moraic) Erasure in Dinka analyzed according to the same general schema is laid out in chapter 4.

(13) **Erasure by Circumfixation in Hausa**

Input:



	$\sigma \uparrow T$	$\square$CONT$_T$	MAX$^{\sigma}_{\uparrow T}$	$\sigma \downarrow T$
☞ a. 			***	
b. 			***	*!
c. 		*!	**	
d. 	*!*			

3.3 The Inconsistency Problem

3.3.1 Quirky Mutation in General

Solution 1 – The Richness of Defective Exponents: Many cases of inconsistent mutation are captured in the following by defective affixal exponents which carry more than one relevant feature, and phonological constraints which condition their differential realization; see for example the analysis of the Anywa FQ in chapter 7. Another case in point is tonal polarity in Dinka which is captured in chapter 5 by an underlying affixal L H melody which never surfaces as such because Dinka has no syllable with rising tones, and bases are generally monosyllabic.

Solution 2 – The Interaction of Strata: The second major source for Inconsistency is the stratal organization of the grammar. Thus the Päri consonant mutation case discussed in chapter 1 where nasals become nasal+stop (e.g. [m] ⇒ [mb]) whereas [r] is glided ([r] ⇒ [jj]) is shown in chapter 7 to derive from stopping at the Stem Level, which is then followed by intervocalic lenition at the Word Level ([r] ⇒ [ɟɟ] ⇒ [jj]). Crucially the mutation process itself uniformly involves hardening which is captured by affixation of an underspecified [–sonorant] root node.

Solution 3 – I-Structure Constraints: Inconsistency is one of the interesting effects of I-structure constraints. Thus the fact that Mayak mid vowels in the Vowel Quality Alternation discussed in chapter 1 do not raise to [+ATR] high vowels follows from a constraint against [⊣] mid-vowels (a pervasive pattern in Mayak) which – due to Containment – blocks derivations such as [ɛ] ⇒ [i]. The stratal organization of Mayak further obscures the relevant generalizations. See chapter 6 for a detailed analysis.

3.3.2 Chain-Shifting Mutation

Solution 1 – Chain-Shifting is only Apparent: Apparent chain-shifting mutation in the Mayak VQA is shown to follow from the interaction of stratal organization and I-Structure constraints in chapter 6 (see also solution 3 in subsection 3.3.1).

Solution 2 – True Chain-Shifting by Sonority Affixation: However, I also acknowledge that there are true cases of chain-shifting mutation which I capture by affixation of abstract sonority elements to segments (cf. chapter 6 on Thok Reel, see also Trommer (2009a,b) on related analyses of chain-shifting mutation patterns in Manx and Irish).

3.3.3 Polarity

Solution 1 – Polarity is only Apparent: A very special case is "voicing polarity" in Dholuo. In chapter 7, I show that polarity is actually not the norm – many roots resist alternation – and is restricted by further phonological conditions (especially vowel-final roots behave markedly differently from consonant-final ones). The actual distribution of voicing alternations is then derived by the interplay of general phonological mechanisms: underspecification, word-final devoicing, voicing assimilation between obstruents, and default assignment of [–vc] to obstruents.

Solution 2 – The Richness of Defective Exponents: Cf. Solution 1 on Dinka tone polarity in subsection 3.3.1.

3.4 The Divergence Problem

The Divergence Problem is addressed in several detailed case studies in this book, and derived crucially from the interaction of the stratal organization of grammar in `esc` with the undeniable fact that floating features are structurally different from segments.

Solution 1: Different Representations: In the analysis of [ATR]-alternations in Päri (chapter 6), these are governed by Root-Level constraints which require that vowels of lexical roots are specified for [±ATR] whereas affix vowels are systematically unspecified for [ATR]. This derives the root-dominant harmony at the Stem Level. However floating [+ATR] exponents are trivially not subject to constraints on vocalic segments, and may survive to the Stem Level where they trigger exceptional overwriting since the Stem-Level ranking actually enforces specification of vowels as [+ATR]. See chapter 5 for an analysis of Divergence in Anywa tone along the same lines.

Solution 2 – Different Strata: The analysis of the Mayak Vowel Quality Alternation in chapter 6 also turns out to be an excellent example for Divergence. VQA is shown to be reducible to specific types of vowel harmony only found with specific affixes. Since the same affixes also show other phonological characteristic peculiarities of Stem-Level phonology, I conclude that VQA is simply the combination of Stem-Level vowel harmony processes of the language.

Chapter 4

μs

Western Nilotic has 4 well-documented patterns of vowel-length manipulating morphology. **Augmentation** (1-a) lengthens underlying vowels by 1 step: Monomoraic (short) Vs get bimoraic (long), bimoraic (long) Vs get trimoraic (extra-long). Augmentation is instantiated by CF and 3SG in Dinka (cf. the data in (3) and (4)). Dinka shows also the 2nd pattern (1-b), where a specific affix imposes a **2μ-Template**, i.e. length/weight of exactly two moras on the base vowel, no matter whether this is underlyingly short or long (cf. (11) for relevant data).[1] **Shortening** (1-c) shortens long Vs to short ones, and leaves short vowels intact,[2] whereas **Length Polarity** (1-d) lengthens short Vs and shortens long Vs, Both, shortening and polarity, are found by different patterns in Päri and Anywa (see sections 4.2 for data).

(1) **Major Patterns of V-Length-changing Morphology in Western Nilotic**

Input:	a. **Augmentation**	b. **2μ-Template**	c. **Shortening**	d. **Length Polarity**
V 1μ	Vː 2μ	Vː 2μ	V 1μ	Vː 2μ
Vː 2μ	Vːː 3μ			V 1μ
	(Dinka, Thok Reel)	(Dinka)	(Anywa, Päri)	(Anywa, Päri)

A fifth pattern, **2μ-Augmentation**, is mentioned in passim in the descriptive literature (Andersen 1995, Remijsen et al. 2009, Reid 2010), but not described in detail for any language.[3]

(2) **Minor Pattern of V-Length-changing Morphology in Western Nilotic**

Input:	**2μ-Augmentation**
V 1μ	Vːː 3μ
Vː 2μ	Vːː 3μ
(Dinka, Shilluk, Thok Reel)	

[1] Recall that apart from Thok Reel Western Nilotic doesn't have morphemes which are underlyingly 3-moraic.

[2] Alternatively, shortening could be interpreted as imposition of a 1μ-template. Under the assumption that there are no μ-less vowels in Western Nilotic (see Piggott (1998) and Féry (1995) for claims that such vowels exist at least in some languages), i.e. that this option is systematically blocked by a high-ranked markedness constraint, a 1μ-template would only result in different empirical data in a language which has a three-way V-length contrast. Interestingly the Western Nilotic languages with such a contrast have neither, shortening nor a morphologically triggered 1μ-template. As will become clear below, under the analysis proposed here, a 1μ-template could not be derived. Thus the prediction I make is that shortening in a Western Nilotic language with 3 V-lenghts should be systematic shortening (Vː→ V and Vːː→ Vː). In the following, I will assume that Western Nilotic doesn't have 1μ-templates, and that the relevant data instantiate V-shortening.

[3] Again this phenomenon might also be interpreted slightly differently, this time as a 3μ-template. Since the data are not very robust anyway, I won't consider this possibility here.

Flack (2007) has argued that the cooccurrence of pattern (2-a) and (1-b) in the very same language, Dinka, provides strong evidence for the existence of morpheme-specific markedness constraints since the augmentation pattern seems to systematically violate a markedness constraint agains trimoraic Vs which is crucial to capture the 2μ-template pattern.

Here I will show that all attested patterns of V-length changing can be derived by the affixation of moraic affixes, i.e. morphemes consisting of one or two μ-exponents which are either prefixes or suffixes. The only reference to morphological structure which will be necessary is again the visibility of morphological color, which allows to distinguish tautomorphemic and heteromorphemic μs.

My point of departure are the cooccurrence restrictions of the different patterns in (2): Length-polarity only occurs in languages which also have shortening, but no augmentation (Päri, Anywa). A 2μ-template only occurs in Dinka, a language which also has augmentation, but no shortening. I will assume in the following that this distribution is not accidental, but systematic and corresponds to two different constraint ranking patterns: In Dinka (and probably Shilluk and Thok Reel as well), mora affixation is in principle additive: affix moras integrate into the prosodic structure of the base, and associate to the base V if not blocked by markedness constraints. On the other hand, Päri and Anywa instantiate the subtractive type: μ-affixation leads always to shortening of long vowels since the affix-μ integrates into the σ of the base triggering de-association of one of the V-moras to avoid over-heavy syllables, but doesn't associate to the base V itself, in effect shortening the base V. Only under specific circumstances (i.e. if the affix-μ is a prefix) it also associates to short base Vs resulting in lengthening/polarity.

In the remainder of the chapter, I will discuss, both language types in turn, Dinka as an example of the additive type (section 4.1), and Anywa as exemplifying the subtractive type (section 4.2).

4.1 Additive μ-Affixation: Dinka

4.1.1 1μ-Augmentation

Many morphological categories of Dinka verbs induce vowel lengthening, hence simple **Augmentation**. Since Dinka has a systematic three-way contrast in vowel length (Remijsen and Ladd 2008), this means that short vowels get long while long vowels get extra-long (Andersen 1995, Flack 2007). (3) shows examples from the 3SG and centrifugal morphology:

(3) **Augmentation in the Dinka 3SG** (Andersen 1995:16,28; Flack 2007:5)

a. wèc	⇒	wèːc	'kick:3SG'
b. tèŋ	⇒	tèːŋ	'dust:3SG'
c. lèːr	⇒	lè̤ːːr	'roll:3SG'
d. mìːt	⇒	mì̤ːːt	'pull:3SG'

(4) **Augmentation in the Dinka CF** (Andersen 1995:16,28; Flack 2007:5)

a. wèc	⇒	wéːc	'kick:CF'
b. tèŋ	⇒	têːŋ	'dust:CF'
c. lèːr	⇒	lê̤ːːr	'roll:CF'
d. mìːt	⇒	mî̤ːːt	'pull:CF'

This pattern can be captured through straightforward association enforced by the constraint μ → •, as shown in (6):

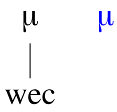
(5) **Constraints on μ-Affixation in Dinka**

a. $\mu \downarrow \bullet$ Assign ∗ to every mora which does not dominate at least 1 segment in I

b. $\text{D}\textsc{ep}^{\mu}_{\uparrow\bullet}$ Assign ∗ to every segment/μ pair which is associated in P but is not associated in M

c. $\text{M}\textsc{ax}^{\mu}_{\uparrow\bullet}$ Assign ∗ to every segment/μ pair which is associated in M but is not associated in P

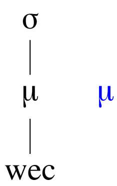
(6) **Mora Affixation in CF**

Input: 

	$\overset{\mu}{\downarrow}\bullet$	$\textsc{Max}^{\mu}_{\uparrow\bullet}$	$\textsc{Dep}^{\mu}_{\uparrow\bullet}$
☞ a. wec			*
b. wec	*!		

The suffix-μ is also associated to the base syllable due to the undominated constraint $\overset{\odot}{*}\bullet^{\odot}$ which excludes configurations where a segmental root node is dominated phonetically by more than one ancestor node, as shown in detail in (7) (for keeping the tree small, I assume that the σ-node of the base is the DAN of the candidate). Associating the affix mora downwards to a segmental root node of the base results indirectly upward association to the base syllable (7-a) because the involved segment would otherwise be dominated by two ancestor nodes as in (7-b), $\sigma_{\circledcirc}$ and the affix-μ:

(7) **Upward Integration of the Affix Mora in the CF**

Input: 

	$\overset{\odot}{*}\bullet^{\odot}$	$\overset{\mu}{\downarrow}\bullet$	$\textsc{Max}^{\mu}_{\uparrow\bullet}$	$\textsc{Dep}^{\mu}_{\uparrow\bullet}$
☞ a. wec				*
b. wec	*!			
c. wec		*!		

Since μ-σ association in the language follows in a predictable way from μ-• association, I will not explicitly discuss it for the following data.

4.1.2 2μ-Augmentation

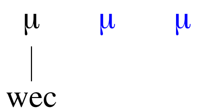
The multiplicative and the causative of Dinka trigger for specific short roots double lengthening (i.e. short vowels get extra-long), hence **2μ-Augmentation**:

(8) **2-μ-Affixation in the Dinka FQ** (Andersen 1995:37)

a. bò̤k	⇒	bô̤:k	'throw:NF'
b. bò̤k	⇒	bó̤::k	'throw:FQ'
c. bò̤k	⇒	bɔ̤́::k	'throw:FQ:NF'

This is derived in exactly the same way as simple augmentation if the causative is represented as a sequence of two floating moras (or two monomoraic suffix exponents):

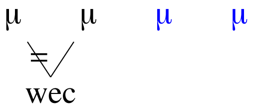
(9) **Mora Affixation in the Causative (1μ-Base)**

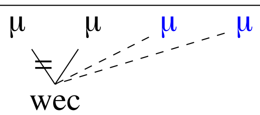
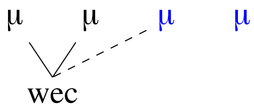
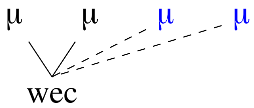
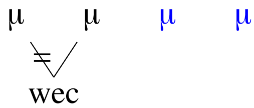
Input: 

	μ↓•	MAX$^{\mu}_{\uparrow\bullet}$	DEP$^{\mu}_{\uparrow\bullet}$
☞ a. wec			**
b. wec	*!		*
c. wec	*!*		

The multiplicative/causative data have to be treated with some caution since Andersen doesn't treat them in detail. Especially Andersen doesn't discuss what effects multiplicative and causative morphology have for undrived long (2-moraic) base vowels. What is clear is that 3-moraic stems do not get 4-moraic in the multiplicative/causative because Dinka systematically bans 4-moraic Vs (Andersen 1995:37). Under the assumption that these also get get extra-long (3-moraic), one of the base vowels would have to deassociate under the pressure of un-dominated $*\underline{V}_{4\mu}$:

(10) **Mora Affixation in the Causative (2μ-Base)**

Input: 

		$*\underline{V}_{4\mu}$	μ ↓ ●	MAX$^{\mu}_{\uparrow\bullet}$	DEP$^{\mu}_{\uparrow\bullet}$
☞ a.				*	**
b.			*!		*
c.		*!			*
d.			*!*		

4.1.3 The 2μ-Template

Finally, in benefactive forms, short vowels are lengthened to long vowels whereas long vowels retain their length. Thus, as Flack (2007) observes, benefactive morphology imposes a **2μ-Template** on roots of any underlying length:

(11) **2-μ-Template in the Dinka Benefactive** (Andersen 1995:16,28), (Flack 2007:6)

a.	(i)	wéc	⇒	wé̤ːc		'kick:BEN'
	(ii)	tèŋ	⇒	tê̤ːŋ		'dust:BEN'
b.	(i)	lèːr	⇒	lê̤ːr	*lê̤ːːr	'roll:BEN'
	(ii)	mìːt	⇒	mî̤ːt	*mî̤ːːt	'pull:BEN'

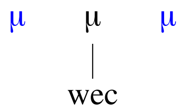
I analyze this as a case of overwriting, completely in analogy to the case of tonal overwriting discussed in chapter 5. More specifically, I assume that the benefactive consists of two exponents, a mora prefix which is prefixed to the first μ of the base and a mora suffix which is suffixed to the final μ of the base.[4] (13) shows how this derives bimoraicity for a monomoraic root.

(12) □$\underline{\text{CONTIGUITY}}_{\mu}$ Assign $*$ to every μ M_1 intervening between two moras M_2, M_3 such that Color(M_2) = Color(M_3) ≠ Color(M_1) in P

[4]As far as I know, there is no evidence of whether coda consonants in Dinka project their own mora which could potentially intervene between the suffix mora and the V root node of the base (see section 4.2 on Anywa for a case where the affix-μ becomes a crucial factor in deriving the details of μ-affixation). Here I assume for simplicity that coda Cs in Dinka are non-moraic. If it turns out that codas are systematically moraic in Dinka, the suffixal exponent of the BEN must be captured as an infix, i.e. a prefix to the final (consonantal) mora of the base.

The □Cont constraint defined in (12) blocks overt cooccurrence by association of both affix tones with the intervening root mora (13-b) whereas (partial) non-association of the affix moras as in (13-c,d) leads to fatal violation of μ → •. Thus we get complete overwriting of root moras (13-a):

(13) **Mora Affixation in the Benefactive**

Input: 

	□Cont$_\mu$	μ ↓ •	Max$^\mu_\uparrow$	Dep$^\mu_\uparrow$
☞ a. wec			*	**
b. wec	*!			**
c. wec		*!		**
d. wec		*!*		

Interestingly enough, the imposition of the μμ-template also blocks further augmentation of bases by morphological categories otherwise inducing lengthening. Thus 3SG forms of benefactives have long, not extra-long vowels:

(14) **Dinka BEN 3SG Forms** (Andersen 1995:16,28; Flack 2007:6)

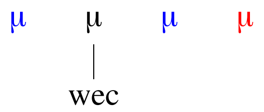
a.	(i)	lèːr	⇒	lè̤ːːr		‘roll:3SG’
	(ii)	lèːr	⇒	lê̤ːr		‘roll:BEN’
	(iii)	lèːr	⇒	lê̤ːr	*lê̤ːːr	‘roll:BEN:3SG’
b.	(i)	mìːt	⇒	mí̤ːːt		‘pull:3SG’
	(ii)	mìːt	⇒	mî̤ːt		‘pull:BEN’
	(iii)	mìːt	⇒	mî̤ːt	*mî̤ːːt	‘pull:BEN:3SG’

I assume that this is the consequence of the constraint $*V^{3\square}$ a vocalic root node should not be dominated by more than two colors (cf. section 2.3.5):

(15) $*V^{3\square}$ Assign $*$ to every V which is dominated by (moras of) more than two colors

Th tableau in (16) shows how $*V^{3\square}$ blocks the lengthening of a short root V in the benefactive 3SG by two more moras to extra-long. Associating all three affix moras (16-e) fatally violates $*V^{3\square}$ just as leaving the first benefactive mora unassociated and the root mora associated (16-f) – crucially the association of the base-V to its mora remains visible for $*V^{3\square}$ even when the association line gets phonetically invisible. Associating only the 3SG mora to the base vowel (16-g) avoids the violation of $*V^{3\square}$, but leads to more violations of $\mu \rightarrow \bullet$, which renders this candidate still inferior to (16-a) (this is crucial for input roots with two moras, where the candidate corresponding to (16-g) would involve lengthening).

(16) **Mora Affixation in the 3SG Benefactive**

Input: 

	$*V^{3\square}$	$\square$CONT$_{\mu}$	$\mu \downarrow \bullet$	MAX$^{\mu}_{\uparrow\bullet}$	DEP$^{\mu}_{\uparrow\bullet}$
☞ a. wec			*	*	**
b. wec		*!			**
c. wec			**!		**
d. wec			**!*		
e. wec	*!			*	***
f. wec	*!		*		**
g. wec			**!		**

That $*V^{3\square}$ is undominated in Dinka becomes evident by looking at data where double lengthening is expected by combining two processes of simple moraic lengthening. Thus, as shown by the data in (3) and (4), both, the centrifugal and the 3SG, induce lengthening in underived roots, but 3SG centrifugal forms show simple, not double lengthening (short vowels get long, not extra-long):

(17) **Dinka CF 3SG Forms** (Andersen 1995:16,28; Flack 2007:5)

a. wèc	+ μ_{CF}	+ μ_{3SG}	⇒	wéːc	*wéːːc	‘kick:CF’
b. tèŋ	+ μ_{CF}	+ μ_{3SG}	⇒	têːŋ	*têːːŋ	‘dust:CF’
c. lèːr	+ μ_{CF}	+ μ_{3SG}	⇒	lê̤ːːr	*lê̤ːːːr	‘roll:CF’
d. mìːt	+ μ_{CF}	+ μ_{3SG}	⇒	mî̤ːːt	*mî̤ːːːt	‘pull:CF’

4.2 The Subtractive Type: μ-Affixation in Anywa

Both types of vowel-length-manipulating morphology in Anywa, **Shortening** and **Length Polarity**, lead to the shortening of underlyingly long base vowels. In addition, polarity also lengthens short base Vs. I assume that in both shortening cases, an affix-μ is attached to the syllable node of the base verb which is already 3-moraic, but is blocked by different factors to link to a base segment. Since Anywa doesn't tolerate overtly 4-moraic syllables, one of the base μs must be dissociated, resulting in shortening. Again the attachment of the affix element with concomitant deassociation of base material follows the containment-based maraudage logic described in chapter 3. Lengthening of short base vowels in V-polarity results from attaching a μ-prefix to a monomoraic V, whereas strictly shortening μs are suffixal and cannot associate to base-Vs since this would result in crossing association lines, due to the intervening (moraic) coda consonant. Finally, lengthening of (association of a μ to an) underlyingly long/2-moraic V is excluded because Anywa in contrast to Dinka systematically disallows extra-long/3-moraic Vs. The section is structured as follows: Subsections 4.2.1 and 4.2.2 provide basic analyses for V-shortening in the antipassive and V-polarity in the frequentative.

4.2.1 V-Shortening in the Antipassive

As shown in (18-a), the Anywa antipassive systematically shortens long/2-moraic Vs to short/1-moraic ones. Underlyingly short/1-moraic Vs remain unchanged (18-b):

(18) **V-Shortening in the Anywa AP** (Reh 1993:223)

a. **Vː ⇒ V**

(i) r**iː**w ⇒ r**i**w 'to lay something crosswise'
(ii) m**aː**t̪ ⇒ m**a̠**t̪ 'drink something'

b. **V ⇒ V**

(i) c**a**m ⇒ c**a̠**m 'eat something'
(ii) ŋɔl ⇒ ŋ**o**l 'cut something off'

In addition to the constraints already introduced in the context of Dinka, the analysis of this pattern makes use of the (undominated) constraints in (19). $*C^{2\mu}$ expresses the assumption which is implicitly almost universally made in the literature on μs, but to my knowledge never spelled out: that coda consonants can maximally be linked to 1 mora.[5] $*\times^{\mu}_{\bullet}$ is a generalized no-crossing constraint banning μs which are associated to a • across another • which is in turn associated to another μ. $*\underline{\sigma}_{3\breve{\mu}}$ and $*V^{3\mu}$ capture the generalizations that Anywa doesn't allow 4-moraic syllables and 3-moraic vowels. Note crucially that $*\underline{\sigma}_{3\breve{\mu}}$ is a phonetic constraint, whereas $*V^{3\mu}$ is a general one. Thus it will be crucial for the analysis that a σ in Anywa can be linked to 4 μs if only 3 of them are phonetically visible, while σ's linked to more than two μs are excluded no matter whether the involved μs are phonetic or morphological. Finally, μ • ⇒ σ captures the interdependence of phonetic μ-• and μ-σ association: μs which phonetically dominate segments must in turn be phonetically dominated by syllables.

[5] See Hyman (1985) for an analysis of extra-long Cs as involving two μs, however in a framework which is substantially different from standard μ-theory.

(19) **Undominated Constraints in Anywa**

a. $*C^{2\mu}$ Assign $*$ to every C which is dominated by more than one μ in I

b. $*\times^{\mu}_{\bullet}$ Assign $*$ to every ordered pair of μ-nodes (M_1, M_2) in I such that:
(i) M_1 dominates the •-node R_1 and M_2 dominates the •-node R_2
(ii) $M_1 \prec M_2$ and $R_2 \prec R_1$

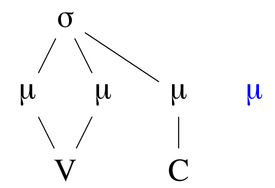
c. $*\underline{\sigma}_{3\breve{\mu}}$ Assign $*$ to every σ which dominates more than 3 μs in P

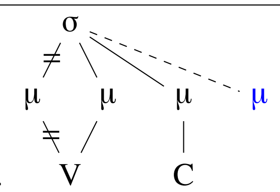
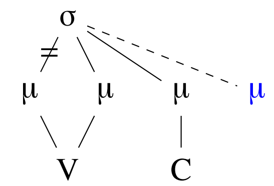
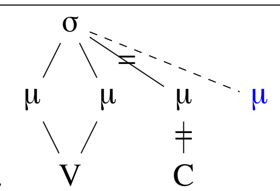
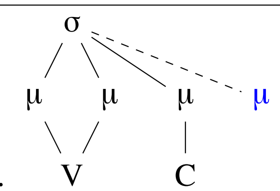
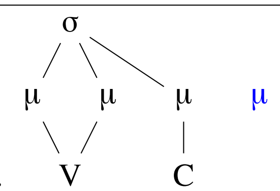
d. $*V^{3\mu}$ Assign $*$ to every V which is dominated by more than 2 μs in I

(20) shows how the ranking of $\mu \rightarrow \sigma$ and the constraints in (19) above Max C and $\mu \Rightarrow \bullet$ derives shortening of a long base vowel under the assumption that the AP morpheme has a moraic suffix exponent. Due to $\mu \rightarrow \sigma$ (fatally violated in (20-e)), the affix mora must attach to the σ-node of the base. However, without further repair operations, this would lead to a σ, which is to heavy, violating $*\underline{\sigma}_{3\breve{\mu}}$ (20-d). One of the μs must delink from the σ-node. The coda-mora is protected by Max C (20-c), so one of the V-μs is rendered phonetically invisible. $\mu_{\bullet} \Rightarrow \sigma$ (fatally violated by (20-b)) ensures that delinking the μ from the σ leads also to delinking it from the V root node (20-a):

(20) **Antipassive: Shortening of Long Vs: σ-Association of μ**

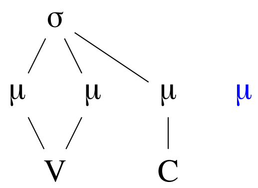
Input:

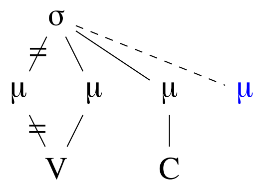
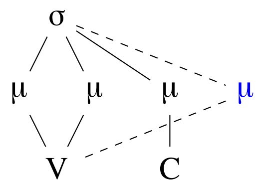
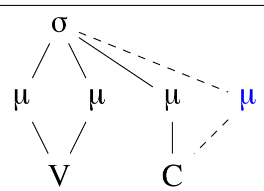


	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\downarrow\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet^{\odot}$	Max C	$\mu \Downarrow \bullet$
☞ a. 								*
b. 						*!		*
c. 							*!	*
d. 				*!				*
e. 	*!							

The tableau in (21) shows for additional candidates corresponding to the same input why association of the affix-μ to base segments is excluded: Association to the coda-C would violate $*\underline{\sigma}_{3\breve{\mu}}$ and $*C^{2\mu}$ (21-c), and association to the base V violates $*\overset{\mu}{\underset{\bullet}{\times}}$ (plus other constraints) (21-b). Since these are undominated whereas $\mu \rightarrow \bullet$ is ranked relatively low, the affix-μ remains unassociated to a •-node ((21-a) = (20-a)) :

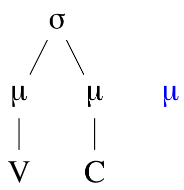
(21) **Antipassive: Shortening of Long Vs: •-Association of μ**

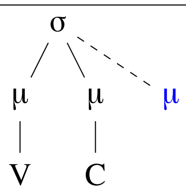
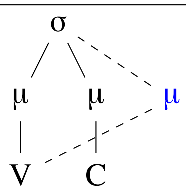
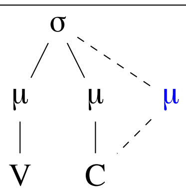
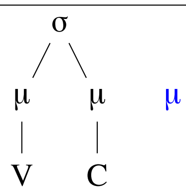
Input: 

	$\overset{\sigma}{\underset{\mu}{\uparrow}}$	$*C^{2\mu}$	$*\overset{\mu}{\underset{\bullet}{\times}}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet\odot$	MAX C	$\overset{\mu}{\underset{\bullet}{\Downarrow}}$
☞ a. 								*
b. 			*!	*!	*!			
c. 		*!		*!				

The crucial role of $*\times^{\mu}_{\bullet}$ (and of the coda mora) becomes more obvious with short-V bases (22), where it is the only constraint blocking association of the μ-suffix to the stem-V (22-b). Association to the coda-C is again excluded by $*C^{2\mu}$, The affix-μ attaches only to the σ-node, which is within the 3μ-limits of Anywa syllable weight and therefore without any further consequences (22-a):

(22) **No Phonetic Changes with Short Vs**

Input: 

	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot\bullet\odot}{*}$	MAX C	$\mu \Downarrow \bullet$
☞ a. 								*
b. 			*!					
c. 		*!						
d. 	*!							*

4.2.2 V-Length Polarity in the Frequentative

Maybe the most intriguing and puzzling pattern of vowel-length manipulating morphology in Anywa is found in the frequentative, which shows vowel-length polarity (and gemination of base-final consonants): short/1-moraic vowels get long (23), and long/2-moraic vowels get short (24):

(23) **Frequentative: Lengthening of Short Root Vowels** (Reh 1993:44,243-245)

a. ŋɔl ⇒ ŋɔːlːɔ ‘cut’
b. buŋ ⇒ buːŋːo ‘cover tightly’

(24) **Frequentative: Shortening of Long Root Vowels** (Reh 1993:43,243-245)

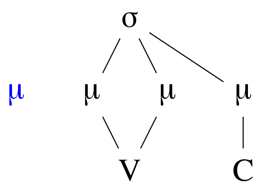
a. caːn ⇒ canːɔ ‘tell’
b. kaːt ⇒ katːɔ ‘weave basket’

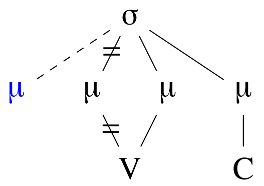
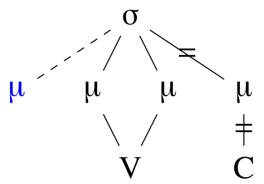
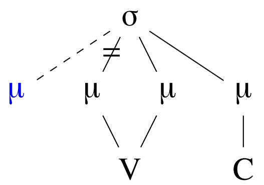
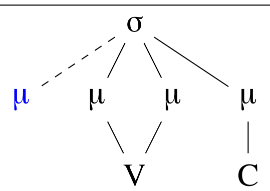
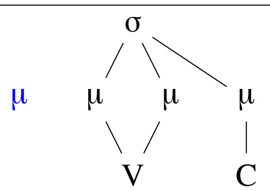
Crucially, in the analysis proposed here, the difference between shortening (AP) and length-polarizing (FQ) morphology is minimal and reduces to a standard parameter of morphological formatives. Whereas the AP-exponent is a μ-suffix, the FQ-affix is a μ-prefix. Phonologically this small morphological difference grants better access to the base vowel for the FQ-μ, which opens up the possibility to trigger lengthening in short base Vs.

Nonetheless I will start my discussion with long base Vs which behave in the FQ almost completely in parallel to the situation already described for the AP: The affix-μ attaches to the base-σ, triggering shortening of the base-V by the transmission belt of $*\underline{\sigma}_{3\breve{\mu}}$:

(25) **Anywa FQ: Shortening of Long Vs: σ-Attachment of μ**

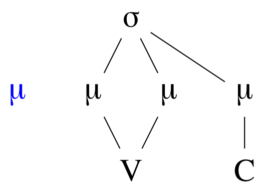
Input:

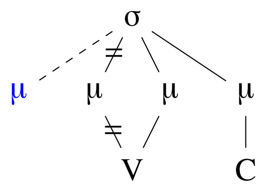
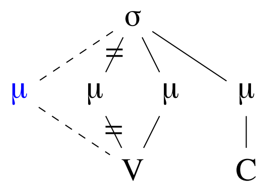
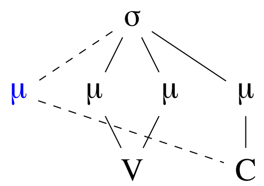


	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\downarrow\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot\bullet\odot}{*}$	MAX C	$\mu \Downarrow \bullet$
☞ a. 								*
b. 							*!	*
c. 						*!		*
d. 				*!				*
e. 	*!							*

Again, association of the affix-μ to the base-V is excluded by $*V^{3\mu}$ (26-b), and attachment to the coda-C by $*\times^{\mu}_{\downarrow\bullet}$ and $*C^{2\mu}$ (26-c):[6]

(26) **Anywa FQ: Shortening of Long Vs: •-Attachment of μ**

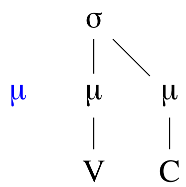
Input: 

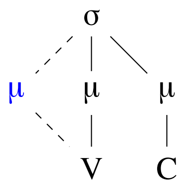
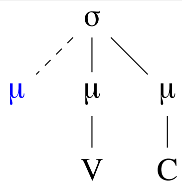
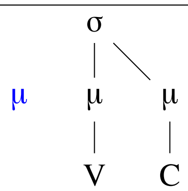
	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\downarrow\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet\odot$	MAX C	$\mu \Downarrow \bullet$
☞ a. 								*
b. 					*!			
c. 		*!	*!*!					

[6]As far as $*C^{2\mu}$ is concerned, the affix-μ could in principle link to an onset consonant, but this option is (probably universally) excluded (Hayes 1989).

Lengthening of short base vowels now results simply as Emergence-of-the-Unmarked for the constraint $\mu \Rightarrow \bullet$ as shown in (27). Association of the affix-μ to the V is neither blocked by the intervening coda-C as for the AP-μ-suffix nor by $*V^{3\mu}$ (as with long base-Vs), and attachment to the base-σ-node is unproblematic for $*\underline{\sigma}_{3\breve{\mu}}$:

(27) **Anywa FQ: Lengthening of Short Vs**

Input: 

	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet\odot$	MAX C	$\mu \Downarrow \bullet$
☞ a. 								
b. 								*!
c. 	*!							

At this point, it is important to point out an important prediction made by the analysis: The constraint ranking proposed here implies that Anywa cannot have strictly V-lengthening moraic morphology (e.g. a pattern which lengthens short base vowels, and leaves long base-Vs intact). Due to the low ranking of $\mu \Rightarrow \bullet$, and the undominated status of $*\underline{\sigma}_{3\breve{\mu}}$, and $*V^{3\mu}$, affixation of one or more affix-μs in any order will always induce V-shortening for underlyingly long base-Vs.

In fact, apart from polarity in the FQ, Reh cites only one case as evidence for V-lengthening morphology in Anywa, the irregular plural forms of a handful of nouns, namely the ones in (28):

(28) **Lengthening in Irregular Plural Forms** (Reh 1993:113)

	SG	**PL**	
a.	t̪āw	t̪ʌ́ːt̪ː-í	'bottom'
b.	ɲʌ̄w	ɲʌ́ːd̪-í/ɲʌ́d̪-í	'udder'
c.	kàc	kʌ́ːɲː-é	'hunger, famine'
d.	kɔ̀t̪	kúːn̪ː-é	'rain'
e.	kàl	kʌ́ːlː-é	'compound,fence'
f.	kwʌ̀c	kwʌ́ːɲː-é	'leopard'
g.	cʌ̀ŋ	cʌ́ːŋː-é	'sun'
h.	pàŋ	pʌ́ːŋː-é	'mortar'
i.	t̪ùol	t̪úolː-é	'snake'

The plural suffixes *-e*/-ɛ and *-i*/-ɪ also occur more regularly with many other noun stems where they don't trigger lengthening of the stem V, as shown in (29) and (30):

(29) **The Plural Suffix *-e*/-ɛ without Lengthening** (Reh 1993:104-105)

	SG	**PL**	
a.	gwáŋ	gwàŋ-ɛ̀	'wildcat'
b.	kɔ́p	kɔ̀b-ɛ̀	'sheath'
c.	wèlː-ó	wèlː-é	'guest'
d.	kéːn̪ː-ó	kèːn̪ː-è	'hearth'

(30) **The Plural Suffix *-i*/-ɪ without Lengthening** (Reh 1993:106)

	SG	**PL**	
a.	lwáŋː-ɔ̄	lwáŋː-í	'fly'
b.	ŋɔ́ːnː-ɔ̄	ŋɔ́ːnː–í	'chameleon'

Thus it is doubtful whether lengthening in this case is really a regular phonological process or whether the plural forms are actually suppletive. On the other hand, if the lengthening cases of *-e*/-ɛ and *-i*/-ɪ are analyzed as affixes which are morphologically distinct from their non-lengthening counterparts, the only clear instances of lengthening *-e*/*-i* are the ones which occur with underlyingly short root vowels. For these cases, the lengthening effect could be derived from a µ-prefix just as lengthening of short base-Vs in the FQ. That we seem to face monotonic lengthening would simply follow from the fact that the small lexically restricted classes of noun roots which select the length-manipulating plural suffixes have all short root vowels. I conclude that there is no productive pattern of V-lengthening in Anywa, and the constraint ranking proposed here for the languages makes the correct predictions.

4.2.3 Compensatory Lengthening

In this subsection, I show that the analysis developed so far is compatible with the major μ-related phonological process of Anywa, Compensatory Lengthening. This compatibility is not self-evident, since Compensatory Lengthening involves (re-)association of delinked μs, whereas the analysis of V-length-changing morphology presented in the preceding subsections relies on the notion that μs under many conditions remain floating in the sense that they do not phonetically dominate a segmental root node.

Compensatory Lengthening in Anywa is triggered by a general deletion process of the language which deletes dorsal and palatal consonants and glides in intervocalic position:

(31) **Intervocalic Palatal/Dorsal Deletion** (Reh 1993:60)

	Singular	**Plural**	
a.	kìːc	kíː-é	‘orphan(s)’
b.	gɛ́ːw	gɛ̀ː	‘fences’
c.	ɲwɔ̀k	ɲwòː-ì	‘pegs’
d.	lʌ̀j	lʌ̀-í	‘animals’

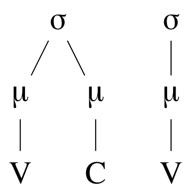
If the stem vowel of the base is a short high or low vowel, it lengthens in this context (see subsection 4.2.3 for discussion of mid-vowels in the same environment):

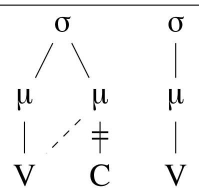
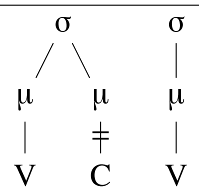
(32) **Compensatory Lengthening** (Reh 1993:60)

	Singular	**Plural**	
a.	kac	kaː-ɛ	‘harvest(s)’
b.	dʌk	dʌː-e	‘pot(s)’

From the perspective of moraic theory (Hayes 1989), these data provide a standard case of Compensatory Lengthening under the assumption that coda-Cs in Anywa are moraic. Deletion of the coda-C leaves the stem-μ floating, and under the pressure of constraints requiring μ-to-• association it reassociates to the nucleus of the syllable, resulting in lengthening. This is exactly the analysis I will adopt here. In fact, it already follows from the constraint ranking developed so far, as shown in (33) for a short-V stem (in the following I assume implicitly that high-ranked constraints trigger the deletion of intervocalic Cs under the appropriate conditions). $\mu \Rightarrow \bullet$ enforces phonetic association of the coda-μ to a root node, and none of the higher-ranked constraints blocks this option (especially there is no crossing of association lines, and the resulting vowel is not associated to more than 2 μs):[7]

(33) **Compensatory Lengthening under Coda-C Deletion**

Input: 

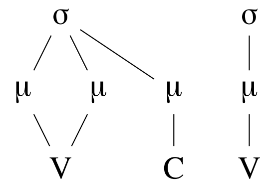
	$\overset{\sigma}{\underset{\mu}{\uparrow}}$	$*C^{2\mu}$	$*\overset{\mu}{\underset{\bullet}{\times}}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet^{\odot}$	MAX C	$\overset{\mu}{\underset{\bullet}{\Downarrow}}$
☞ a. 							*	
b. 							*	*!

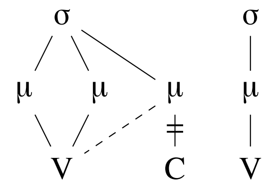
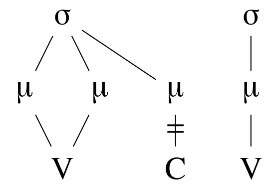
[7] Most Compensatory Lengthening-data, where deletion of a coda consonant leads to lengthening of preceding Vs are in word-final position or involve an additional right-adjacent onset-C which potentially blocks association of the μ to a following V (cf. diachronic compensatory lengthening before anterior sonorants in Latin *kasnus* ⇒ *ka:nus*, Hayes 1989:260). The Anywa data suggest that there is a more general restriction which compels coda-μs to associate to the preceding, not to a following V, maybe a faithfulness constraint which requires that μs underlyingly associated to a σ-node may not reassociate to a (segment belonging to a) of a different σ. This would be in line with the results of Kavitskaya (2002) who argues that tautosyllabic Compensatory Lengthening is much more frequent than heterosyllabic Compensatory Lengthening. An interesting alternative would be to assume that there is a constraint $*[C\ V]_{\mu}$, which penalizes μs which are associated to a C and a following V at the same time. The phonetic clone of this constraint would derive a big portion of the ban on onset μs, whereas the general clone would also ban reassociation of a consonantal μ to a right-adjacent V. Since the concrete implementation of this restriction seems to be irrelevant for moraic affixes (which are not underlyingly associated), I leave it open here.

With long-V bases, compensatory lengthening is simply blocked by undominated $*V^{3\mu}$:

(34) **No Compensatory Lengthening for Long Root Vs**

Input:



	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times\overset{\mu}{\downarrow}\bullet$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet\odot$	MAX C	$\mu \Downarrow \bullet$
a. 					*!		*	
☞ b. 							*	*

4.2.4 The Mid-Vowel-Diphthong-Conundrum

Diphthongs and mid vowels pose two complications for length-manipulating morphology in Anywa which I have neglected so far. According to the description of Reh, diphthongs don't shorten (or lengthen) in frequentative and antipassive, but become long mid Vs as shown in (35) and (36):

(35) **Shifting of Diphthongs to Long Mid-Vs in the Antipassive** (Reh 1993:222-223)

	Underived	Antipassive	
a.	pùot	póːt	'beat'
b.	píɛθ	péːt	'winnow'
c.	θíeθ	θéːt	'bewitch'

(36) **Shifting of Diphthongs to Long Mid-Vs in the FQ** (Reh 1993:245,43)

	Underived	Frequentative	
a.	túoc	tóːjː	'tie'
b.	ɲʊ̀ɔp	ɲɔ̀ːpː	'make beer'
c.	lìeθ	lèːθː	'make hot'

Conversely, long mid Vs do neither lengthen nor shorten in both morphological contexts (37), (38):

(37) **No Shortening of Long Mid Vs in the Antipassive** (Reh 1993:41,225)

	Underived	Antipassive	
a.	gɛ̀ːr	gèːt	'build'
b.	lɔ̀ːɲ	lóːɲ	'swallow'
c.	gɔ̀ːp	gòːp	'scrape'

(38) **No Length Alternation of Long Mid Vs in the FQ** (Reh 1993:44)

	Underived	Frequentative	
a.	còːt	cóːtː	'break (rope)'
b.	ɟɛ́ːk	ɟɛ́ːkː	'sift out'
c.	dèːt	déːtː	'lock'

Reh suggests that these complications are due to the fact that the "functional" system of Anywa vowels is thoroughly dissociated from their phonetics in the sense that diphthongs function as long vowels, whereas long mid Vs are functionally short vowels. I will adopt Reh's proposal for mid Vs and slightly extend the argument for the phonetically abstract characterization of simple Vs in Anywa. On the other hand, I show that the behavior of diphthongs under the analysis of length-changing morphology proposed here follows straightforwardly if they are taken by surface appearance as the combination of two independent vocalic segments.

Take as a starting point the inventory of Anywa vowels from Reh (1993) in (39):

(39) **Anywa Vowel Inventory** (Reh 1993:36)

	Short		Long		Diphthongs	
High	/i,ɪ/	/u,ʊ/	/ii,ɪɪ/	/uu,ʊʊ/	/ie,ɪɛ/	/uo,ʊɔ/
Mid	/e,ɛ/	/o,ɔ/	/ee,ɛɛ/	/oo,ɔɔ/		
Low	/ʌ,a/		/ʌʌ,aa/			

As shown in detail by (Reh 1993:section 2.2), the sounds <ɪ>,<ʊ>, <e>, and <o> (in the following, I use '<' and '>' to mark the notation used by Reh to keep it apart from the phonological interpretion of the sounds which I indicate by the standard phonetic brackets '[' and ']') have a highly defective distribution in Anywa – for example they hardly ever surface in lexical roots, and never form the output of (morpho-)phonological processes, which leads Reh to the suggestion that the core system of Anywa Vs is actually better represented as in (40): short <ɛ> and <ɔ> are reanalyzed as phonologically high Vs (hence [ɪ] and [ʊ]), whereas <ee>, <ɛɛ>, <oo>, and <ɔɔ> are interpreted as short vowels ([e],[ɛ],[o], and [ɔ]). The diphthongs take over the role of long mid vowels:

(40) **Anywa Vowels in the Classification of Reh (1993:41)**

	Short		Long	
High	<i/ɛ>	<u/ɔ>	<ii/ɪɪ>	<uu/ʊʊ>
Mid	<ee/ɛɛ>	<oo/ɔɔ>	<ie/ɪɛ>	<uo/ʊɔ>
Low	<ʌ/a>		<ʌʌ/aa>	

I will adopt this system apart from the reanalysis for the diphthongs, assuming that the Anywa inventory doesn't have long mid vowels. as shown in (41), where (41-a) shows the single vowel phonemes in the notation used by Reh, whereas (41-b) uses the IPA symbols which are adequate under the reanalysis:

(41) **Proposed Classification of Anywa Vowels**

a.	Short		Long	
High	<i/ɛ>	<u/ɔ>	<ii/ɪɪ>	<uu/ʊʊ>
Mid	<ee/ɛɛ>	<oo/ɔɔ>	–	–
Low	<ʌ/a>		<ʌʌ/aa>	

b.	Short		Long	
High	[i/ɪ]	[u/ʊ]	[iː/ɪː]	[uː/ʊː]
Mid	[e/ɛ]	[o/ɔ]	–	–
Low	[ʌ/a]		[ʌː/aː]	

Evidence for the classification of <ɔ> as [ʊ], and of <ɛ> as [ɪ] comes from shortening and lengthening processes. Thus in the FQ vowel-length polarity (42) and (43) as well as in Compensatory Lengthening (44) long <ɪɪ> systematically corresponds to short <ɛ>, and long <ʊʊ> corresponds to short <ɔ>:

(42) **Correspondence of <ε> ~ <ɪɪ>: and <ɔ> ~<ʊʊ> FQ Shortening** (Reh 1993:43)

	Underived	Frequentative	
a.	bɪ̀ːɟ	bɛ̀jː	'squeeze'
b.	ɲʊ̀ːθ	ɲɔ̀θː	'show'

(43) **Correspondence of ε/[ɪ] and ɔ/[ʊ]: FQ Lengthening** (Reh 1993:44)

	Underived	Frequentative	
a.	bɛ́l	bɪ́ːlː	'taste'
b.	dɔ̀l	dʊ́ːlː	'fold'

(44) **Correspondence of ε/[ɪ] and ɔ/[ʊ]: Compensatory Lengthening** (Reh 1993:60)

a.	θɛ̀w	+ -ɛ̀	PL	⇒	θɪ̀ːɛ̀	'currents'
b.	cwɛ̀j	+ -ɔ̄	SG	⇒	cwɪ̀ːɔ̄	'leech'
c.	ā-mɔ́k	+ -ā	SG	⇒	āmʊ́ːā	'I devoured it'

Evidence for the interpretation of <ee/εε> as [e/ε] and of <oo/ɔɔ> as [o/ɔ] is the very fact that these sounds never undergo shortening in the contexts where truly long Vs do, V-shortening (AP) V-polarity (FQ) as already shown by the data in (37) and (38).

Given these preliminaries, the behavior of mid vowels and diphthongs can be straightforwardly derived by the analysis developed in the preceding subsections and the following two undominated constraints which are specific to these classes of vowels. (45) captures the crucial gap in the Anywa V-inventory by excluding long mid-Vs. (46) implements the observation that in the "shortening" of diphthongs in the AP and FQ (cf. examples (35) and (36)) the second part of the diphthong survives which I take to be the head of the syllable.[8]

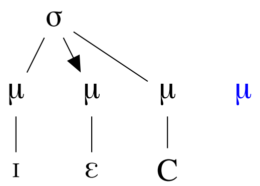
(45) *E̲$^{2\mu}$ Assign $*$ to every mid V in P which is associated to two μs

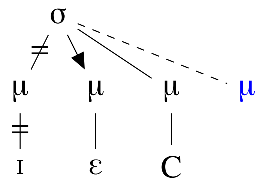
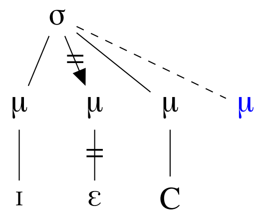
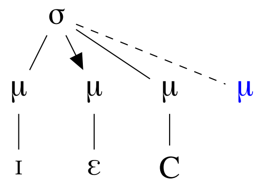
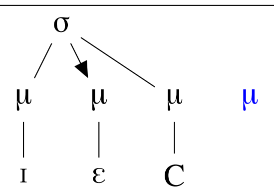
(46) Max ↑ Assign $*$ to every V which is dominated by a head-μ in M but is not is dominated by a head-μ in P

[8] Note that the addition of these two constraints doesn't change any of the results obtained for simple non-mid Vs in subsections 4.2.1 and 4.2.2. None of the winning candidates violates Max ↑ by deleting the V of the base, and *E̲$^{2\mu}$ is vacuously satisfied by all non-mid Vs.

The tableau in (47) shows how diphthong shortening is derived in the AP ("→" marks the head-μ of the σ). Again the μ-suffix must attach to the base σ to satisfy $\mu \rightarrow \sigma$ (cf. the fatal violation of the constraint in (47-d)), resulting in the familiar problem with $*\underline{\sigma}_{3\breve{\mu}}$ (crucially violated in (47-c)). Since [ɛ] is protected by undominated MAX ↑ (cf. (47-b)), the first vowel [ɪ] is deleted. (47) doesn't explicitly show candidates where the affix-μ would associate to one of the segments of the base-σ since this would lead to the fatal violations of undominated constraints which I have already discussed for long vowels in tableau (21).

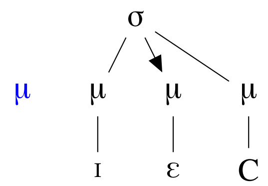
(47) **Antipassive: Shortening of Diphthongs to Mid-Vs**

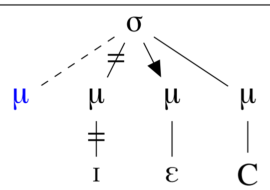
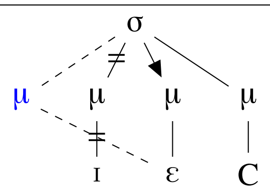
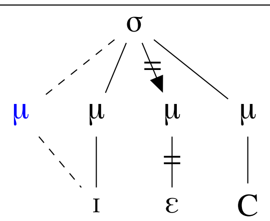
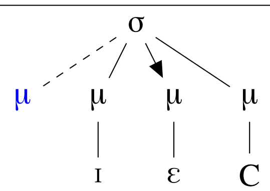
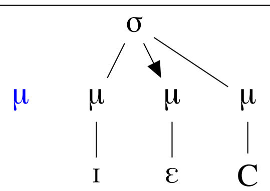
Input: 

	MAX ↑	$*\underline{E}^{2\mu}$	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\odot\bullet\odot$	MAX C	$\mu \Downarrow \bullet$
☞ a. 										*
b. 	*!									*
c. 						*!				*
d. 			*!							*

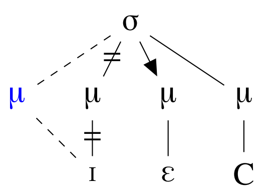
Shortening of diphthongs in the AP is almost completely parallel as shown in (48), hence I will just mention two relevant details: The μ-prefix could in principle associate to the [ɪ] of the diphthong, but this is again ruled out by MAX ↑ (48-c). Association to [ɛ] would violate $*\times^{\mu}_{\downarrow\bullet}$ which is also sensitive to phonetically invisible association lines (48-b):

(48) **Frequentative: Shortening of Diphthongs to Mid-Vs**

Input: 

	MAX ↑	$*\underline{E}^{2\mu}$	$\sigma \uparrow \mu$	$*C^{2\mu}$	$*\times^{\mu}_{\downarrow\bullet}$	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\overset{\odot}{*}\bullet\odot$	MAX C	$\mu \Downarrow \bullet$
☞ a. 										*
b. 		*!			*!					
c. 	*!									
d. 						*!				*
e. 			*!							*

There is one more candidate (49) we have to consider, where the affix mora replaces in Duke-of-York style the mora of the high vowel:

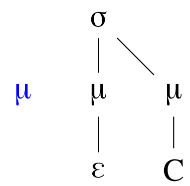
(49) 

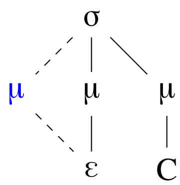
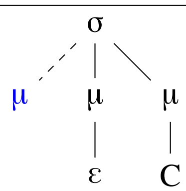
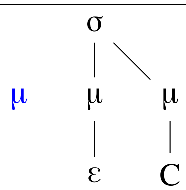
I assume that this is excluded by the undominated I-structure constraint *V̌:which penalizes long vowels which are not dominated by the head-μ of a PWord. In fact, also the P-structure version of this constraint (*V̲̌:) is never violated in Anywa: Affix vowels, and prenuclear vowels in diphthongs never exhibit a length contrast.

Let us now turn to the behavior of underlyingly mid-vowel stems. By assumption (i.e. by adopting (41)), all underlying mid vowels are phonologically short. For the antipassive, it is easy to see that the affix-μ won't have any phonetic effect on the base V just as I have already shown for other short Vs in tableau (22), where the underlyingly short base V remains short. The only additional constraints I have introduced in this subsection do not change this result: MAX ↑ is irrelevant because all plausible candidates in (22) satisfy it anyway (the vowel of the base-σ is not deleted), and $*\underline{E}^{2\mu}$ is not violated by the winning candidate since this maintains a short (1-moraic) vowel.

On the other hand, mid-vowels behave differently in the FQ from other short Vs: With mid-Vs association to the base-V (hence lengthening) is blocked for the moraic prefix (contrary to the situation for short non-mid Vs where lengthening obtains, cf. tableau (27)) since this is excluded by undominated $*\underline{E}^{2\mu}$ (50-a):

(50) **Anywa FQ: No Lengthening of Short Mid Vs**

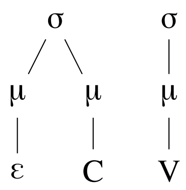
Input: 

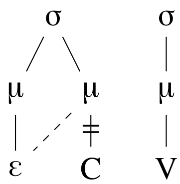
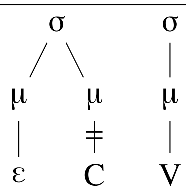
	MAX ↑	$*\underline{E}^{2\mu}$	σ ↑ μ	$*C^{2\mu}$	*×̣	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	⊙●⊙	MAX C	μ ⇓ ●
a. 		*!								
☞ b. 										*
c. 	*!									*

In a nutshell, $*\underline{E}^{2\mu}$ blocks shortening as well as lengthening for mid-Vs. Assuming that μ-affixation is Stem Level, mid-Vs do not lengthen because this would result in a Stem-Level violation of $*\underline{E}^{2\mu}$, and do not shorten because $*\underline{E}^{2\mu}$ is also undominated at the Root Level, and hence the Stem Level has no long mid-Vs (which might be shortened) to begin with.

Note finally that, due to high-ranked $*\underline{E}^{2\mu}$, the analysis predicts for mid-V stems which undergo intervocalic C-deletion that they should fail to undergo Compensatory Lengthening, as shown in (51):

(51) **No Compensatory Lengthening under Coda-C Deletion for Mid Vs**

Input: 

	MAX ↑	$*\underline{E}^{2\mu}$	σ ↑ μ	$*C^{2\mu}$	$*\times^{\mu}_{\bullet}$!	$*\underline{\sigma}_{3\breve{\mu}}$	$*V_{3\mu}$	$\odot\bullet\odot$ (*)	MAX C	μ ⇓ ●
a. 		*!							*	
☞ b. 									*	*

This prediction is indeed borne out by the data:

(52) **No Compensatory Lengthening under Coda-C Deletion for Mid Vs** (Reh 1993:60)

a. gɛ́ːw + -ɛ̀ PL ⇒ gɛ̀ː ‘fences’
b. ɲwɔ̀k + -ì PL ⇒ ɲwɔ̀ːì ‘pegs’

Chapter 5

Tone

5.1 Introduction

Just as its moraic morphophonology, also Western Nilotic tone shows the side-by side of extending non-segmental material of the base by corresponding affix material, and complete overwriting – a point which I will develop here in full detail for verbal tone in Dinka (section 5.3) after a short discussion of the much simpler overwriting system of Jumjum (section 5.2). The case study of floating tone in Anywa (section 5.4) shows in detail that floating tone in lexical roots and affixes behaves in principle identically – apart from independent differences due to the linearization of morphological material and the formation of prosodic words.

5.2 Tone Erasure: Jumjum Tone Replacement

In Jumjum, the modified noun construction is expressed by changing all tones of the base noun to L (Andersen 2004):

(1) **Tonal Overwriting in Jumjum Modified Nouns** (Andersen 2004:161)

	Underlying Tone	Absolutive	MN		
a.	H	d̪ɛ́ːŋ	d̪ɛ̀ːŋ	‘cow’	
b.	HL	jîːn	jìːn	‘giraffe’	(giraffe:SG)
c.	L	kùːn	kùːn	‘thorn’	(thorn:SG)
d.	HL	cícàm	cìcàm	‘knife’	
e.	LH	cʌ̀w-nʌ́	cʌ̀w-nʌ̀	‘arrow’	(arrow:SG)

This can be captured straightforwardly under the assumption that the MN category has two exponents, one a L prefix, and the other one a L suffix:

(2) [+MN] ↔ $< (\mathrm{L}, \_\_\mathrm{T}_{l}) \oplus (\mathrm{L}, \mathrm{L}_{r}\_\_) >$

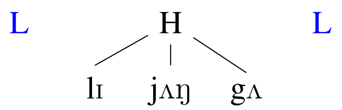
Complete overwriting is now the effect of floating-tone maraudage triggered by σ ← T (3-b) and boosted by □CONTIGUITY$_{T}$ (3-a) which requires that homomorphemic phonetic tones should not be separated by heteromorphemic tones.

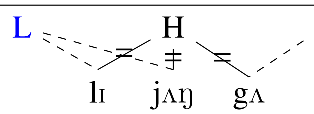
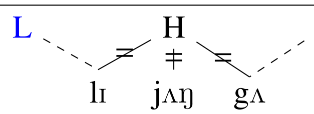
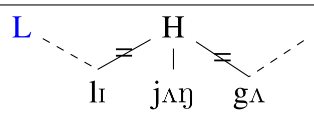
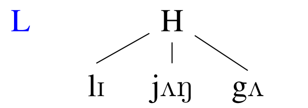
(3) **Constraints**

a. □CONTIGUITY$_T$	Assign ∗ to every tone T_1 which linearly intervenes between two tones T_2, T_3 in P such that Color(T_2) = Color(T_3) ≠ Color(T_1)
b. $\overset{\sigma}{\underset{T}{\uparrow}}$	Assign ∗ to every tone which is not dominated by a σ in I
c. $\overset{\sigma}{\underset{T}{\downarrow}}$	Assign ∗ to every σ which does not dominate a tone in I
d. MAX$_{\overset{\sigma}{\underset{T}{\uparrow}}}$	

(4) shows the derivation for the MN form of the plural noun *lɪjʌŋ-gʌ*, 'feathers' (4). The fully faithful output (4-d) violates σ ← T twice and fatally since the floating L tones are not associated to a syllable.[1] (4-c) provides minimal repair for σ ← T, but still induces a violation of □CONTIGUITY$_T$. In (4-b), deassociation of the stem H is complete which renders it phonetically invisible, and hence obviates the □CONT$_T$ violation. However, this leaves the second syllable of the base without a tone violating σ → T, which is avoided in (4-a) by spreading one of the L tones to this syllable.

(4) **Jumjum: Tonal Overwriting by a L- -L Circumfix**

Input: 

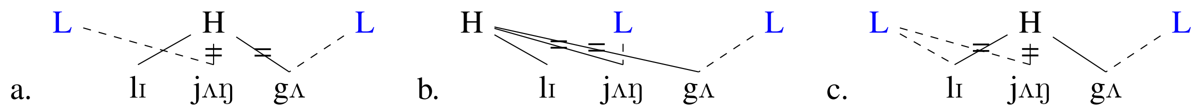
	$\overset{\sigma}{\underset{T}{\uparrow}}$	□CONT$_T$	MAX$_{\overset{\sigma}{\underset{T}{\uparrow}}}$	$\overset{\sigma}{\underset{T}{\downarrow}}$
☞ a. 			∗∗∗	
b. 			∗∗∗	∗!
c. 		∗!	∗∗	
d. 	∗!∗			

(5) shows three further conceivable outputs which would escape complete overwriting. In (5-a) the H tone remains associated to the first base syllable whereas the first L tone of the affix associates to the second base syllable. However this candidate is impossible for principled reasons since it involves crossing of phonetic association lines. In (5-b) this problem is circumvented by metathesis of initial L and H. Again, I assume that this is in principle impossible. As has been convincingly shown by Zimmermann (2009) (see also Moskal 2009),

[1] This candidate doesn't violate □CONT$_T$ since the affixal L tones are not associated and hence not phonetic.

segmental metathesis is universally excluded, hence it is natural to assume that this also holds for tone. In (5-c), the H of the base is retained minimally by forming a falling contour tone of the last syllable together with the suffixal L tone, but this candidate still violates □CONT$_T$ (the base H remains phonetically visible) and fares hence worse than (4-a).

(5)



That tonal overwriting is highly morpheme-specific may be observed in a classical example from Hausa (Inkelas and Zoll 2007:146). The imperative in Hausa is formed by replacing the underlying tonal melody of the base by LH (6-b)

(6) **Tonal Overwriting in the Hausa Ventive** (Newman 2000:663)

	Underlying Form		**Ventive**		
a.	LH	fitá:	H	fít-ó:	‘go out’
b.	HL	fáɗì	H	fáɗ-ó:	‘fall down’
c.	HLH	gángàrá:	H	gángár-ó:	‘roll down’
d.	LHL	tàimákà:	H	táimák-ó:	‘help’

(7) **Tonal Overwriting in the Hausa Imperative** (Newman 2000:262-263)

	Underlying Form		**Imperative**		
a.	H	kwá:ná	LH	kwà:ná	‘spend the night’
b.	HL	tá:ʃì	LH	tà:ʃí	‘get up’
c.	HLH	káràntá:	LH	kàràntá:	‘read’

This can be captured in a completely parallel way to the Jumjum antigenitive as shown in (8):

(8)

```
        L   H   L    H   H
            |   |    |
Input:      ka  ran  ta
```

	σ ↑ T	□CONT$_T$	MAX$^{σ}_{T}$	σ ↓ T
☞ a. L H L H H / ka ran ta			***	
b. L H L H H / ka ran ta			***	*!
c. L H L H H / ka ran ta		*!	**	
d. L H L H H / ka ran ta	*!*			

Overwriting in Hausa is also found with specific overt affixes as shown in (9) (all following Hausa data are originally from Newman 1986, 2000). The affixes which exhibit this type of overwriting are called 'dominant' in the literature on Hausa tone. Note also that the stem-final vowel is deleted in the context of the vowel-initial suffix. (10) shows the derivation of (9-b):

(9) **Dominant Affix** (Inkelas 1998:127)

a.	ba-katsina	+	-ee	→	bakastsinee
	L L H L		HL		H H H L
	'from-Katsina'		-ethonym		'a Katsina man'
b.	ba-zamfara	+	-ee	→	bazamfaree
	L L L L		HL		H H H L
	'from-Zamfara'		-ethonym		'a Zamfara man'

(10)

H L H L

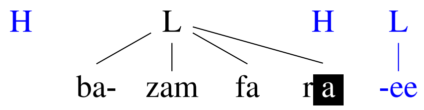
Input: ba- zam fa ra -ee

	$\sigma \uparrow T$	□CONT$_T$	MAX$^{\sigma}_{\uparrow T}$	$\sigma \downarrow T$
☞ a. H L H L ba- zam fa ra -ee			***	
b. H L H L ba- zam fa ra -ee			***	*!
c. H L H L ba- zam fa ra -ee		*!	**	
d. H L H L ba- zam fa ra -ee	*!*			

A floating vowel melody in alliance with a segmental affix opens up the possibility of tautomorphemic association. However, none of the concrete possibilities to do this fares better than complete overwriting of the base since they would lead to additional constraint violations of □CONT$_T$, MAX$^{\sigma}_{\uparrow T}$, or $\sigma \rightarrow T$ (11-a,b,c), and unnecessary contour tones (11-c,d) (*CONT penalizes phonetic contour tones):

(11)

Input:



	σ↑T	□CONT_T	MAX σ↑T	σ↓T	*CONT
☞ a. ba- zam fa ɾa -ee (H L H L)			***		
b. ba- zam fa ɾa -ee (H L H L)			****!		
c. ba- zam fa ɾa -ee (H L H L)			***	*!	*
d. ba- zam fa ɾa -ee (H L H L)			***		*!

Crucially, Hausa also has affixes with tonal melodies which affect the tone pattern of the base by adding peripheral tones, but do not overwrite it: (called 'non-tone integrating' or 'recessive' in the literature). Thus the nominalizing suffix *-wǎ* which iself bears the tonal melody LH, adds a L tone to the right edge of its base, effectively concatenating the tone melody of base and suffix:

(12) **Tonal Non-Overwriting in Hausa Verbal-Noun Formation** (Newman 2000:705)

		Verb		**verbal Noun**	
a.	HL	búgàː	HL-H	búgàː-wáː	'beat'
b.	HLH	káràntáː	HL$\widehat{\text{HL}}$-H	káràntâː-wáː	'read'
c.	H	sánár̃	H$\widehat{\text{HL}}$-H	sánâr̃-wáː	'inform'
d.	$\widehat{\text{HL}}$	cêː	$\widehat{\text{HL}}$-H	cêwáː	'say'

This already follows from the ranking developed for dominant/circumfixal tone under the assumption that recessive tone patterns are simply floating suffixal tone melodies as shown in (13). The floating L of *-wá* attaches to the last syllable of the base (13-a) tolerating a violation of *CONT since all alternatives would violate higher-ranked constraints. Most crucially □CONT_T does not enforce deletion of stem tone. DE σ↑T (see (82) for more discussion) blocks association to affixal material.

(13)

H L H L H
Input: ka ran ta wa

	$\sigma \uparrow T$	□CONT$_T$	MAX$^{\sigma}_{\uparrow T}$	$\sigma \downarrow T$	DE$^{\sigma}_{\uparrow T}$	*CONT
☞ a. H L H L H ka ran ta wa						*
b. H L H L H ka ran ta wa						**
c. H L H L H ka ran ta wa					*!	*
d. H L H L H ka ran ta wa			*!			
e. H L H L H ka ran ta wa	*!					

(14) **Recessive Affix** (Inkelas 1998:127)

a. ba-goo-bir + -ii → bagoobirii
L L H   H   L L H H
'from-Gobir'   -ethonym   'a Gobir man'

b. ba-zamfara + -ii → bazamfarii
L L L L   H   L L L H
'from-Zamfara'   -ethonym   'a Zamfara man'

5.3 Tonal Extension and Overwriting in Dinka

Tone in Dinka verbs is highly grammaticalized to a degree that it is far from obvious which tone specific verb (classes) bears underlyingly. In fact while Andersen claims that verbs with short Vs have either L or F, and verbs with long vowels either H or F, I assume that both long and short-V verbs have always non-contour tones in their underlying representation (i.e., either L or H, see section 5.3.2 for arguments). Crucially, as shown in (15), the tone a verb stem bears on the surface can be computed on the basis of underlying root tone and V-length and the derivational and inflectional categories affixed to the verb (columns exhibit derivational, and rows inflectional categories): [2]

[2]The data here present a slight simplification and reinterpretation of Andersen (1995:52-53,table 8). Andersen's CVC/F,CVC/L,CVVC/F,CVVC/H correspond to my CVC/H,CVC/L,CVVC/L,CVVC/. The inflectional category FIN ("finite") is represented as Ø-inflection by Andersen. See appendix 5.3.7 for a corresponding table which explicates in detail where the data presented here depart from Andersen's presentation. Crucially, I am abstracting away here from a number of alternations involving different grammatical formatives discussed in detail by Andersen (1995:s. 7.1): *First*, declarative particles trigger tonal alternations on non-derived stems in clauses where they are left-adjacent to the verb root (Andersen 1995:46). *Second*, plural suffixes show a kind of polar tone with respect to verb stems (Andersen 1995:50). *Third*, CP stems may alternatively exhibit a H-tone stem when they precede PL affixes (i.e. in 1PL,2Pl,3PL forms) (Andersen 1995:57). *Fourth,* verb stems with short stem vowels have H-tones before the PL suffixes (1PL,2Pl,3PL) in contexts where a L-tone would be expected (Andersen 1995:51). That this exception is due to a phonological alternation, not directly to morphological exponence is obvious from the fact that it occurs in a morphologically heterogeneous set of environments (e.g. underived PL forms of short-V verbs, but also AP PL forms of underlyingly long H-tone verbs which just in this form have short stem vowels). For the analysis, I will assume that these PL forms have L-tones on their stems. Andersen also treats a number of generalizations on the tone patterns of verb stems as "contextually determined" because they (partially) cooccur with specific tones on other exponents of the respective inflectional categories. For example he treats part of the stem tone pattern for 2SG as triggered by the tone of the 2SG affix *-e*. Since he admits that this indirect conditioning of stem tone usually requires additional morphophonological restrictions (other affixes with the same tone don't trigger the same alternations), I treat the stem tone patterns for these cases as independent tonal exponents for the respective morphological categories.

(15) **Verbal Tone in Dinka**

a.	CVC/H				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	H	L	F	F
1/3S	L	H	L	F	F
PL	H	H	L	F	F
NF	F	H	L	F	L
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	L	L	H	L	L

b.	CVC/L				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	F	L	F	F
1/3S	L	F	L	F	F
PL	H	F	L	F	F
NF	L	F	L	F	F
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	L	L	H	L	L

c.	CVVC/H				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	H	L	H	L
1/3S	L	H	L	H	L
PL	L	H	L	H	H
NF	H	H	L	H	L
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	H	L	H	L	L

d.	CVVC/L					
	Ø	**CF/B**	**CP**	**BAP**	**AP_1**	**AP_2**
FIN	L	F	L	F	L	H
1/3S	L	F	L	F	L	H
PL	L	F	L	F	L	H
NF	F	F	L	F	H	L
NTS	H	H	H	H	H	H
PAS:CT	F	F	F	F	F	F
PAS	F	F	F	F	F	F
2SG	F	L	H	L	L	L

The tonal paradigm in (15) is structured into three different areas (separated in (15) by double lines):

1. **Outer Inflection:** (all forms with NTS, 2SG, PAS, PAS:CT inflection): Stem tones are almost exhaustively determined by the tone pattern of the inflectional category. Thus all NTS forms have a H stem tone whereas all PAS:CT forms have F tones, no matter what the underlying stem tone is or which tone pattern is expected for the derivational category a root has undergone.

2. **Inner Inflection:** (base forms, and underived 1/3S, 1/2/3PL, and NF forms) If the verb stem hasn't undergone derivation, the stem tone is determined by its underlying tone and the inflectional tone. In derived forms, tone corresponding to inner inflection is blocked

3. **Derivation:** (CF/B, CP, BAP forms with no or inner inflection) determines the stem tone in the presence of inflection, partially on the basis of the underlying stem tone, but is suppressed in the context of outer inflection.

I interpret these three "tonal fields" as follows: Outer inflection corresponds to floating tonal affixes at the Word Level which crucially overwrites virtually all tonal patterns on stems at the Stem Level. Both, derivation and inner inflection, are the result of affixing Stem-Level affix tones to verb roots. In the Stem-Level phonology derivational tone affixation blocks inflectional tone affixation by the interaction of phonological constraints that will be spelled out in detail below.

The section is structured as follows: In subsection 5.3.2, I show how derivational and inflectional affix tones are realized on stems with different tones. Subsection 5.3.3 derives the correct output for cases where different tonal Stem-Level affixes compete for realization. Finally, subsection 5.3.5 develops tonal overwriting at the Word Level, and subsection 5.3.6 shows that the Word-Level constraint ranking developed for verbs also accounts for the major pattern of nominal case marking, a striking case of tonal polarity.

5.3.1 Dinka Tonotactics

I assume that the possibility to combine syllables with tone in Dinka is governed by the following 4 primitive constraints:

(16) **Constraints Governing Dinka Tonotactics**

a. $*\underline{\text{R}}$	Assign $*$ to every σ which is associated to a L and a right-adjacent H in P
b. $*\underline{\text{F}}$	Assign $*$ to every σ which is associated to a H and a right-adjacent L in P
c. $\overset{*}{{}_{\text{H}}\underline{\sigma}_{\text{H}}}$	Assign $*$ to every σ which is associated to more than one H in P
d. $\overset{*}{{}_{\text{L}}\underline{\sigma}_{\text{L}}}$	Assign $*$ to every σ which is associated to more than one L in P

At the Root Level all four constraints dominate the relevant faithfulness constraints, especially $\text{M}{\scriptstyle\text{AX}}\overset{\sigma}{\underset{\text{T}}{\uparrow}}$:

(17) **Dinka Root-Level Tonotactics**

	$*\underline{F}$	$*\underline{R}$	$^{*}{}_{H}\underline{\sigma}_{H}$	$^{*}{}_{L}\underline{\sigma}_{L}$	$\textsc{Max}^{\sigma}_{\uparrow T}$
✓ a. H / σ					
✓ b. L / σ					
✝ c. H L / σ	*!				
✝ d. L H / σ		*!			
✝ e. H H / σ			*!		
✝ f. L L / σ				*!	
✝ g. H L H / σ	*!	*!	*!		
✝ h. L H L / σ	*!	*!		*!	

At the Stem- and Word-Level, $*\underline{F}$ is low-ranked (actually it will never play a visible role in the analyses of the subsequent sections), whereas all other constraints on complex tones are again undominated:

(18) **Dinka Stem- and Word-Level Tonotactics**

	$*\underline{R}$	$^{*}_{H}\underline{\sigma}_{H}$	$^{*}_{L}\underline{\sigma}_{L}$	$\text{Max}^{\sigma}_{\uparrow T}$	$*\underline{F}$
✓ a. H σ					
✓ b. L σ					
✓ c. H L σ					*
† d. L H σ	*!				
† e. H H σ		*!			
† f. L L σ			*!		
† g. H L H σ	*!	*!			
† h. L H L σ	*!		*!		* *

This derives the fact that Dinka never exhibits rising tones on simple syllables nor any syllable which is associated to more than two tones. In the analyses below I will systematically neglect $^{*}_{H}\underline{\sigma}_{H}$, $^{*}_{L}\underline{\sigma}_{L}$ and candidates violating them to keep tableaus transparent. However, I will include the ban on rising tone contours – $*\underline{R}$ – since it is central to the mechanics of tonal affixation in Dinka.

Note finally one of the typological predictions of the constraint system in (16). Most crucially it derives the generalization in (19):

(19) If a language has HLH or LHL contours, it also has the two-way contours LH and HL

To see why (20) follows, let us assume that a language L has a HLH contour, but not a HL. Since L has HLH, it must have the ranking $\text{Max}^{\sigma}_{\uparrow T} \gg \{*\underline{R},*\underline{F}\}$ because otherwise the violations a HLH incurs on $*\underline{R}$ and $*\underline{F}$ would lead to deassociation for one of its tones, and it would never surface as such. But if $\text{Max}^{\sigma}_{\uparrow T} \gg \{*\underline{R},*\underline{F}\}$ holds then underlying HL and LH contours should surface since they do not incur violations of $^{*}_{H}\underline{\sigma}_{H}$ or of $^{*}_{L}\underline{\sigma}_{L}$, and by Richness of the Base (Prince and Smolensky 1993) the language should have rising and falling tones, contrary to our original assumption. Thus hypothesizing a language with HLH and without HL/LH leads to a contradiction. Since the same proof by contraposition can be made for LHL, (19) follows from (16).

5.3.2 Basics of Stem-Level Affixation

(20) shows again the simple Stem-Level tone patterns of Dinka, i.e tables in (15) without outer inflection and the AP, which will be discussed in later subsections. (21) and (22) summarize the tonal exponents I will assume for the single morphemes (recall that inner inflectional tone only surfaces if the verb stem has not undergone derivation, hence becomes only visible in the Ø-column):

(20) **Stem-Level Tone in Dinka**

a.	**CVC/H**			
	Ø	**CF/B**	**CP**	**BAP**
FIN	L	H	L	F
1/3S	L	H	L	F
PL	H	H	L	F
NF	F	H	L	F

b.	**CVC/L**			
	Ø	**CF/B**	**CP**	**BAP**
FIN	L	F	L	F
1/3S	L	F	L	F
PL	H	F	L	F
NF	L	F	L	F

c.	**CVVC/H**			
	Ø	**CF/B**	**CP**	**BAP**
FIN	L	H	L	H
1/3S	L	H	L	H
PL	L	H	L	H
NF	H	H	L	H

d.	**CVVC/L**			
	Ø	**CF/B**	**CP**	**BAP**
FIN	L	F	L	F
1/3S	L	F	L	F
PL	L	F	L	F
NF	F	F	L	F

(21) **Derivational Stem-Level Exponents** (block inflectional Stem-Level tones)

a. CF ↔ H-

b. B ↔ H-

c. CP ↔ L-

d. BAP ↔ H- ⊕ -L / V_{μ}

(22) **Inflectional Stem-Level Exponents** (only show up in underived verbs)

a. FIN ↔ L-

b. 1SG ↔ L-

c. 3SG ↔ L-

d. PL ↔ -H / V_{μ} ⊕ L- / $V_{\mu\mu}$

e. NF ↔ -L / V_{μ} ⊕ H- / $V_{\mu\mu}$

What makes the verbal tonology of Dinka highly opaque is the fact that no morphological context consistently exhibits the underlying stem tone. The environments which are at least the most transparent ones in this respect are the benefactive and the CF (and the BAP/NF tone patterns found with underlyingly long-V roots) which are formed by prefixing a H contour to the underlying melody of the stem. For underlyingly H-tone verbs this doesn't change the stem tone whereas it results in a F for underlyingly L-tone verbs, as shown by the data in (23):

(23) **L ⇒ F in the Dinka Centrifugal** (Andersen 1995:28-29)

Short H	/wḛ́c/	⇒	[wḛ́:c]	'to kick'
Long H	/tḛ́:m/	⇒	[tḛ́::m]	'to cut'
Short L	/tḛ̀ŋ/	⇒	[tḛ̂:ŋ]	'to dust'
Long L	/lḛ̀:r/	⇒	[wḛ̂:c]	'to roll'

Apart from standard constraints on faithfulness and *R̲ which I have already discussed in section 5.3.1, we need only one additional constraint for the analysis of simple Stem-Level affixation, σ ← [T, which specializes σ ← T to tones in the initial position of a prosodic word:

(24) $\sigma \uparrow$ [T Assign ∗ to every PW-initial tone which is not dominated by a σ in I

The CF is now captured by affixation of a H-prefix and association. This happens without phonetic effect for the H-tone verb in (25) – the stem H is simply replaced by the affix H , and results in a F (HL) tone for the L-tone verb in (26). Recall from subsection 5.3.1 that syllables which are associated phonetically to more than one instance of the same tone are systematically excluded by $^{*}_{\text{H}}\underline{\sigma}_{\text{H}}$ and $^{*}_{\text{H}}\underline{\sigma}_{\text{H}}$, and will not be included in the tableaus here. Thus (25) omits the candidate where the stem syllable is associated overtly to stem *and* affix H.

(25) **Simple CF/B of Underlying H**

Input: H H | σ (the stem H is linked to σ; the affix H is unlinked)

	*R̲	$\sigma \uparrow$ [T	$\sigma \uparrow$ T	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. H H σ (dashed line from the affix H to σ; the stem H's link to σ is cut)				*	*
b. H H | σ (the stem H stays linked to σ)		*!	*		

(26) **Simple CF/B of Underlying L**

```
        H   L
            |
Input:      σ
```

	*R	σ ↑ [T	σ ↑ T	MAX σ↑T	DEP σ↑T
☞ a. H L (H linked by dashed line to σ; L linked to σ) σ					*
b. H L (L linked to σ) σ		*!	*		

This is a good point to discuss the analytical assignment of underlying stem tones I have chosen. Andersen assumes that stem tone consistently shows up overtly in non-finite forms. (27) shows the correspondence to the tonal classes I propose here and to the corresponding tones which are found in the outputs of CF/B forms:

(27) **Underlying verb Tones in Different Analyses**

My Representation	Andersen (1995) (NF tone)		CF/B
a. CVC/H	CVC/F	⇒	H
b. CVC/L	CVC/L		F
c. CVVC/H	CVVC/H		H
d. CVVC/L	CVVC/F		F

Andersen's representations confer at least two problematic aspects: First, they are based on the problematic assumption that underlying tonal contrasts are arbitrarily different for verbs with short (F vs. L) and long root vowels (F vs. L). Second, they don't allow a straightforward analysis of the CF/B pattern by tonal affixation. Thus for short-V verbs the CF/B morphology would have to transform a L tone into a F (presumably by prefixation of H), and a F into a H tone (by subtraction of the L). On the other hand. long-V verbs would simply retain their underlying tonal melody under CF/B affixation. It should be obvious that the analysis proposed here allows a much transparent account of this type of morphology.

Let us now turn to the most frequent tone pattern in the Dinka system where all underlying tones of the verb root are overwritten by a simple L tone. This is found in the CP, FIN, 1SG, 3SG, and the Plural marking for stems with long underlying Vs. It follows straightforwardly from prefixing a L tone, as shown in (28). The floating L must associate to the base σ to satisfy $\sigma \leftarrow [T$ and $\sigma \leftarrow T$ (crucially violated in (28-c)), but without further repairs this leads to a phonetic rising tone, which is excluded by *R (28-b). The result is tone maraudage: The affix L replaces the underlying stem H (28-a):

(28) **CP: Overwriting of Underlying H by L-**

Input: L H | σ

	*R	$\sigma \uparrow [T$	$\sigma \uparrow T$	$\text{Max}^{\sigma}_{\uparrow T}$	$\text{Dep}^{\sigma}_{\uparrow T}$
☞ a. L H σ				*	*
b. L H σ	*!				*
c. L H σ		*!	*		

With underlyingly L-tone verbs, the affix L- vacuously associates to the syllable, "replacing" the original stem-L:

(29) **CP: Vacuous Association of L- to Underlying L**

Input: L L | σ

	*R	$\sigma \uparrow [T$	$\sigma \uparrow T$	$\text{Max}^{\sigma}_{\uparrow T}$	$\text{Dep}^{\sigma}_{\uparrow T}$
☞ b. L L σ				*	*
c. L L σ		*!	*		

The mirror-image pattern is found with PL suffixes and underlyingly short-V verbs which get consistent H tone in the output. This follows from suffixing -H. Again simple association of the floating affix tone would lead to a problematic rising tone (30-b). Since σ ← [T and σ ← T are ranked above $\text{MAX}_{\sigma\leftarrow T}$ we get again maraudage and overwriting (H-tone roots remain vacuously H):

(30) **PL: Overwriting of Underlying L by -H**

Input: L (linked to σ) H (floating)

	*R	σ ← [T	σ ← T	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. L H — L ╪ σ, H / σ				*	*
b. L H — L | σ, H / σ	*!				*
b. L H — L | σ		*!	*		

A final case of overwriting is found for short-V verbs in the BAP, which surface consistently with a F tone. This is the result of prefixing H- and suffixing -L at the same time, which for both, underlying L (31) and L-tone verbs (32), results in association of both floating tones under deassociation of the root tone, and a falling HL contour:

(31) **BAP: Overwriting of L by H- -L**

Input: H (floating) L (linked to σ) L (floating)

	*R	σ ← [T	σ ← T	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. H L L — H \ σ, L ╪ σ, L / σ				*	**
b. H L L — L | σ		*!	**		

(32) **BAP: Overwriting of H by H- -L**

```
         H   H   L
             |
Input:       σ
```

	*R	σ ↑ [T	σ ↑ T	$\text{MAX}\overset{\sigma}{\underset{T}{\uparrow}}$	$\text{DEP}\overset{\sigma}{\underset{T}{\uparrow}}$
☞ a. H H L (H and L associated to σ, H–σ association delinked) σ				*	**
b. H H L (H associated to σ) σ		*!	**		

Note finally an interesting point about the morphological representation of the BAP (cf. (21)-d). All verb roots with BAP, whether underlyingly short or long surface with a H-tone prefix. With underlyingly long root Vs (where this is the only tonal exponent of BAP), this results in the pattern we have seen for the CF/B of all verb roots: Underlying H gets F, and L remains L. With short-V verbs, the same H-prefix combines with an additional -L exponent (which is restricted by a phonological subcategorization requirement to short stems) to the circumfix deriving the same pattern as in (31)/(32). This shows nicely that the decomposition of morphemes into single exponents allows a concise characterization of general morphophonological subpatterns.

5.3.3 The Interaction of Stem-Level Affixes

We still need to account for the fact that inflectional tone only surfaces with stems which have not undergone derivation, in other words, derivational tone seems to block the later addition of inflectional tone. The three constraints which are crucial to derive this pattern are defined in (33), (34), and (35). $*\sigma_{3\square}$ penalizes syllables which are associated to tones of three colors. Since verb stems at the Stem-Level are already associated to a (tautomorphemic) colored tone, this constraint has the effect that it gets impossible to affix two further floating tones which belong to different affixes (hence to two more colors).

(33) $*\sigma_{3\square}$ Assign $*$ to every σ which is associated to tones of more than two colors in I

Now while high-ranked $*\sigma_{3\square}$ correctly excludes the possibility that a verb-σ is linked to tones of a derivational affix and an inflectional affix at the same time, it doesn't inherently favor realization of the derivational tone over the inflectional one . $*\vee\overset{\sigma}{\underset{T}{\uparrow}}$ (34), which blocks association of a tone to a syllable across an intervening tone derives part of the preference for realizing derivational tone material.

(34) $*\vee\overset{\sigma}{\underset{T}{\uparrow}}$ Assign $*$ to every triple of tones (T_1, T_2, T_3) in I such that:
(i) $T_1 \prec T_2 \prec T_3$
(ii) T_1 and T_3 are associated to the syllable S, but
(iii) T_2 is not associated to S

Under the standard assumption that derivational affixes attach inside of inflectional ones, derivational tones intervene between stem syllables and inflectional tone if both tone affixes appear on the same side of the verb, i.e. if both are prefixes or if both are suffixes.

The second constraint which tends to favor realization of derivational tone over inflectional tone is $\sigma \leftarrow$ [T (35).

(35) $\begin{array}{c}\sigma \\ \uparrow \\ [T\end{array}$ Assign $*$ to every PW-initial tone which is not dominated by a σ in I

Whereas (35) does in principle not make any distinction between derivational and inflectional tones, the fact that derivational affixes are more consistently prefixing than inflectional one makes (35) a powerful weapon in the hands of derivation to suppress inflection. Let us have a closer look at this difference in distribution. Consider again the tonal exponents of the Dinka Stem Level in (36) and (37) (repeated from (21) and (22)):

(36) **Derivational Stem-Level Exponents** (block inflectional Stem-Level tones)

a. CF ↔ H-

b. B ↔ H-

c. CP ↔ L-

d. BAP ↔ H- ⊕ -L / V_{μ}

(37) **Inflectional Stem-Level Exponents**

a. FIN ↔ L-

b. 1SG ↔ L-

c. 3SG ↔ L-

d. PL ↔ -H / V_{μ} ⊕ L- / $V_{\mu\mu}$

e. NF ↔ -L / V_{μ} ⊕ H- / $V_{\mu\mu}$

Given (36), it is easy to see see that every derived verb stem has at least one corresponding tonal prefix either because the tone affix consists only of a prefix (36-a,b,c), or because one of the exponents is a prefix which occurs in every derived form (36-d). On the other hand, inflectional tone either consists only of a prefix ((37-a,b,c) and (37-c,d) with long-V verbs) or of only a suffix ((37-c,d) with short-V verbs).

(38) **Generalizations on Cooccurrence of Homomorphemic Tonal Exponents**

- Derivational tone is either of the form **T-** or of the form **T- -T**
- Inflectional tone is either of the form **T-** or of the form **-T**

This leaves us with the following 4 possibilities for linear cooccurrence of derivational and inflectional exponents:

(39) **Cooccurrence Possibilities for Heteromorphemic Tonal Exponents**

a.	Derivation has a prefix tone	Inflection has a prefix tone:	$[T_i\text{-} [T_d\text{-} T_v]]$
b.	Derivation has a prefix tone	Inflection has a suffix tone:	$[[T_d\ T_v]\ \text{-}T_i]$
c.	Derivation has circumfixal tone	Inflection has a prefix tone:	$[T_i\text{-} [T_d\text{-} T_v\ \text{-}T_d]]$
d.	Derivation has circumfixal tone	Inflection has a suffix tone:	$[[T_d\text{-} T_v\ \text{-}T_d]\ \text{-}T_i]$

In the following I will show that the ranking in (40), already employed in the preceding subsection, correctly predicts preference for derivational tone under all four possibilities listed in (39).

(40) $$\left\{ \begin{array}{l} *\sigma_{3\square} \\ *\forall^{\sigma}_{\uparrow T} \end{array} \right\} \gg \overset{\sigma}{\underset{[T}{\uparrow}} \gg \ldots$$

Let us start with option ((39)-a) exemplified in (41) by a 3SG centrifugal of a H-tone verb – both CF and 3SG have only prefixal tone exponents. The possibility that both tonal affixes associate to the stem syllable is excluded by $*\sigma_{3\square}$ (41-c), but $\sigma \leftarrow T$ enforces that at least one of the affix tones links to the verb σ. Associating only the inflectional (3SG) tone is only possible by skipping the derivational (CF) tone and leads to a fatal violation of $*\forall^{\sigma}_{\uparrow T}$ (41-b). hence association of the verb σ to the derivational tone becomes optimal (41-a):

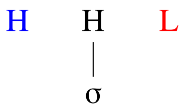
(41) $\mathbf{[T_i\text{-} [T_d\text{-} T_V]] \Rightarrow T_d\text{-} V}$ (3SG- CF- V)

Input: L H H (H linked to σ)

	$*\sigma_{3\square}$	$*\underline{R}$	$*\forall^{\sigma}_{\uparrow T}$	$\overset{\sigma}{\underset{[T}{\uparrow}}$	$\overset{\sigma}{\underset{T}{\uparrow}}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. L H H (second H delinked from σ, first H dashed to σ)				*	*		*
b. L H H (second H delinked from σ, L dashed to σ)			*!		*	*	*
c. L H H (second H delinked from σ, L and first H dashed to σ)	*!						**
d. L H H (second H linked to σ)				*	**!		

Option ((39)-b) is shown in (42) for a non-finite CF form of a H-tone verb, where the inflectional category "non-finite" is expressed by a L-suffix. Again the verb-σ cannot link to both floating tones due to $*\sigma_{3\square}$ (42-c). At this point the decision between (42-a) and (42-b) is due to σ ← [T which enforces association of the derivational prefix at the cost of the inflectional suffix:

(42) **[[T_d- T_V] -T_i]** ⇒ **T_d- V** (CF- V_μ -NF)

Input: 

	$*\sigma_{3\square}$	*<u>R</u>	$*\forall \overset{\sigma}{\underset{T}{\uparrow}}$	$\overset{\sigma}{\underset{[T}{\uparrow}}$	$\overset{\sigma}{\underset{T}{\uparrow}}$	MAX$\overset{\sigma}{\underset{T}{\uparrow}}$	DEP$\overset{\sigma}{\underset{T}{\uparrow}}$
☞ a. H H L σ					*		*
b. H H L σ				*!	*		*
c. H H L σ	*!						**
d. H H L σ				*!	**		

(43) illustrates the possibility that derivational tone is circumfixal whereas the inflectional tone is a prefix ((39)-c). One of the few combinations where this is the case is the 3SG of the BAP. Once again, $*\forall \overset{\sigma}{\underset{T}{\uparrow}}$ excludes the possibility to associate the verb σ with inflectional tone across the derivational one:

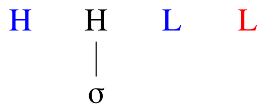
(43) $\mathbf{[T_i\text{-}\ [T_d\text{-}\ T_V\ \text{-}T_d]] \Rightarrow T_d\text{-}\ V\ \text{-}T_d}$ (3SG- BAP- V_μ -BAP)

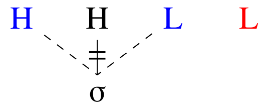
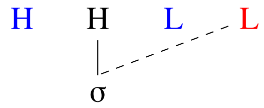
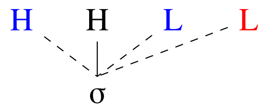
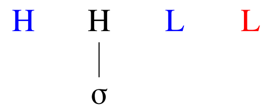
L H H L
| (H–σ)
Input: σ

	$*\sigma_{3\square}$	*<u>R</u>	$*\forall \overset{\sigma}{\underset{T}{\uparrow}}$	$\overset{\sigma}{\underset{[T}{\uparrow}}$	$\overset{\sigma}{\underset{T}{\uparrow}}$	MAX $\overset{\sigma}{\underset{T}{\uparrow}}$	DEP $\overset{\sigma}{\underset{T}{\uparrow}}$
☞ a. L H H L / σ (H–σ delinked; H, L linked to σ)				*	*		*
b. L H H L / σ (H–σ delinked; L linked to σ)			*!		*	*	*
c. L H H L / σ (H–σ delinked; L, H, L linked to σ)	*!						**
d. L H H L / σ (H–σ)				*	**!*		

Finally (44) illustrates the case of a derivational circumfix cooccurring with an inflectional suffix in an non-finite BAP form, where association to the inflectional tone suffix is disfavored by both constraints, $*\vee^{\sigma}_{\uparrow T}$ and $\sigma \leftarrow [T$:

(44) $\mathbf{[[T_d\text{-}\ T_V\ \text{-}T_d]\ \text{-}T_i] \Rightarrow T_d\text{-}\ V}$ (BAP- V_μ -BAP -NF)

Input: 

	$*\sigma_{3\square}$	$*\underline{R}$	$*\vee^{\sigma}_{\uparrow T}$	$\sigma \leftarrow [T$	$\sigma \leftarrow T$	$\textsc{Max}^{\sigma}_{\uparrow T}$	$\textsc{Dep}^{\sigma}_{\uparrow T}$
☞ a. 					*		**
b. 			*!	*	**		*
c. 	*!						***
d. 				*!	***		

5.3.4 The Antipassive Puzzle

The distribution of tone in AP forms opens up a further micro-cosmos of complexity whose intricacy is on its own of roughly the same complexity as the rest of the verbal paradigm. (45) shows again the tone patterns of derivation and inner inflection in Dinka, this time including the AP.

(45) **Stem-Level Tone in Dinka**

a.	**CVC/H**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	H	L	F	F
1/3S	L	H	L	F	F
PL	H	H	L	F	F
NF	F	H	L	F	L

b.	**CVC/L**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	F	L	F	F
1/3S	L	F	L	F	F
PL	H	F	L	F	F
NF	L	F	L	F	F

c.	**CVVC/H**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
FIN	L	H	L	H	L
1/3S	L	H	L	H	L
PL	L	H	L	H	H
NF	H	H	L	H	L

d.	**CVVC/L**					
	Ø	**CF/B**	**CP**	**BAP**	**AP_1**	**AP_2**
FIN	L	F	L	F	L	H
1/3S	L	F	L	F	L	H
PL	L	F	L	F	L	H
NF	F	F	L	F	H	L

The most straightforward part of the AP paradigm are the forms found with short-V verbs which show a consistent F with exception of the L in the NF form. On the other hand, there are two completely disjoint patterns with long H-tone verbs, one used with creaky roots (AP_1) and the other one with breathy ones (AP_2). I will not address here the tonal allomorphy in the creaky case (AP_2), but provide a tentative analysis for the rest of the system (i.e., taking (AP_1) as the more basic pattern for CVVC/L roots), as shown in (46):

(46) **Exponents for the AP**

AP

a. ↔ L- / V_μ (CFV/H:NF & CVVC/H:Ø & CVVC/H:NF)

b. ↔ H- ⊕ -L / $\overline{V_\mu}$

Crucially the F tone in short verbs (45-a,b) is parallel to the one in the BAP, and can again be derived by a combination of a H prefix and a L suffix restricted to this environment (46-b).

For long verb roots, (45-c,d), I assume that there is simply no general tonal affix for the AP, i.e., the different tones emerging in these forms is either the underlying tone of the stem or of the inflectional affixes. Consider first the NF, for which I posit the revised representation in (47). The default allomorph (47-b) is identical to ((22)-e), whereas (47-a) is inserted instead in NF:AP forms of long verbs.

(47) **Revised Exponent Entries for NF**

NF

a. ↔ -H / $V_{\mu\mu}$, AP

b. ↔ -L / V_μ ⊕ H- / $V_{\mu\mu}$

For CVVC/L verbs, (47-a) overwrites the stem tone (in parallel to the PL H-suffix in (30)).

That the H-tone suffix does not surface in CVVC/H NF:AP forms, where it is replaced by L seems to be connected to the exceptional L in NF CVC/H forms. Interestingly enough, these two forms (and the FIN CVVC/H form which also has stem L) share one other property which sets them apart from all other AP forms (which have long or extra-long Vs): they have a short stem vowel. I assume that the tone pattern is dependent on the vowel-length pattern, namely that there is a L prefix which has morphological precedence over the other AP exponents and is restricted to the environment of phonetically short base vowels. To highlight that it is the phonetic shape, not the morphological shape of the base to which the context restriction refers, this is underlined in (46-a). Crucially, the long V of CVVC/H roots must be shortened by a preceding moraic affix. The L-prefix will then prevail over the suffix -H due to σ ← [T , and overwrite the underlying H of the verb stem to satisfy *R:

(48) $\mathbf{[[T_d\text{-}\ T_V]\ \text{-}T_i] \Rightarrow T_d\text{-}\ V}$ (AP- $V_{\mu\,\mu}$ -NF)

L H H
|
Input: σ

	$*\sigma_{3\square}$	*R	$*\forall^{\sigma}_{\uparrow T}$	σ ↑ [T	σ ↑ T	$\textsc{Max}^{\sigma}_{\uparrow T}$	$\textsc{Dep}^{\sigma}_{\uparrow T}$
☞ a. L H H σ					*	*	*
b. L H H σ		*!			*		*
c. L H H σ				*!	*		*
d. L H H σ	*!	*!					**
e. L H H σ				*!	**		

Recall that in all other forms of long verbs, there is simply no tonal AP-exponent which could be inserted – (47) does not contain exponents which would be adequate for AP forms with FIN,1SG/3SG, and PL inflection. As a consequence, inflectional tone should surface in these forms, and this is in fact what we get in AP forms of long verbs for FIN and 1/3SG which exhibit the L tone characteristic of the inflectional category. If this analysis is on the right track, it is important for the general analysis of Dinka tone because it shows that blocking of inflectional by derivational tone is not a morphological effect (i.e. not the fact that a verb is derived morphologically makes it it impossible to spell out inflectional), but phonological: As soon as morphological derivation is not expressed by phonological tone, inflectional tone can freely surface.

One final wrinkle of the data are the 1PL/2PL/3PL AP forms of long verbs which exhibit simply the underlying stem tone. I assume that this is due to even more presence of absent morphological material, namely the fact that the tonal PL exponent has a Ø-allomorph in the context of AP, as shown in (49):

(49) **Revised Representation of the PL Exponent** (cf. (22))

PL
↔ -Ø / AP
↔ -H / V_{μ} ⊕ L- / $V_{\mu\mu}$

Thus PL:AP forms of underlyingly long verbs have neither inflectional nor derivational tonal affixes, which leads to straightforward surfacing of the underlying root tone.[3]

5.3.5 Word-Level Affixation

(50) summarizes the tone patterns of "outer inflection" which I have identified above. By hypothesis, this is the class of tonal Word-Level exponents of Dinka:

(50) **Word-Level Tone in Dinka Verbs**

a.	**CVC/H**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	L	L	H	L	L

b.	**CVC/L**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	L	L	H	L	L

c.	**CVVC/H**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	H	F	F	F	F
2SG	H	L	H	L	L

d.	**CVVC/L**				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
NTS	H	H	H	H	H
PAS:CT	F	F	F	F	F
PAS	F	F	F	F	F
2SG	F	L	H	L	L

I assume that empirically the tone patterns of outer inflection overwrite all tones introduced by earlier (Stem-Level) derivation. Hence every apparent sensitivity of an outer-inflection tone pattern to derivation is purely morphological (suppletion). Note also an interesting asymmetry in the data which follows partially from the stratal analysis, partially (as we will see below) from the highly destructive/overwriting specification of Word-Level tonal affixes. Verb stems which have undergone derivation do not show any differences according to lexical tone/length classes. For example the CP forms in (50) do not differ according to the tone or length of the original verb root, e.g. a PAS:CP form has a F tone in (50-a,b,c,d) even though not all inflected CP or all PAS forms show this tone. This is expected because CP-tone at the Word Level has already eliminated the differences between underlying tones by overwriting it with L. Direct reflexes of tonal verb (and verb) classes in (50) are only found in underived forms (the Ø-column), for example 2SG forms of underived long H-tone verbs are H, whereas the corresponding form for L-tone verbs has a F.

[3]Note that for short verb PL:AP forms, the tone which surfaces is the AP HL-circumfix specified in ((46)-b).

(51) lists the exponent entries I posit for (50). The fact that NTS and PAS:CT have the same tone patterns in all contexts is reflected by the fact that their exponents do not contain disjunction or context restrictions (51-a,b). On the other hand, both PAS and 2SG show an exceptional H-tone prefix in the underived forms of long-V stems which is captured in (51-c,d), by a special allomorph which is restricted to bases with bimoraic vowels and adjacency to the root ($\sqrt{}$) of the verb, hence underived environments (in cases of derivation, at least one functional category would intervene between inflection and the verb root), and blocks the more general exponents for the same categories. 2SG also has a blocking allomorph in the context of CP which accounts for the fact that it has an exceptional and consistent H tone in this context: [4]

(51) **Word-Level Exponents**

a. NTS $\leftrightarrow$ -H

b. PAS:CT $\leftrightarrow$ H- $\oplus$ -L

c. PAS $\leftrightarrow$ H- / $V_{\mu\mu}$, $\sqrt{}$
$\leftrightarrow$ H- $\oplus$ -L

d. 2SG $\leftrightarrow$ H- / $V_{\mu\mu}$, $\sqrt{}$
$\leftrightarrow$ H- / CP
$\leftrightarrow$ L-

In the following, I show shortly that the entries in (51) derive the correct tone patterns for all relevant inputs under the ranking of constraints in (52)

(52) **Dinka Word-Level Ranking:** $*\underline{\mathrm{R}} \gg \overset{\sigma}{\underset{\mathrm{T}}{\uparrow}} \gg {}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}} \gg {}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}} \gg \textsc{Max}\overset{\sigma}{\underset{\mathrm{T}}{\uparrow}} \gg \textsc{Dep}\overset{\sigma}{\underset{\mathrm{T}}{\uparrow}}$

${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}}$ and ${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$, as defined in (53) and (54), penalize σ's associated to two H and two L tones respectively (cf. Clements and Ford (1979)) and will only become relevant for the analysis of polar tone in the oblique case which is also Word-Level (cf. subsection 5.3.6).

(53) ${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}}$ Assign $*$ to every σ which is associated to more than one H in I

(54) ${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$ Assign $*$ to every σ which is associated to more than one L in I

Otherwise, the ranking assumed here is a simplified version of the Stem-Level ranking since the verbal system doesn't have cooccurring inflectional categories at the Word-Level, hence there are no competition processes which would provide evidence for the ranking of constraints such as $\sigma \leftarrow [\mathrm{T}$.

[4] As discussed in subsections 5.3.2, and 5.3.3, CP has a consistent L tone in all forms, hence given the fact that L is also the default realization of 2SG a purely phonological account of the H in CP:2SG would have to derive a H from a combination of two L-tones, a difficult enterprise. Note also that the exceptional CP:2SG H cannot be an exponent of CP (which is Stem-Level) because it would then be overwritten by the Word-Level L- of the 2SG.

Suffixal -H (NTS)

(55), (56), and (57) show the overwriting of stem-L and H by the H-suffix of NTS. The interaction of σ ← T and *R̲ is parallel to the one I have already discussed for the Stem-Level H-suffix expressing 1PL/2PL/3PL in subsection 5.3.2.

(55) **NTS: -H Overwrites Stem-L**

L H
|
Input: σ

	*R̲	σ ↑ T	$^{*}_{H}\sigma_{H}$	$^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. L H; L ǂ σ, H - - σ					*	*
b. L H; L | σ, H - - σ	*!					*
c. L H; L | σ		*!				

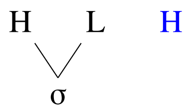
(56) **NTS: -H Vacuously Overwrites Stem-H**

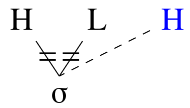
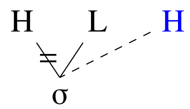
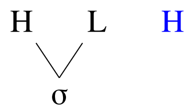
H H
|
Input: σ

	*R̲	σ ↑ T	$^{*}_{H}\sigma_{H}$	$^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. H H; H ǂ σ, H - - σ			*		*	*
b. H H; H | σ		*!				

In addition to L and H, stems which are input for Word-Level computation may also contain F tones (which result for example by Stem-Level affixation of CP H-prefixes). (57) shows that Fs are overwritten by suffixal -H in just the same way as stem L's. The affixal H must associate to the stem σ by σ ← T which triggers deassociation of stem-L because the contour LH would otherwise violate *R̲:

(57) **NTS: -H Overwrites Stem F**

Input: 

	*R̲	σ ↑ T	${}^{*}_{H}\sigma_{H}$	${}^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{T}$	DEP$^{\sigma}_{T}$
☞ a. 			*		**	*
b. 	*!				*	*
c. 		*!				

Prefixal H- (PAS & 2SG)

Prefixal H only attaches to underived verb stems (cf. the vocabulary entries in (51)); hence we have to consider only inputs with underlying L (58) and H tone (59). Otherwise the derivations are analogous to the ones for Stem-Level CF/B.

(58) **H– Extends Stem-L to F**

H L
|
Input: σ

	*R	σ ↑ T	$^{*}{}_{H}\sigma_{H}$	$^{*}{}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. H L σ						*
b. H L σ					*!	*
c. H L σ		*!				

(59) **H– Vacuously Replaces Stem-H**

H H
|
Input: σ

	*R	σ ↑ T	$^{*}{}_{H}\sigma_{H}$	$^{*}{}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. H H σ			*		*	*
b. H H σ		*!				

Prefixal L- (2SG)

Prefixal L in the 2SG overwrites underlying H tones (60) and vacuously replaces underlying L tones (61) just as in Stem-Level CP. Again the overwriting of H to avoid *$\underline{\text{R}}$ violations extends straightforwardly to input stems with a F (62):

(60) **L– Overwrites Stem-H**

Input: L H | σ (H linked to σ)

	*$\underline{\text{R}}$	$\sigma \uparrow T$	$^{*}{}_{H}\sigma_{H}$	$^{*}{}_{L}\sigma_{L}$	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. L H σ (L linked to σ, H delinked)					*	*
b. L H σ (L and H both linked to σ)	*!					*
c. L H σ (H linked to σ)		*!				

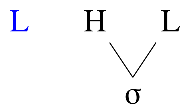
(61) **L- Vacuously Replaces Stem-L**

Input: L L | σ (L linked to σ)

	*$\underline{\text{R}}$	$\sigma \uparrow T$	$^{*}{}_{H}\sigma_{H}$	$^{*}{}_{L}\sigma_{L}$	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. L L σ (prefixal L linked to σ, stem L delinked)				*	*	*
b. L L σ (stem L linked to σ)		*!				

(62) **L- Overwrites Stem-HL**

Input:



	*R	σ ↑ T	$^{*}_{H}\sigma_{H}$	$^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{T}$↑	DEP$^{\sigma}_{T}$↑
☞ a. L H L σ (L linked to σ; H and L delinked)				*	*	*
b. L H L σ (L linked to σ; L delinked)	*!				*	*
c. L H L σ (H and L linked to σ)		*!				

Circumfixal H- -L (PAS:CT & PAS)

Simultaneous affixation of a prefixal H and a suffixal L gives rise to complete overwriting of all stem tones (63), (64), (65), which in all cases results in a falling tone. Note that the ranking of $\sigma \leftarrow T$ above ${}^{*}_{H}\sigma_{H}$ and ${}^{*}_{L}\sigma_{L}$ is crucial because at least one of these is violated by all winning candidates:

(63) **H– –L Extends Stem-L to F**

```
         H    L    L
              |
Input:        σ
```

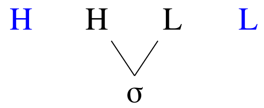
	*R	$\sigma \uparrow T$	${}^{*}_{H}\sigma_{H}$	${}^{*}_{L}\sigma_{L}$	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. H L L (H and L linked to σ by dashed lines; stem L delinked: ǂ) σ				*	*	**
c. H L L (L linked to σ) σ		*!*				

(64) **H– –L Extends Stem-H to F**

```
         H    H    L
              |
Input:        σ
```

	*R	$\sigma \uparrow T$	${}^{*}_{H}\sigma_{H}$	${}^{*}_{L}\sigma_{L}$	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. H H L (H and L linked to σ by dashed lines; stem H delinked: ǂ) σ			*		*	**
c. H H L (H linked to σ) σ		*!*				

(65) **H– –L Vacuously Overwrites Stem-HL**

Input: 

	*R	$\sigma \uparrow T$	$^{*}_{H}\sigma_{H}$	$^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. H H L L σ			*	*	**	**
b. H H L L σ		*!*				

5.3.6 Polar Tone in Oblique Case Marking

Oblique case marking in Dinka shows a fascinating kind of tonal polarity. Oblique case is marked by a complex pattern of tonal alternation which is partially conditioned by lexical class. However the main pattern identified by Andersen (2002) is that L gets F (66-a) whereas F and H get L (66-b,c).

(66) **Tone Polarity in Dinka Oblique Case** (Andersen 2002:9-10)

		Absolutive	Oblique	
a.	(i)	tɔ̀ŋ	tɔ̂ŋ	'spear'
	(ii)	pìɲ	pîɲ	'land'
	(iii)	ɯ̯ɔ̤̀t	ɯ̯ɔ̤̂t	'house'
b.	(i)	dít	dìt	'bird'
	(ii)	bá̤ɲ	bà̤ɲ	'chief'
	(iii)	lé̤c	lè̤c	'stick'
c.	(i)	ɟâːk	ɟàːk	'pelican'
	(ii)	pṳ̂ːl	pùːl	'pool'

In the following, I show that polar tone follows if we interpret the relevant oblique affix as a rising tone, i.e. a tonal prefix consisting of a L and a following H tone. Given the absolute ban on syllables associated to L and following H in Word-Level, the Dinka unique situation arises that not all tones of an affix can associate to the stem-σ. At this point, ${}^{*}_{H}\sigma_{H}$ and ${}^{*}_{L}\sigma_{L}$ become crucial since they prohibit in an OCP-like manner that multiple instances of a tone are linked to the same σ. As a consequence, the affix tone which associates to the stem σ is, roughly speaking, the tone to whose quality the stem is not already associated underlyingly: the "polar tone". [5]

[5]This analysis is similar in spirit to the approaches to featural polarity developed in de Lacy (2002b), Wolf (2005b, 2007), where polarity emerges from polar allomorphs, suppletive allomorphs of a single morpheme which are phonologically opposite-valued floating instances of the same phonological feature. However for de Lacy and Wolf the selection of the "right" feature (the one distinct from the underlying one) is achieved by constraints specialized to the distinctive realization of floating features. In the analysis here selection of the floating feature for docking is achieved by purely phonological means.

(67) shows how this approach works with a L-tone stem. *<u>R</u> blocks the option of attaching both prefix tones to the stem-σ (67-d), ${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$ excludes the option of just associating the floating L (67-c) – note that deassociating the underlying stem-L would not have any remedying effect on (67-c) since ${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$ is the generalized version of the constraint. The rising tone of the winning candidate (67-a) is compatible with Dinka phonotactics and avoids the $\text{M}\textsc{ax}^{\sigma}_{\mathrm{T}}$ violation incurred by the overwriting candidate (67-b):

(67) **L ⇒ F**

Input: L H L | σ

	*<u>R</u>	σ ↑ T	${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}}$	${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$	$\text{M}\textsc{ax}^{\sigma}_{\mathrm{T}}$	$\text{D}\textsc{ep}^{\sigma}_{\mathrm{T}}$
☞ a. L H L σ (H and L linked to σ)		*				*
b. L H L σ (H linked to σ, L delinked)		*			*!	*
c. L H L σ (first L linked to σ, stem L delinked)		*		*!		*
d. L H L σ (first L and H linked to σ, stem L delinked)	*!			*		**
e. L H L σ (L linked to σ)		**!				

Underlyingly H-tone stems show roughly the mirror image: Again not both affix tones can be associated (68-d), but this time the floating H-tone wins the competition for the base syllable to avoid a ${}^{*}_{L}\sigma_{L}$-violation (fatally violated by (68-c)). However, in addition, the stem-H must be delinked because otherwise a R would result (cf. (68-b)):

(68) **H ⇒ L**

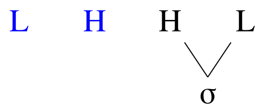
Input: L H H | σ

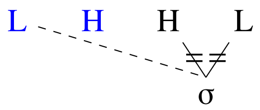
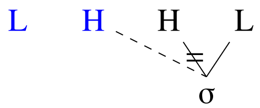
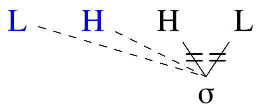
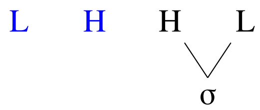
	*R	σ ↑ T	${}^{*}_{H}\sigma_{H}$	${}^{*}_{L}\sigma_{L}$	$\text{MAX}^{\sigma}_{\uparrow T}$	$\text{DEP}^{\sigma}_{\uparrow T}$
☞ a. L H H σ		*			*	*
b. L H H σ		*	*!		*	*
c. L H H σ		*	*!		*	*
d. L H H σ	*!					**
e. L H H σ		*!*				

With underlying F stem tones the ranking ${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}} \gg {}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$ becomes crucial. Both, the candidates where only the floating H- tone is associated (69-b) and where only the floating L (69-a) is associated, violate one of these constraints, but ${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}} \gg {}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$ correctly favors association of the L. Again this also enforces deassociation of the stem H to avoid the formation of a R:

(69) **F ⇒ L**

Input:



	*R	$\sigma \uparrow T$	${}^{*}_{\mathrm{H}}\sigma_{\mathrm{H}}$	${}^{*}_{\mathrm{L}}\sigma_{\mathrm{L}}$	MAX$^{\sigma}_{\uparrow T}$	DEP$^{\sigma}_{\uparrow T}$
☞ a. 		*		*	**	*
b. 		*	*!		*	*
c. 	*!					**
d. 		*!*				

5.3.7 Data Appendix

(70) **Remarks on Dinka Tone Data**

	CVC/H				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
Ø	L[1]	H	L	F	F
1/3S	L	H	L	F	F
PL	H[4]	H	L[3]	F	F
NF	F	H	L	F	L
NTS	H	H	H	H	H
2S	L	L[2]	H	L[2]	L[2]
PAS:CT	F[2]	F[2]	F[2]	F[2]	F[2]
PAS	H	F[2]	F[2]	F[2]	F[2]

	CVC/L				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
Ø	L[1]	F	L	F	F
1/3S	L	F	L	F	F
PL	H[4]	F	L[3]	F	F
NF	L	F	L	F	F
NTS	H	H	H	H	H
2S	L	L[2]	H	L[2]	L[2]
PAS:CT	F[2]	F[2]	F[2]	F[2]	F[2]
PAS	H	F[2]	F[2]	F[2]	F[2]

	CVVC/H				
	Ø	**CF/B**	**CP**	**BAP**	**AP**
Ø	L	H	L	H	L[1]
1/3S	L	H	L	H	L
PL	L	H	L[3]	H	H[4]
NF	H	H	L	H	L
NTS	H	H	H	H	H
2S	H	L[2]	H	L[2]	L[2]
PAS:CT	F[2]	F[2]	F[2]	F[2]	F[2]
PAS	F	F[2]	F	F	F

	CVVC/L					
	Ø	**CF/B**	**CP**	**BAP**	**AP_1**	**AP_2**
Ø	L	F	L	F	L	H
1/3S	L	F	L	F	L	H
PL	L	F	L[3]	F	L	H
NF	F	F	L	F	H	L
NTS	H	H	H	H	H	H
2S	F	L[2]	H	L[2]	L[2]	L
PAS:CT	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]
PAS	H	F[2]	F[2]	F[2]	F[2]	F[2]

1. Instead of a L tone, these forms – which share that they have short stem vowels and are inflectionally unmarked – have a H if they are not preceded by the declarative particle *a-* (Andersen 1995:46-49). Andersen argues that L is the basic tone.

2. Andersen argues that these tones are "contextually determined" in the sense that they can be predicted by the presence of an affix expressing the same category. Thus all L[2] tones expressing 2SG cooccur with the 2SG suffix *-é*, and vice versa whenever *-é* is used (in all 2SG forms except underived and CP forms) the stem tone is L[2] (Andersen 1995:49-50). Since there are other affixes which don't trigger the same effects, I assume that all these tones are floating affix tones which do not require any special treatment.

3. Instead of L, CP 1PL/2PL/3PL forms have H on the stem as a free variant (Andersen 1995:57).

4. These forms – which share that they have short stem vowels and are followed by an inflectional PL suffix – have a H-tone whereas at least partially an other tone would be expected (e.g. L in the PL AP of CVVC/H roots). Andersen treats these H-tones again as "contextually determined" by the suffix (tone) (Andersen 1995:51-52), but since the alternation here doesn't seem to follow from general phonological conditions, I interpret here all H[4] tones as stem tones deriving from floating tone affixes.

5.4 Floating Tone in Anywa

The focus of this section is the parallel behavior of floating tone in affixes and lexical roots, a major prediction of the phonological approach to mutation morphology. I will take floating H tones in Anywa as a test case because they play a crucial role in the phonology of the language, and Anywa's tonology is relatively well-documented. However, a crucial step I will take simultaneously to the analysis of floating tone is to establish that Anywa in fact *has* pervasive patterns of floating tones because Reh (1993), the major source on the language treats the relevant phenomena in terms of a (phonetically low) "mid" tone. In terms of stratal organization, I assume that the patterns I analyze here correspond to the Word-Level tonology of Anywa, whereas verbal derivation – which I won't address here because it seems to work similar to the corresponding patterns in Dinka – shows much more pervasive patterns of tonal overwriting. An important side theme of the section is the interaction of tonal mutation morphology and the spread of preassociated tone.

5.4.1 Data

Reh (1993:47) assumes that Anywa in addition to a L(ow) and a H(igh) tone also has a M(id) tone which is phonetically usually indistinguishable from a L tone, but behaves phonologically quite differently – roughly speaking M tones are phonologically active (they trigger phonological processes) whereas L tones only undergo phonological processes.[6] In the following, I will argue that M-tone morphemes are actually associated to a L tone followed by a floating H tone. In the following, I introduce the relevant tone sandhi processes as described by Reh (1993:67-70):

H-tone Spreading: In H-tone spreading the H of a H-tone root spreads to a L-tone suffix:

(71) **H-tone spreading** (Reh 1993:68)

mʌ́th -ɔ̀ 'INF' → mʌ́th-ɔ́

Note that word forms in Anywa have maximally one suffix (and all segmental suffixes are monosyllabic). Therefore spreading from a root is always bounded to a single vowel. Apparently there is no H-tone spreading from H-tone suffixes to L-tone roots.

[6]Single morphemes in Anywa either carry L or H tone, but never a contour tone (see Reh 199345 on some potential exceptions). A rising tone may however result from sandhi processes – see the discussion of L-tone Creation below.

L-tone Raising: In L-tone raising, the L of a L-tone root becomes H after a M-tone prefix (72-a) or clitic. In (72-b) L-tone raising feeds H-tone Spreading:

(72) **L-tone Raising** (Reh 1993:68)

a.	ā-	dhyàŋ		→	ā-dhyáŋ	'durra bird'
b.	ā-	càŋ	-Yì	→	ā-cáŋ-Yí	'you ate it'

Under the assumption that M-tones are actually L + floating H, L-tone raising is in fact another case of H-tone spreading (the floating H spreads to a following L-tone syllable). Whereas this spreading is iterative in a prefix-root-suffix sequence, spreading is restricted to one vowel/morpheme if an M-tone prefix/clitic precedes a L-tone prefix (73-a) or a compound (73-b):

(73) **Restricted L-tone Raising** (Reh 1993:68-69)

a.	ɛ̄nā-	ɲìla:l		→	ɛ̄nā-ɲíla:l
	3S:be	child			'(s)he is a child'
b.	ā-	tù:ŋ	cìɛl	→	ā-tú:ŋ-cìɛl
	DRV	horn	one		'(s)he is a child'

The non-iterativity of spreading here confirms the observation made above that there is no spreading of a H-tone to a root from a morpheme which is itself overtly H.

Floating H-tone spreading (L-tone raising) also happens if a H-tone root precedes a L-tone suffix. However in this case, also the root itself becomes phonetically H:

(74) **L-tone Raising in Suffixes** (Reh 1993:69)

a.	gāth	-ɛ̀	→	gáth-ɛ́
	'trade'	PL		'types of trade'
b.	ācū:l	-ɛ̀	→	ācú:l-ɛ́
	island	PL		'islands'

In terms of the floating-H analysis, the floating H tone also associates to its root syllable if it associates to the suffix. In the following, I will call the exceptional association of the floating H tone with its root 'backfiring'.

L-tone Creation: If a H-tone prefix precedes a H-tone root, a L tone is inserted on the root and the H tone is shifted to the suffix:

(75) **L-tone Creation after H-tone Prefix** (Reh 1993:204)

ʊ́	máth	-à	→	ʊ́-màth-á
HAB	drink:PD	-1SG		'whenever I drink'

L-tone creation also happens if a M-tone prefix/clitic is attached to a H-tone root (76-a). If there is no suffix, the root gets a rising tone (i.e. bears the original H tone preceded by the inserted L tone) (76-b):

(76) **L-tone Creation after M-tone Prefix/Clitic** (Reh 1993:68-69)

a.	mānā	ké:nó	→	mānā-kè:nó
	this:be	hearth		'this is a hearth'
b.	ɛ̄nā-	ó:	→	ɛ̄nā-ǒ:
	3S:PA	come		'(s)he came'

There is no L-tone creation if the H-tone has been created by backfiring of a spreaded floating H tone:

(77) **L-tone Creation after M-tone Prefix/Clitic** (Reh 1993:68-69)

mʊ̄ːyyā:	gāth	-ɛ̀	→	mʊ̄ːyyā:-gáth-ɛ́
these:be	trade	-PL		'these are types of trade'

(This is the reason why Reh calls backfiring 'stable high tone creation'). In the following two subsection, I will show that the reanalysis of Mid tones as L-tone syllables with floating H-tones allows to reduce the tone-sandhi phenomena of Anywa, to two processes: H-Spreading (subsection 5.4.2) and L-epenthesis (subsection 5.4.3) which are governed by independently motivated phonological constraints such as the ban against falling tones (*F) and the OCP.

5.4.2 Analysis: H-Spreading

In line with Myers (1997) (for Bantu tone), I assume that the driving force behind spreading in Anywa is the requirement that specific prosodic constituents are associated to H tones, namely the constraint $\sigma \Rightarrow$ H. Again following Myers (1997), I assume that there are high-ranked constraints, not further discussed here, which disallow spreading or shifting of tones to the left. This derives spreading from H-tone roots to L-tone suffixes as follows: The L-tone suffix induces a violation of $\sigma \Rightarrow$ H (78-c) which can be repaired either by spreading (78-a) or by shifting (78-b) the H tone of the root to the suffix. Since shifting involves a violation of high-ranked $\text{MAX}_{\sigma \leftarrow \text{H}}$, spreading turns out to be optimal (I will discuss the three undominated constraints below when they become relevant):

(78) **High Tone Spreading from Root to Suffix**

Input:

H	L
|	|
gwʌ	-ɔ

	$\overset{*}{_H}\square_H$	$^{PW}_{*}\underline{H}^{PW}$	$DE\overset{\sigma}{\underset{T}{\uparrow}}$	$MAX\overset{\sigma}{\underset{H}{\uparrow}}$	$\sigma \Downarrow H$	$DEP\overset{\sigma}{\underset{T}{\uparrow}}$
☞ a. H (linked to gwʌ, spreading to -ɔ) L (delinked ǂ) gwʌ -ɔ						*
b. H (delinked ǂ, spreading to -ɔ) L (delinked ǂ) gwʌ -ɔ				*!	*	*
c. H (linked to gwʌ) L (linked to -ɔ) gwʌ -ɔ					*!	

Under the assumption that in Anywa, as in many other languages (Peperkamp 1997), prefixes (and different roots in compound structures) form prosodic words on their own, whereas suffixes are integrated into the prosodic word of a preceding root,[7] root-to-suffix spreading applies inside a single PWord. That there is no analogous spreading from H-tone prefixes to L-tone roots (i.e. across a PWord boundary) follows from the constraint $^{PW}_{*}\underline{H}^{PW}$ penalizing H-tones dominated by more than one PWord.

(79) $^{PW}_{*}\underline{H}^{PW}$ Assign ∗ to every H which is dominated by more than 1 PWord in P

[7] I assume that this follows indirectly from prosodic alignment of exponents at the Root and Stem Level, where exponents of lexical morphemes (roots and derivational affixes) are required to align to Words, whereas inflectional affixes do not project prosodic structure above the syllable. Since prefixes in Anywa are systematically derivational, and the suffixes in Reh's grammar at least compatible with an analysis as inflectional formative (which I assume to be true) prefixes and roots in contrast to suffix enter the Word-Level computation with tautomorphemic PWords, which are preserved there due to high-ranked faithfulness constraints.

Since ${}^{PW}_{*}\underline{H}^{PW}$ dominates all other constraints discussed so far, it blocks spreading of the prefix-H (80-a). Shifting (80-b), i.e. spreading of the H with concomitant deassociation from the prefix syllable would avoid the ${}^{PW}_{*}\underline{H}^{PW}$-violation, but again at the cost of a MAX$_{\sigma \leftarrow H}$ violation. Hence the input is parsed as it is (80-c):

(80) **No High Tone Spreading from Prefix to Root**

Input: H | ʊ-   L | dɪ

	${}^{*}_{H}\square_{H}$	${}^{PW}_{*}\underline{H}^{PW}$	DE$^{\sigma}_{\uparrow T}$	MAX$^{\sigma}_{\uparrow H}$	$\sigma \Downarrow H$	DEP$^{\sigma}_{\uparrow T}$
a. H | ʊ- (H spreads to dɪ), L ǂ dɪ		*!				*
b. H ǂ ʊ- (H shifts to dɪ), L ǂ dɪ				*!	*	*
☞ c. H | ʊ-, L | dɪ					*	

On the other hand, the floating H of a ‘mid’ tone prefix *can* spread to a following H-tone root since it is not associated phonetically to its morpheme/syllable, hence not linked phonetically to the prefix PWord, thus obviating the violation of ${}^{PW}_{*}\underline{H}^{PW}$ (81-a). What is blocked is simultaneous association of the floating H to the prefix-σ since this would again lead to a ${}^{PW}_{*}\underline{H}^{PW}$-violation (81-b). Associating the floating H only to the prefix fares equally well as (81-a) for all other constraints, but violates fatally the DERIVEDENVIRONMENT constraint in (82), which is also undominated in Anywa:

(81) **Floating High Tone Spreading from Prefix to Root**

Input: o- (L H; L linked) diek (L linked)

	${}^{*}_{H}\square_{H}$	${}^{PW}_{*}\underline{H}^{PW}$	$DE^{\sigma}_{\uparrow T}$	$MAX^{\sigma}_{\uparrow H}$	$\sigma \Downarrow H$	$DEP^{\sigma}_{\uparrow T}$
☞ a. o- (L H) diek (L): H spreads to diek, L delinked					*	*
b. o- (L H) diek (L): H linked to o- and diek, both L delinked		*!				**
c. o- (L H) diek (L): H linked to o-			*!		*	*
d. o- (L H) diek (L): H floating					**!	

(82) $DE^{\sigma}_{\uparrow T}$ Assign ∗ to every tone which is dominated via a colorless association line to a σ of its own morphological color, but not to a σ of a different morphological color

However, ${}^{PW}_{\ *}\underline{H}^{PW}$ still blocks iterative spreading of floating H's to different members of a compound (or to a prefix and subsequently to a root) since this would again result in a phonetic H-tone span phonetically crossing a PWord boundary (83-b):[8]

(83) **Restricted Floating High Tone Spreading (No Spreading to the Second Part of a Compound)**

Input: a- (L H) tu:ŋ (L) cɪɛl (L)

	$^{*}_{H}\square_{H}$	${}^{PW}_{\ *}\underline{H}^{PW}$	$DE^{\sigma}_{\uparrow T}$	$MAX^{\sigma}_{\uparrow H}$	$\sigma \Downarrow H$	$DEP^{\sigma}_{\uparrow T}$
☞ a. a- tu:ŋ cɪɛl (L H L L; H spreads to tu:ŋ, L delinked)					**	*
b. a- tu:ŋ cɪɛl (L H L L; H spreads to tu:ŋ and cɪɛl, both L delinked)		*!				**
c. a- tu:ŋ cɪɛl (L H L L; no spreading)					***!	

Incestuous association of the floating H-tone to its own (the tautomorphemic) syllable could in principle also happen in underived forms without affixes, and is again excluded by the constraint $DE_{\sigma \leftarrow T}$:

(84) **No Tautomorphemic Association of a Floating H in Non-derived Environments**

Input: gath (L H)

	$^{*}_{H}\square_{H}$	${}^{PW}_{\ *}\underline{H}^{PW}$	$DE^{\sigma}_{\uparrow T}$	$MAX^{\sigma}_{\uparrow H}$	$\sigma \Downarrow H$	$DEP^{\sigma}_{\uparrow T}$
a. gath (L H; H associated)			*!			*
☞ b. gath (L H; H floating)					*	

[8]Note that iterative spreading from a prefix to a root *and* to a suffix is possible since there is no PWord boundary between roots and suffixes.

However, tautomorphemic tone association is possible in the case of independently triggered spreading of a H tone to a L-tone suffix. Thus in (85-b), $\text{DE}_{\sigma \leftarrow \text{T}}$ is not violated and the floating H associates both to the suffix and the tautomorphemic root to minimize violations of $\sigma \Rightarrow \text{H}$:

(85) **Floating H-Tone Spreading from Root to Suffix with Backfiring**

Input: gath (L H, L linked) -ɛ (L linked)

	$^{*}_{\text{H}}\Box_{\text{H}}$	${}^{\text{PW}}\underline{\text{H}}^{\text{PW}}_{*}$	$\text{DE}^{\sigma}_{\uparrow \text{T}}$	$\text{MAX}^{\sigma}_{\uparrow \text{H}}$	$\sigma \Downarrow \text{H}$	$\text{DEP}^{\sigma}_{\uparrow \text{T}}$
a. gath (L H, L linked) ɛ (L delinked, H linked)					*!	*
☞ b. gath (L delinked, H linked) ɛ (L delinked, H linked)						**
c. gath (L H, L linked) -ɛ (L linked)					*!*	

The immunity of 'mid'-tone morphemes to H-spreading is a consequence of the undominated constraint $^{*}_{\text{H}}\Box_{\text{H}}$ which disallows colors linked to more than one H-tone (cf. section 2.3.5). The constraint definition is repeated in (86).[9]

(86) $^{*}_{\text{H}}\Box_{\text{H}}$ Assign $*$ to every color which reflexively dominates more than one H tone

[9]A color C reflexively dominates a phonological node N if either N is of color C or some node N' is of color C and dominates N. See the discussion of (104) in section 2.3.5 for the notion of domination by colors.

Spreading of a prefix-H to a root which has itself a floating H (87-b) crucially violates ${}_{H}\overset{*}{\square}_{H}$ because here the color of the root dominates its own H and – via association – the H-tone of the prefix. In effect, both H-tones remain floating:

(87) **Immunity of L + Floating H against Spreading**

```
        L  H   L  H
        |      |
Input:  a-     ca:n
```

	${}_{H}\overset{*}{\square}_{H}$	${}^{PW}\underset{*}{\underline{H}}{}^{PW}$	DE$\overset{\sigma}{\underset{T}{\uparrow}}$	MAX$\overset{\sigma}{\underset{H}{\uparrow}}$	σ ⇓ H	DEP$\overset{\sigma}{\underset{T}{\uparrow}}$
☞ a. L H L H / | | / a- ca:n					**	
b. L H L H / | ╲ǂ / a- ca:n (L linked to a-, prefix H spread to ca:n, root L delinked)	*!				*	*

5.4.3 Analysis: L-Epenthesis

I propose that L-tone epenthesis in Anywa is a consequence of a specific version of the OCP (see Odden 1986, Myers 1997, Boersma 1998 for discussion of slightly different interpretations of the OCP) defined in (88):

(88)	${}^{\mathrm{PW}}_{\mathrm{H}}\mathrm{OCP}^{\mathrm{PW}}_{\mathrm{H}}$	Assign $*$ to every pair of adjacent H tones H_1, H_2 such that H_1 is dominated by PWord P_1, H_2 is dominated by PWord P_2 and P_1 is adjacent to P_2 in I

${}^{\mathrm{PW}}_{\mathrm{H}}\mathrm{OCP}^{\mathrm{PW}}_{\mathrm{H}}$ penalizes adjacent PWords linked to adjacent H-tones. In the most obvious case, this is violated by a H-tone prefix attached to a H-tone root as in (90). Apart from manipulation of segmental material, the only repair strategy which is possible is to insert a L tone between the two offending H-tones. 'Deleting' (i.e. deassociating) one of the H tones wouldn't avoid the OCP-violation because the H tones themselves and their linking to their respective PWords cannot be deleted under Containment and (88) is an I-constraint.[10]

The integration of epenthetic L into phonological structure is governed by the four constraints in (89) which are crucially undominated in Anywa:

(89) **Constraints Restricting the Association of Epenthetic L**

a. ${}_{\mathrm{L}}^{*}\sigma_{\mathrm{L}}$	Assign $*$ to every σ which is associated to two L-nodes in I
b. *F	Assign $*$ to every σ which is associated to a H and a right-adjacent L in I
c. *Ⓣ	Assign $*$ to every tone which is neither in M nor in P
d. R]	Assign $*$ to every σ which is linked to a L and a right-adjacent H and not rightmost on its tier in P

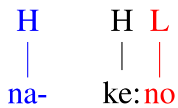
${}_{\mathrm{L}}^{*}\sigma_{\mathrm{L}}$ (89-a) and *F (89-b) have already been introduced and applied in the analysis of Dinka. Whereas ${}_{\mathrm{L}}^{*}\sigma_{\mathrm{L}}$ has again relatively abstract (indirect) effects, the empirical motivation for *F is straightforward: Anywa doesn't have falling tone contours on single syllables. *Ⓣ (89-c) ensures that the epenthetic L which repairs the OCP-violation will always get phonetically visible. For keeping tableaux transparent, I will omit this constraint and potential candidates violating it from the following tableaux. (89-d) is the Colored-Containment translation of the constraint Coincide(contour, final vowel) suggested in and motivated in detail in Zoll (2003:236) which restricts contour tones to final syllables (in the formulation chosen here I let it refer only to rising tones to highlight its effects in Anywa, but nothing crucial hinges on this choice because Anywa doesn't have falling contours anyway).[11]

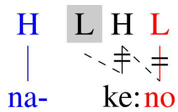
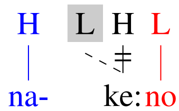
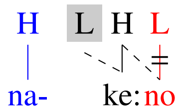
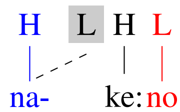
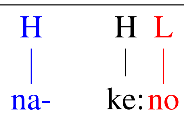
[10]Recall also from footnote 7 that PWord structure is already underlying at the Word Level, hence modifying PWord-boundaries at Word Level evaluation would also not remedy ${}^{\mathrm{PW}}_{\mathrm{H}}\mathrm{OCP}^{\mathrm{PW}}_{\mathrm{H}}$-violations.

[11]Reh (1993) doesn't explicitly discuss possible locations of R-tones in Anywa, but it seems to follow both from her informal description and from the examples she gives that the language does only exhibit rising tones in word-final position.

(90) shows how L-epenthesis between a H-tone prefix and a H-tone root is derived (${}^{*}_{H}\square_{H}$, $DE_{\sigma\leftarrow T}$, and ${}^{PW}_{*}\underline{H}^{PW}$ are largely irrelevant in contexts triggering L-epenthesis and therefore omitted from the following tableaux). Association of the inserted L-tone (enforced by undominated *(T)) to the prefix-σ would result in a violation of *F (90-d),[12] Associating the L-tone to the following syllable without deassociating the prelinked H of the latter would result in a non-final R excluded by R] (90-c). Thus delinking happens simultaneous with associating the root-H to the suffix syllable (90-a) which is expected anyway (thus this is H-spread (shift) from a root syllable without backfiring):[13]

(90) **L Insertion between Prefix-H and Root-H + Suffix**

Input: 

	${}^{PW}_{H}OCP^{PW}_{H}$	*F	R]	${}^{*}_{L}\sigma_L$	$MAX^{\sigma}_{\uparrow H}$	σ ⇓ H	$DEP^{\sigma}_{\uparrow T}$
☞ a. 					*	*	*
b. 					*	*!*	
c. 			*!				*
d. 		*!				*	
e. 	*!					*	

[12]Association of the L to the prefix and concomitant deassociation of the prefix H would have the same constraint profile as the winning candidate, but could be excluded by imposing a special faithfulness constraint on the word-initial syllable or the more general ban on leftward-spreading which also holds for H-tone spreading.

[13]Note that the association lines of L don't violate $DEP_{\sigma\leftarrow T}$ which only counts insertion of association lines between nodes when both nodes are underlying (in M).

If the root which is preceded by the H-tone prefix does not bear a suffix, a rising tone is created on the root syllable (91-a). This doesn't violate R] because the rising tone is in word-final position:

(91) **L-Insertion between Prefix-H and Root-H (without Suffix)**

	H	H
	|	|
Input:	na-	ke:

	$^{PW}_{H}$OCP$^{PW}_{H}$	*F	R]	$^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{\uparrow}{}_{H}$	$\sigma \Downarrow H$	DEP$^{\sigma}_{\uparrow}{}_{T}$
a. na- ke: (H | na-; L H, L linked to ke: by a dashed line, H delinked from ke:)					*!		
☞ b. na- ke: (H | na-; L H, L linked to ke: by a dashed line, H | ke:)							
c. na- ke: (H | na-; L H, L linked to na- by a dashed line, H | ke:)		*!					
d. na- ke: (H | na-; H | ke:)	*!						

Since ${}^{PW}_{H}$OCP${}^{PW}_{H}$ is not restricted to phonetically visible H tones, but penalizes all adjacent H tones (92-d), the analysis extends straightforwardly to L-insertion triggered by floating H-tone ('mid'-tone) prefixes. The only complication is that we have to exclude the possibility that the epenthetic L tone associates to the prefix instead of the root. This is achieved by the constraint ${}^{*}_{L}\sigma_{L}$, which bans syllables linked to more than one L tone (92-c):[14]

(92) **L-Insertion between Floating Prefix-H and Root-H**

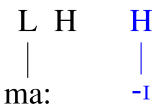
Input: L H (L linked to na-) H (linked to ke:) — na- ke:

	${}^{PW}_{H}$OCP${}^{PW}_{H}$	*F	R]	${}^{*}_{L}\sigma_{L}$	MAX$^{\sigma}_{H}$	σ ⇓ H	DEP$^{\sigma}_{T}$
☞ a. L H L H — na- ke:						*	
b. L H L H — na- ke					*!	**	
c. L H L H — na- no				*!		*	
d. L H H — na- ke:	*!					*	

[14] This option might also be excluded independently by $*\vee^{\sigma}_{T}$ (cf. (34)).

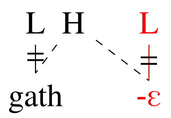
Let us finally turn to the cases where L-tone insertion might be expected, but does not obtain. Between H root tones and H suffix tones, ${}^{PW}_{H}OCP^{PW}_{H}$ does simply not require any repair since this is not a PWord boundary. L-tone insertion is blocked by low-ranked $\text{Dep}_{\sigma\leftarrow T}$:

(93) **No L-Insertion between Floating Root-H and Suffix-H**

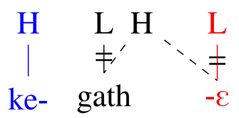
Input: 

	${}^{PW}_{H}OCP^{PW}_{H}$	*F	R]	$^{*}_{L}\sigma_{L}$	$\text{Max}^{\sigma}_{\uparrow H}$	σ ⇓ H	$\text{Dep}^{\sigma}_{\uparrow T}$
a. L H L H / ma: -ɪ						*	*!
b. L H L H / ma: -ɪ					*!	**	
c. L H L H / ma: -ɪ				*!		*	
☞ b. L H H / ma: -ɪ						*	

L-insertion also fails to be triggered if a mid-tone prefix precedes a H-tone which is created by floating H-tone spreading and backfiring. To see this, Recall that the output of backfiring is as in (94):

(94) 

Adding a H-tone prefix now would not lead to a violation of ${}^{PW}_{H}OCP^{PW}_{H}$ because the deassociated L tone already separates the prefix and the root H tone:

(95) 

Chapter 6

Vowels

6.1 Overview

This chapter has two interrelated thematic foci related to the vocalic features [ATR], [high], and [low]: First, it shows how a phonological account of vowel-feature mutation may be integrated into an account of the major phonological process involving these features in Western Nilotic: vowel harmony. Second, the chapter provides accounts to fascinating cases of chain-shifting mutation which either lower (Thok Reel, section 6.3) or raise tongue height in vowel articulation (Mayak, section 6.4). I will argue that only the lowering mutation of Thok Reel provides a genuine case of chain shift triggered by affixation of abstract sonority grid marks, whereas the Mayak case is an epiphenomenon of two independent vowel-harmony processes. An important side theme is the analysis of partially morphologically conditioned harmony systems in the restricted approach to morphology-phonology interaction proposed in this book. This is the main topic of section 6.2 which discusses root-controlled [ATR]-harmony in Päri and shows how harmony integrates with [+ATR]-mutation in verbal derivation.

6.2 Päri: [ATR]-Harmony and Mutation

Päri exhibits a simple type of split in morphological dominance. Affixes show [ATR]-harmony with roots, resulting in a straightforward case of root-dominance. On the other hand, different forms of verbal mutation morphology overwrite the underlying [ATR]-specification of roots. This split is prima facie evidence for divergence: Mutation seems to follow different principles than morphology employing segments, a potential argument for a morphological approach to mutation. In this section, I will show that both phenomena, overwriting of root-[ATR] by mutation and of affix-[ATR] by roots follow from standard principles of Autosegmental Phonology, namely simple constraints on autosegmental association such as in in (1), where (1-a) is central in triggering [ATR]-harmony, and (1-b) for overwriting in [ATR]-mutation. For brevity, I will often represent here and throughout the book [+ATR] as [⊣], [–ATR] as [⊢], and [ATR] as [⊢⊣], i.e. by the corresponding IPA diacritics:

(1) **Crucial Constraints on [⊣]-Association**

a. V ↓ [⊢⊣] Assign ∗ to every V which does not dominate any [⊣] or [⊢] in I

b. V́ ↑ [⊣] Assign ∗ to every [⊣] which is not dominated by a main-stressed V in I

6.2.1 Data

Harmony: [⊢⊣] vowel harmony in Päri is root-dominant, i.e. the affix adjusts slavishly to the root in its ATR values. The only exception is affixal [a] which resists [⊢⊣] harmony (conversely the [⊣] low vowel [ʌ] which is attested in roots both, as underlying vowel and as the result of [⊣] mutation on the basis of [a] doesn't occur in affixes at all). This is illustrated in (2) for suffixes, and in (3) for prefixes:

(2) **Päri [⊢⊣] Harmony in Possessive Suffixes** (Andersen 1989:10)

	[⊢]	[⊣]
	'bird'	'meat'
2SG	wɪ̀ɲɟ-í	rìŋg-í
3SG	wɪ̀ɲɟ-ɛ̀	rìŋg-è
1SG	wɪ̀ɲɟ-á	rìŋg-á
1PI	wɪ̀ɲɟ-ɔ̌	rìŋg-ǒ
2PL	wɪ̀ɲɟ-ʊ́	rìŋg-ú

(3) **Päri [⊢⊣] Harmony in Agreement Prefixes** (Andersen 1989:11)

	[⊢]	[⊣]
	'return'	'beat' (AP)
2SG	ɪ́-dɔ̀ːk	í-pòːd-ô
1SG	á-dɔ̀ːk	á-pòːd-ô
2PL	ʊ́-dɔ̀ːk	ú-pòːd-ô

We will see evidence in chapter 7 that the 2SG suffix is Word Level, whereas the other agreement suffixes are Stem-Level. Thus [⊢⊣]-harmony applies obviously at both strata. Note also that none of the (agreement) prefixes triggers any mutation effects for vocalic or consonantal features, hence I take the position that all prefixes in Päri are Word-Level affixes.

Mutation: Several verbal derivational categories in Päri are marked among other changes by turning the stem vowel into its [⊣] counterpart (the same process is also found in Dinka and Anywa). This is shown in (4) for the BEN.

(4) **[⊣]-Mutation in the Päri BEN** (Andersen 1988:92)

	Underived	BEN	
a.	á-jàp	á-jʌ́p-ì	'open'
b.	á-kʌ̀t	á-kʌ́t-ì	'plait'
c.	á-gɛ̀ːr	á-géːjː-ì	'build'
d.	á-jɪ́k	á-jík-ì	'make'
e.	á-lʊ̀ːp	á-lúpː-ì	'speak'

That the morphologically induced [⊣] also extends via [⊢⊣]-harmony to suffixes is obvious from the inflected BEN forms in (5):

(5) **[⊣]-Mutation in Inflected BEN Forms** ('to cook') (Andersen 1988:95)

	Underived	BEN
1SG	á-t̪áːl-á	á-t̪ʌ́nd̪-á
2SG	á-t̪áːl-ì	á-t̪ʌ́nd̪-ì
3SG	á-t̪áːl-ɛ́	á-t̪ʌ́nd̪-é
1PE	á-t̪áːnd̪-á	á-t̪ʌ́nd̪-ù-wà
1PI	á-t̪áːl-ɔ́	á-t̪ʌ́nd̪-ò
2PL	á-t̪áːnd̪-ʊ́	á-t̪ʌ́nd̪-ù
3PL	á-t̪áːnd̪-ɛ́	á-t̪ʌ́nd̪-ì-gì

The verbal morphological categories which trigger [⊢⊣]-mutation (BEN, CP, and AP) are all derivational, and according to their behavior in consonant mutation (cf, again chapter 7), Stem-Level. Therefore I will assume that the process is restricted to this stratum.

Mutation-Harmony Divergence: Crucially, Päri doesn't have corresponding mutation processes which work in the opposite direction, i.e., which systematically change underlying [⊣] Vs into their [⊢] counterparts and leaving underlying [⊢] Vs intact. This leaves us with an apparent paradox for a phonological account of mutation: [⊢⊣] is governed by root-dominance for segmental affixes, but by [⊣]-dominance in mutation – hence non-segmental affixation. There is one further source of mutation-harmony divergence: Underlying short [ɔ] changes to [u], not to its [⊣]-counterpart [o], as shown in (6) to (8):[1]

(6) **[ɔ] ⇒ [u] in Inchoative [⊣]-Mutation** (Andersen 1989:12)

	Underived		INC	
a. [ɪ]	ŋìc	[i]	ŋìɲɲ-ò	'be cold'
b. [a]	tàr	[ʌ]	tʌ̀rr-ò	'be white'
c. [ɔ]	cɔ̀l	[u]	cùll-ò	'be black'

(7) **[ɔ] ⇒ [u] in Centripetal [⊣]-Mutation** (Andersen 1989:12)

	Underived 3SG		CP 3SG	
a. [ɪ]	á-lìm-ɛ́	[i]	á-lìm-é	'collect'
b. [a]	á-jàb-ɛ́	[ʌ]	á-jʌ̀b-é	'open'
c. [ɔ]	á-ŋɔ̀d-ɛ́	[u]	á-ŋùd-é	'cut'

(8) **[ɔ] ⇒ [u] in Frequentative-Antipassive [⊣]-Mutation** (Andersen 1989:12)

	Underived 3SG		CP 3SG	
a. [ɪ]	á-ɲìb-ɛ́	[i]	ɲìb-ò	'light'
b. [a]	á-càm-ɛ́	[ʌ]	cʌ̀m-ò	'eat'
c. [ɔ]	á-kɔ̀ŋ-ɛ́	[u]	kùŋ-ò	'help'

Compare this to the behavior of affixes in vowel harmony where *-o* and -ɔ alternate as expected (as the 1PI suffix *-O* in á-t̪áːl-ɔ́ á and á-t̪ʌ́nd̪-ò cf. (5)). It is also instructive that [o] may occur in derived verb forms although only as an optional variant when it is the result of vowel shortening, not of [⊣]-mutation, such as in the FQ form in (9-b):

(9) **Optional Short Stem [o] derived by FQ-Shortening** (Andersen 1989:15)

	Underived 3SG		FQ 3SG	
a. [oː]	á-gòːl-é	[oː]	á-gòːnd-é	'scratch'
b. [oː]	á-d̪òːŋ-é	[o]	á-d̪òŋg-é	'push'

Thus, [⊣]-mutation seems to have an idiosyncratic component not found in other phonological and morphophonological processes of the language in that it not just involves raising all [⊢] vowels to [⊣] ones, but also short mid vowels to high ones,[2] a case of Divergence which seems difficult to reconcile with a purely phonological analysis.

[1] Short [o] does not occur in underived verb forms in Päri. It is found in some nouns (e.g. *gól*), 'mane', (Andersen 1989:5), but for nouns in Western Nilotic it is notoriously hard to say whether singulars or plural are the basic forms. Hence it is plausible that Päri blocks [o] completely at the Root Level. See Andersen (1989:5) for more discussion.

[2] Short [ɛ] has a distribution which is similarly defective to the one of [o] – no underived verb root exhibits this vowel, so there is no evidence whether [⊣]-mutation of [ɛ] results in [e] or [i]. See Andersen (1989:5) for more discussion.

6.2.2 Analysis: The Distribution of [⊢⊣] at the Root Level

The analysis of vowel harmony I develop here is founded on the classical idea of feature filling (Booij 1984, Rice and Avery 1989, Steriade 1995): Vowels of segmental affixes (apart from those containing [a]) are underspecified for [⊢⊣] and therefore take over the [⊢⊣]-values of fully specified root vowels. Further asymmetries follow from the fact that vowels of lexical roots bear main stress (are the heads of PWords) whereas affix vowels do not project prosodic structure and are hence unstressed.

In contrast to the cited literature, I assume that these asymmetries in the specification of lexical roots and affixes are neither arbitrarily stipulated nor do they follow from universal (but inviolable) principles. Instead, they are derived the the Root-Level stratum of phonological evaluation, which has full access to the distinction between lexical roots and affixes.

In particular, I assume the Root-Level ranking in (10): (recall from section 2.3.5 that I use the DAN symbol ⊚ as designator for the constraint which penalizes candidates without a designated ancestor node):

(10) $\{\text{R}\textsc{t} \approx \text{PW}, \text{A}\textsc{ff} < \text{F}\textsc{t}, \circledcirc, \begin{matrix}\check{\text{A}}\\ \Downarrow\\ \text{a}\end{matrix}\} \gg \begin{matrix}\acute{\text{V}}\\ \Updownarrow\\ [⊢⊣]\end{matrix} \gg \text{F}\textsc{aith}^{⊢⊣}_{\updownarrow\bullet}$

Undominated Rt ≈ PW and Aff < ensure that lexical roots project PWords whereas affixes maximally build up syllables. As a result, root vowels have main stress, and affix vowels not. Since the effect of these constraints is constant, I will omit them in the following tableaux and tacitly presuppose the correct (non-)assignment of stress to vowels. I will further assume tacitly that Max • and Dep are ranked above all the constraints discussed here, barring any repair operations by deleting or inserting segmental material. (11) shows the crucial constraints linking stress (hence indirectly the lexical root/affix status of a vowel) to [⊢⊣]-specification. (11-a) ensures at the Root (and subsequent levels) that low unstressed/affix vowels are [⊢], (11-b) requires that stressed (lexical root) Vs have full specification for [⊢⊣], and (11-c) effectively bars segmental affixes with a [⊢⊣]-specification (which is overwritten by (11-b)):

(11) **Constraints Linking Stress and [⊢⊣]**

a. $\begin{matrix}\check{\text{A}}\\ \Downarrow\\ \text{a}\end{matrix}$ Assign ∗ to every unstressed low vowel which does not dominate [⊢] in P

b. $\begin{matrix}\acute{\text{V}}\\ \Downarrow\\ [⊢⊣]\end{matrix}$ Assign ∗ to every main-stressed V which does not dominate a [⊢⊣] node in P

c. $\begin{matrix}\acute{\text{V}}\\ \Uparrow\\ [⊢⊣]\end{matrix}$ Assign ∗ to every [⊢⊣] node which is not dominated by a main-stressed V in P

The tableaux in (12) to (14) show how [⊢⊣] is assigned to the vowels of lexical roots (The capital vowels [I] and [A] stand for high front/low front vowels which are unspecified for [⊢⊣]). If the vowel is underlyingly associated to a [⊢⊣]-feature this association is maintained in the output (12-a,b). Note especially that underlying [ʌ] is preserved because Ǎ ⇒ a only applies to unstressed Vs, and all vowels in lexical roots are stressed. If a lexical vowel is underlyingly not associated to [⊣] or [⊢] as in (14), it is associated to one of these features in the output due to V́ ⇒ [⊢⊣]. Whether the output of (14) is [⊣] or [⊢] is empirically indecidable, but I assume that the low-ranked markedness constraints *[⊢] ≫ *[⊣] ranked in this order fix that such roots become uniformly [⊢⊣].

(12) **Lexical Root with [⊢] Input V**

Input: [ɪ]

	◎	Ă ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
a. [Í]			*!	*
☞ b. [ɪ́]				
c. [í]				*

(13) **Lexical Root with [⊣] Input V**

Input: [ʌ]

	◎	Ă ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
a. [Á]			*!	*
b. [á]				*!
☞ c. [ʌ́]				

(14) **Lexical Root with Underspecified Input V**

Input: [I]

	◎	Ă ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
a. [Í]			*!	
☞ b. [ɪ́]				*
☞ c. [í]				*

(15) shows the assignment of [⊢⊣] to a non-low affix vowel. Even though the input is specified for [⊢⊣], the output becomes underspecified due to [⊢⊣] ⇒ V́:

(15) **Non-Low Segmental Affix**

Input: [i]

	◎	Ă ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
☞ a. [I]				*
b. [ɪ]			*!	*
c. [i]			*!	

On the other hand, all affixal low vowels become [⊢] independently of their input specifications for [⊢⊣]:

(16) **Low Segmental Affix**

Input: [ʌ]

	◎	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
a. [A]		*!		*
☞ b. [a]			*	*
c. [ʌ]		*!	*	

Affixes consisting only of floating [⊢⊣]-features such as [⊣], also violate [⊢⊣] ⇒ V́, and we would expect them to be deleted just as the [⊢⊣]-features in (15). However, assuming that segmental epenthesis is blocked, the only possibility to not realize a single feature in P is to produce a candidate without a ◎ (17-b), assigning the floating feature ◎-status as in (17-a) automatically means that it is phonetically realized (because it is reflexively dominated by the ◎). Thus undominated ◎ has the effect that single floating-feature affixes survive the ranking which deprives affixes with segmental content of all [⊢⊣]-features:

(17) **Floating [⊣]**

Input: [⊣]

	◎	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	FAITH⊢⊣↕•
☞ a. $[⊣]_{◎}$			*	
b. [⊣]	*!			

6.2.3 Analysis: Harmony and Mutation at the Stem Level

The Stem-Level ranking is similar to the one at the Root-Level. However, ⊚ is ranked ineffectively low, which has the effect that the Stem Level does not countenance floating features as Word-Level affixes, and will not be even included in the following tableaux, whereas the three additional constraints in (18) become crucial:[3] (18-a) triggers [⊢⊣]-harmony, (18-b) [⊣]-mutation, and (18-c) fixes that (modulo the mutation effect) vowels of lexical roots basically maintain the [⊢⊣]-value established at the Root Level:

(18) **Stem-Level Constraints on V-[⊢⊣] association**

a. V ↓ [⊢⊣] Assign ∗ to every V which does not dominate a [⊢⊣] node in I

b. V́ ↑ [⊣] Assign ∗ to every [⊣] node which is not dominated by a stressed vowel in I

c. MAX V́↓⊢⊣ (MAX V↓[⊢⊣] restricted to vowels which are stressed in P)

(19) shows a simple case of stem-suffix harmony: The underspecified affix vowel violates V → [⊢⊣] (19-c), epenthesis of a new [⊢⊣]-node is blocked by DEP [⊢⊣] (19-c), hence spreading obtains, which does not violate any of the other relevant constraints (19-c):

(19) **Simple [⊢⊣]-Harmony with Non-Low Affix**

Input: kʌt I (with [⊣] linked to kʌt)

	V́ ↑ [⊣]	MAX V́↓⊢⊣	Ă ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
☞ a. kʌt i ([⊣] linked to kʌt, spread to i)						
b. kʌt ɪ ([⊣] linked to kʌt; new [⊢] linked to ɪ)						*!
c. kʌt I ([⊣] linked to kʌt)					*!	

[3] Note that (18)-b could be included in the Root-Level ranking at the same ranking position, but would not lead to different outputs.

In the case of affix [a], V → [⊢⊣] is irrelevant because all input vowels are already specified for [⊢⊣]. However, the [⊢] of [a] violates [⊢⊣] ⇒ V́ because it is not linked to a stressed V. Ǎ ⇒ a ensures that it is not delinked in favor of the [⊣] of the stem vowel (20-a):

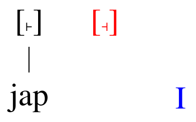
(20) **Simple [⊢⊣] Non-Harmony with Affix [a]**

```
        [⊣]   [⊢]
         |     |
Input:  kʌt    a
```

	V́ ↑ [⊣]	Max V́↓⊢⊣	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	Dep [⊢⊣]
[⊣] [⊢] | ╲ ǂ a. kʌt ʌ			*!			
[⊣] [⊢] ǂ ╱ | b. ka t a		*!				
[⊣] [⊢] | | ☞ c. kʌt a				*		

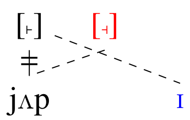
Let us turn to mutation. An interesting property of Päri morphology is that all verb forms which have undergone derivation also carry exactly one suffix, either the final derivational element (FDE) or one of the inflectional suffixes (see chapter 7 for more discussion). Therefore I will discuss combined cases of mutation and vowel harmony. (21) shows the case of a suffix with a non-low vowel. The floating [⊣] associates to the stem V (in violation of Max$^{\acute{V}}_{\downarrow[\vdash\dashv]}$) to satisfy [⊣] → V́ (cf. (21-c,d,e)), and to the suffix V due to V → [⊢⊣] (cf. (21-b)), resulting in double association (21-a):

(21) **[⊣]-Mutation and Harmony at the Stem-Level: Non-low Affix**

Input: 

	V́ ↑ [⊣]	Max$^{\acute{V}}_{\downarrow[\vdash\dashv]}$	Ă ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	Dep [⊢⊣]
☞ a. jʌp i		*				
b. jʌp ɪ		*			*!	
c. jap ɪ	*!					
d. jap i	*!			*		
e. jap ɪ	*!				*	

A candidate which would avoids violation of Max$^{\acute{V}}_{\downarrow[\vdash\dashv]}$ by line crossing is (22). I assume that this is excluded by ∗×$^{[\vdash\dashv]}_{\bullet}$, ranked above all the constraints in (21).

(22) 

With suffixal [a], the floating [⊣] associates to the stem V due to undominated [⊣] → V́, but not to the suffix V (23-b) since this is blocked by Ă ⇒ a (cf. (23-a)):

(23) **[⊣]-Mutation and Harmony at the Stem Level: Affix [a]**

Input: jap [⊢] (associated), [⊣] (floating), a [⊢] (associated)

	V́ ↑ [⊣]	MAX$^{\acute{V}}_{[\vdash\dashv]}$↓	Ă ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
a. jʌp ʌ — [⊢] ǂ jʌp, [⊣] → stem; [⊢] ǂ ʌ, [⊣] → suffix			*!			
☞ b. jʌp a — [⊢] ǂ jʌp, [⊣] → stem; [⊢] | a				*		
c. jap ʌ — [⊢] | jap; [⊢] ǂ ʌ, [⊣] → suffix	*!					
d. jap a — [⊢] | jap; [⊣] floating; [⊢] | a	*!				*	

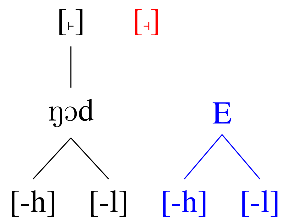
Up to this point, the analysis still (incorrectly) predicts that stem [ɔ] should mutate to [o], not to [u] (cf. (6)). This can be fixed by the undominated constraint in (24) which penalizes stressed short mid vowels which are associated to [⊣] and [⊢] at the same time:

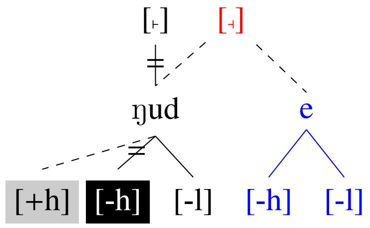
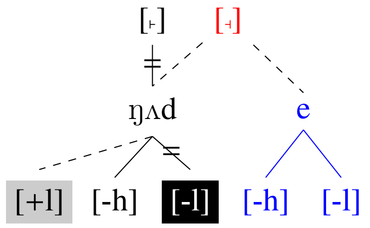
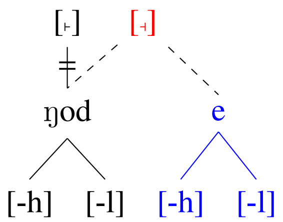
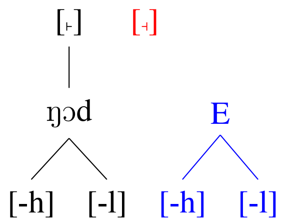
(24) $^{*}_{\vdash}$É$_{\dashv}$ Assign ∗ to every stressed short V which is associated to [–h],[–l], [⊣], and [⊢] in I

(24) correctly blocks (25-c) where the stem vowel dominates [⊢] underlyingly (in M) and [⊢⊣] on the surface (in P). MAX$^{\bullet}_{[l]}$↓ blocks the option to repair the violation of $^{*}_{\vdash}$É$_{\dashv}$ by changing [ɛ] into low [ʌ]. Independent motivation for the undominated status of the latter constraint comes from the fact that underlying affixal [a] does not change into a non-low vowel in the context of [⊣]-mutation. Thus (23-a) would avoid violations of Ă ⇒ a and [⊢⊣] ⇒ V́ at the same time, and outrank the winning candidate (23-b) if the suffix [a] was allowed to change into [o] or [e] (which are licit if unstressed). This escape hatch is blocked by MAX$^{\bullet}_{[l]}$↓.

(25) **[⊣]-Mutation of Underlying [ɔ]** (ŋɔ*d*-ɛ ⇒ ŋ*ud*-*e*)

Input:



	⁎É	Max• [l]	V́ ↑ [⊣]	Max V́ [⊢⊣]	Ă ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	Dep [⊢⊣]
☞ a. 				*				
b. 		*!					*	
c. 	*!						*	
d. 			*!				*	

Note that ⁎É will not block short [ó] in underived environments, nor have any effects in cases where short [ó] is derived by shortening of long [óː]. Especially instructive in this context is BEN-formation which uses both vowel shortening and vowel mutation to [⊣] as shown in (26-a,b). Whereas short [ɔ] becomes high [u] (26-c), long [oː] does not, but just shortens (26-d):

(26) **[⊣]-Mutation and V-Shortening in the BEN** (Andersen 1988:92)

Underived	**BEN**	
a. a-rɪːθ	a-riːθ-i	'sew'
b. a-baːc	a-bʌc-i	'throw'
c. a-ŋɔl	a-ŋund-i	'cut (with knife)'
d. a-goːr	a-gojj-i	'write'

This is predicted by the analysis based on $^{*}_{\vdash}\acute{E}_{\dashv}$ because [o] according to this constraint is perfectly well-formed if it is not underlyingly linked to [⊢]. Moreover (26-d) shows that raising to [ʊ] in the BEN is not triggered by a floating [+high] feature since this assumption would independently predict that underlying [oː] should raise to [u].

Let us now consider the fictitious case of a floating [⊢] affix, which the Root Level could generate along with floating [⊣] affixes due to high-ranked ◎ (to be sure, Päri doesn't have any such mutation processes). A floating exponent of this type would simply remain ineffective under the constraint ranking developed here: The floating [⊢] could not associate to the stem V since this would lead to fatal violation of $\text{Max}^{\acute{V}}_{\downarrow\,\vdash\dashv}$ (27-a,b), but also not to the affix vowel since this would result in a [⊣]-node in P which is not dominated by a stressed V, incurring a violation of [⊢⊣] ⇒ V́ (27-d), whereas leaving the affix [⊢] afloat as in (27-c,e) avoids this complication since [⊢] in this way is not included in P-Structure. Thus the optimal candidate spreads simply the [⊣]-node of the stem to the suffix, just what would happen in the absence of floating [⊢]. Crucially, the Stem-Level ranking derives the impossibility of [⊢]-mutation.

(27) **Potential [⊢]-Mutation and Harmony at the Stem-Level: Non-low Affix**

Input: jʌp (linked to [⊣]) I, floating [⊢]

	V́ ↑ [⊣]	$\text{Max}^{\acute{V}}_{\downarrow\,\vdash\dashv}$	Ă ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	Dep [⊢⊣]
a. jap i ([⊣] delinked, [⊢] linked to stem and affix)		*!				
b. jap I ([⊣] delinked, [⊢] linked to stem)		*!			*	
☞ c. jʌp ɪ ([⊣] spread to affix, [⊢] floating)						
d. jʌp ɪ ([⊢] linked to affix)				*!		
e. jʌp I ([⊢] floating)					*!	

For the sake of completeness, the tableaux from (28) to (31) illustrate the fate of morphologically simplex objects at the Stem Level: Non-complex stems simply maintain their [⊢⊣]-values due to $\text{Max}^{\acute{V}}_{\downarrow\,\vdash\dashv}$ (28), (Word Level) affixes result again as underspecified for [⊢⊣] if they have a non-low (29), and as [⊢] if they have a low vowel (30). What is interestingly different is the outcome for a floating [⊢⊣] exponent, which remains unparsed since ◎ is ranked too low to save it (31):

(28) **Simplex Stem**

Input: [í]

	V́ ↑ [⊣]	MAX$^{\acute{V}}_{\vdash\dashv}$ ↓	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
a. [Í]		*!		*		
☞ b. [ɪ́]						
c. [í]		*!				

(29) **Non-Low Segmental Affix**

Input: [i]

	V́ ↑ [⊣]	MAX$^{\acute{V}}_{\vdash\dashv}$ ↓	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
☞ a. [I]					*	
b. [ɪ]				*!		
c. [i]				*!		

(30) **Low Segmental Affix**

Input: [ʌ]

	V́ ↑ [⊣]	MAX$^{\acute{V}}_{\vdash\dashv}$ ↓	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
a. [A]			*!		*	
☞ b. [a]				*		
c. [ʌ]			*!	*		

(31) **Floating [⊣]**

Input: [⊣]

	V́ ↑ [⊣]	MAX$^{\acute{V}}_{\vdash\dashv}$ ↓	Ǎ ⇓ a	V́ ⇕ [⊢⊣]	V ↓ [⊢⊣]	DEP [⊢⊣]
a. [⊣]◎				*!	*	
☞ b. [⊣]					*	

6.2.4 Analysis: Harmony and Mutation at the Word Level

The Word-Level ranking of constraints governing vowel quality in Päri is completely identical to the Stem-Level ranking. The crucial difference between both strata lies in the effect of the Stem-Level stratum: As we have seen in section 6.2.3, Word-Level exponents consisting of floating features are deleted ('ineffable') at the Stem Level, and therefore never arrive at the Word Level. Consequently, the only alternation observed in the Word-Level morphology is [⊢⊣]-harmony. Since segmental affixes and stems at the Word-Level show exactly the same asymmetries in [⊢⊣]-specification as their Stem-Level counterparts (all non-low affix vowels are underspecified, and all other vowels are obligatory specified), harmony behaves completely parallel.

6.3 Thok Reel: Chain-Shifting Vowel Lowering

Thok Reel exhibits a morphologically induced lowering of stem vowels which is clearly chain-shifting. Thus, as exemplified in (32) with underlying [e] and [ɛ], breathy tenses mid vowels become creaky tense mid, tense creaky mid vowels become lax creaky mid, and lax creaky mid vowels become creaky low (see below for evidence that the change from breathy to creaky involves phonetic lowering):

(32) **Chain-shifting Vowel Mutation in Thok Reel** (Reid 2010:75)

e̤		
↓		
ḛ	ḛ	
	↓	
	ɛ̰	ɛ̰
		↓
		a̰

Chain-shifting mutation presents an immediate challenge to a concatenativist approach to mutation morphology since the phonological changes involved are systematic but still inconsistent. Here, I will propose in a line with Trommer (2009a) that the Thok Reel pattern follows from affixation of an abstract sonority grid mark .[4]

6.3.1 Theoretical Background

Following de Lacy (2002a), I will assume in the following that relative sonority is not just an abstract property of linguistic description, but an integral part of segmental feature structures. Thus just as segments may be associated to the feature [voice] which may have different values, they are associated to a feature node Sonority. The formally unusual property of Sonority under this account is that its values are not binary but grids formally isomorphous to the representations used in the grid-based approach to metrical stress theory developed by Liberman (1975), Liberman and Prince (1977). Thus the sonority differences between the major classes of consonants are represented as in (33-b), where “o” stands for an empty grid position, and “x” (the ‘grid mark’) for a position associated with a grid mark. Multiple grid marks will in the following be abbreviated by exponents to grid mark symbols as in (33-b):

(33) **Sonority of Consonants**

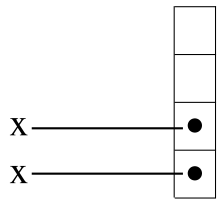
	a. **Representation**	b. **Abbreviation**
(i) **Voiceless Obstruents & Laryngeals:**	son:oooo	son:
(ii) **Voiced Obstruents:**	son:xooo	son:x^1
(iii) **Sonorants:**	son:xxoo	son:x^2

At a slightly more formal level, I understand a grid as an array whose positions may in turn be associated with sonority grid marks as shown in (34).

[4]A similar pattern of chain-shifting vowel lowering is found in Dinka (Andersen 1993). Thok Reel AP verbs shows a chain-shifting pattern which is partially different from the one found in underived transitive verbs, exhibiting slightly different outputs, pervasive optionality, and apparent sensitivity to paradigmatically related transitive forms (Reid 2010:79-89). Thus a proper understanding of this pattern seems to depend on a better understanding of the verbal morphology of Thok Reel than the currently available data allow.

(34) **Internal Structure of Multiple-Valued Features** (33-iii)

xxoo =



6.3.2 Data

In Thok Reel, verbs exhibit the underlying quality of their stems vowels only in 2SG and 3SG forms. In all other forms, non-low root vowels are lowered to some degree partially also involving diphthongization. (35) shows the corresponding root vowels and (36) a representative verb paradigm according to Reid (2010):

(35) **Chain-shifting Vowel Mutation in Thok Reel Transitive Verbs** (Reid 2010:75)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
2SG/3SG	i̤	e	e̤	ɛ	ɛ̤	a	a̤	ɔ	ɔ̤	o	o̤	u	ṳ
elsewhere	jɛ̤	ɛ	e	a	a̤	a	a̤	a	a̤	a/ɔ	o	wɔ	w̤ɔ

(36) **Chain-shifting in a Verb with Underlying** ɛ̤ ('distribute') (Reid 2010:33)

1SG è-dá̤ːw
2SG è-dɛ̤̀ːw-ɪ̤́
3SG è-dɛ̤̀ːw-ɪ̤́
1PI è-dá̤ːw-kɔ̤̀n
1PE è-dá̤ːw-kɔ̤̀
2PL è-dá̤ːw-è̤j
3PL kɛ̀ː-dá̤ːw-è̤

The data in (35) and (36) reveal two crucial points: *First,* a lowering analysis of these data is superior to a raising account (where 2/3SG vowels would be derived from an underlying stem vowel surfacing in the other forms of the person/number paradigm) since it allows to predict alternating vowels. Thus positing an underlying [a̤] surfacing in the plural and 1SG forms of a stem would not allow to predict whether the verb exhibits [a̤], [ɛ̤] or [ɔ̤] in the 2SG/3SG (classes 5 and 8 and 10 of (35)), whereas 2SG/3SG [a̤], [ɛ̤], and [ɔ̤] uniformly and deterministically turn up as [a̤] in the rest of the paradigm. See Reid (2010:75) for a more detailed discussion of this point. *Second,* the alternation is obviously not triggered by overt phonological material since the 1SG which shows lowering is without suffix just as the 3SG which doesn't.

There is one further complication in the data: The mutated form of underlying o̰ depends on the phonological context. As shown by the examples in (37), it lowers to [ɔ̰] after [w], and to [a] in all other contexts:

(37) **Context-dependent Chain-Shifting of [o̰]** (Reid 2010:77) o → ɔ/w__ ; o → a/elsewhere

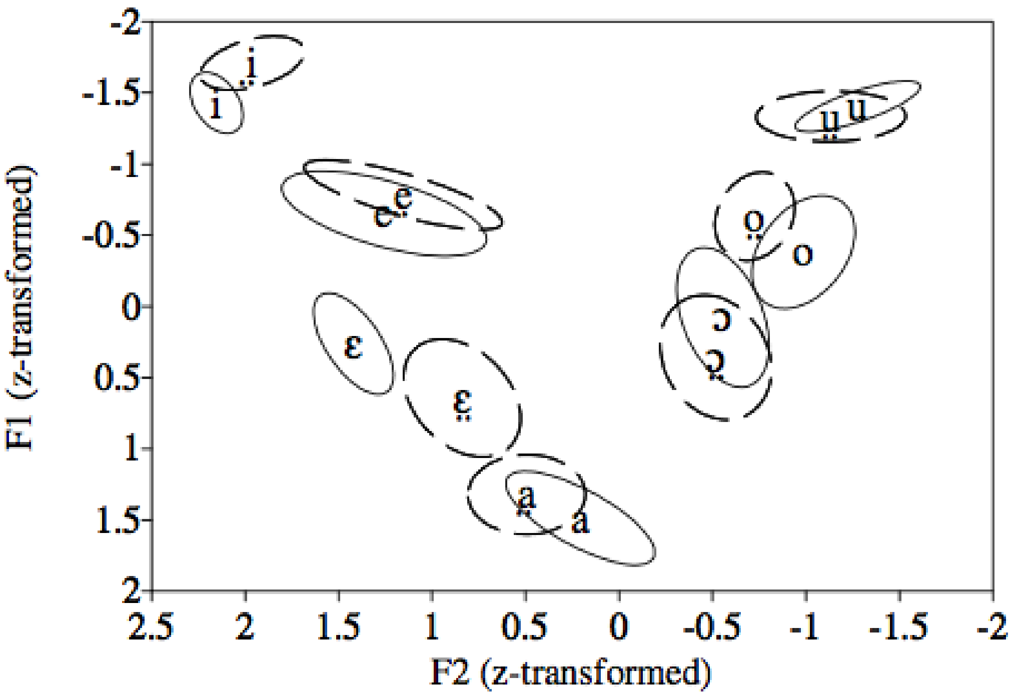
(38) **Context-dependent Chain-Shifting of [o̰]** (Reid 2010:77)

	'bury'	'take (somewhere)'
3SG	kwóɲ	nóːŋ
1PL	kwɔ́ɲ-kɔ̀(n)	náŋ-kɔ̀(n)

6.3.3 The Representation of Thok Reel Vowels

Thok Reel has the vowels /i,u,e,o,ɛ,ɔ,a/, both in breathy and creaky variants. (39) shows relevant formant measurements:

(39) **Thok Reel Vowels** (Reid 2010:64)



I will assume that this translates into the phonological feature system in (40), where [i]/[u] are [High], [e]/[o] are not specified for aperture, and [ɛ,a,ɔ] are all [Low], all further distinctions resulting from the place features [Coronal]/[Dorsal] and glottal features:

(40) **Feature Representation of the Thok Reel vowel inventory**

	[spread glottis]			**[constricted glottis]**		
	[Coronal]		**[Labial]**	**[Coronal]**		**[Labial]**
[High]	i̤		ṳ	ḭ		ṵ
	e̤		o̤	ḛ		o̰
[Low]	ɛ̤	a̤	ɔ̤	ɛ̰	a̰	ɔ̰

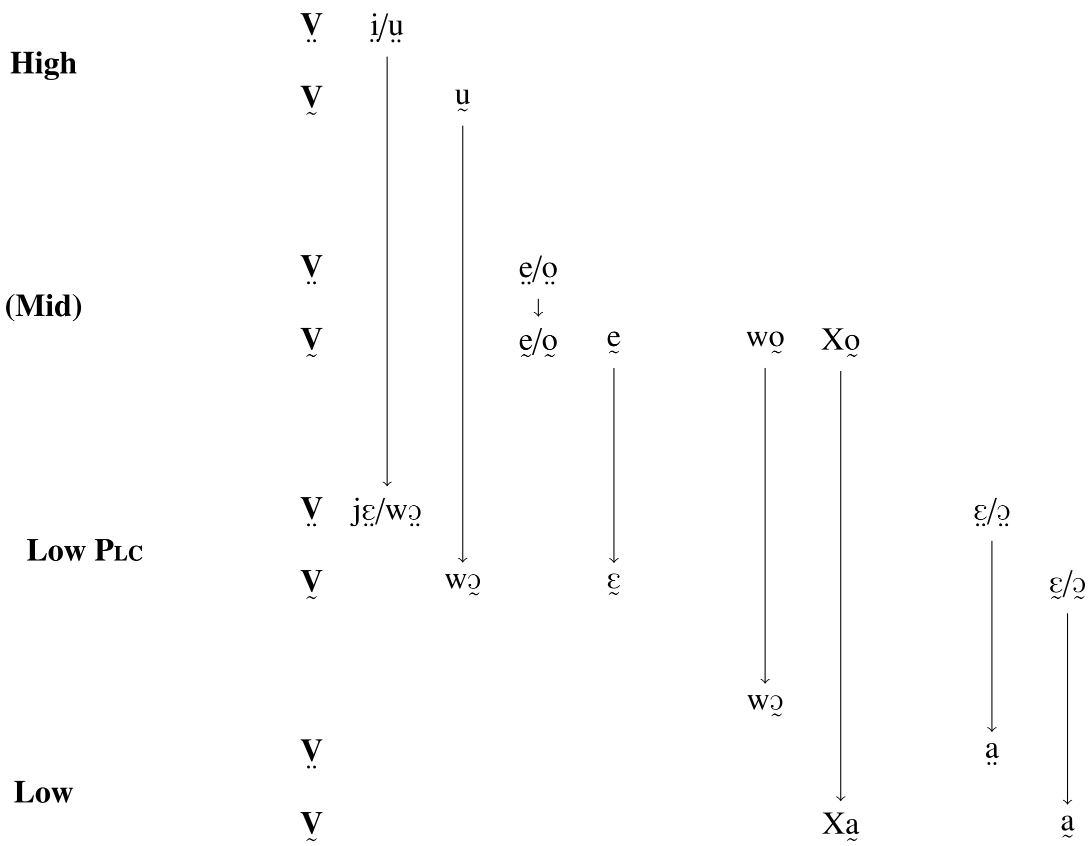
I adopt the standard position that the sonority of vowels is inversely correlated with tongue height and directly correlates with the first formant (F1). Since creaky vowels have systematically lower F_1 than their breathy counterparts (cf. (39)), I interpret the vowels as ordered on the continuous sonority scale in (41).

(41) **Sonority of Thok Reel Vowels**

x^1:	i̤,ṳ
x^2:	ḭ,ṵ
x^3:	e̤,o̤
x^4:	ḛ,o̰
x^5:	ɛ̤,ɔ̤
x^6:	ɛ̰,ɔ̰
x^7:	a̤
x^8:	a̰

Based on the just established phonological representations, vowel mutation in Thok Reel can be graphically depicted as in (42):[5]

(42) **Chain-shifting Vowel Mutation in Thok Reel**



Thus in all cases, the underlying vowel is replaced by one with higher sonority (more grid marks), but the specific single changes can be neither captured by distinctive features nor by a fixed amount of grid marks. Thus the change from [e̤] to [ḛ] replaces [spread glottis] by [constricted glottis], but has no effect on aperture features. On the contrary the shifting of [ɛ̤] to [a̤] inserts [Low], but leaves the glottal feature specifications of the vowel intact. [ɛ̤] ⇒ [ɛ̰] involves addition of a single grid mark, [ɛ̤] ⇒ [a̤] addition of two, and [o̰] ⇒ [a̰] of four.

[5]In Reid's data there are no verbs with underlying [ḭ] – she speculates that this might be an accidental gap. The analysis proposed in the following predicts that [ḭ] should mutate to [jɛ̰].

6.3.4 Analysis:

I assume that the exponents showing up in the vowel shift (e.g. for 1SG) specify a single sonority grid mark:

(43) $x_{son} \leftrightarrow$ [+1 –pl]

Different degrees of lowering result from suffixation of the element in (43) to the grid mark tier of the root vowel and the sandwiching of phonological wellformedness constraints between basic faithfulness constraints on association and insertion of grid marks (44):

(44) **Basic Ranking:** $x \rightarrow \bullet \gg$ PConstraints $\gg$ DEP x

(45) gives the definitions of the relevant faithfulness/association constraints and of the central markedness constraint $\underset{g}{*}V_g$:

(45) **Central Constraints**

a. $\overset{\bullet}{\underset{x}{\uparrow}}$ Assign ∗ to every x_{son} which is not dominated by a • in I

b. DEP X Assign ∗ to every colorless x_{son} in I

c. $\underset{g}{*}V_g$ Assign ∗ to every peripheral V which dominates more than one glottal feature ([spread glottis] or [constricted glottis]) in I

Following Containment logic, $\underset{g}{*}V_g$ not only penalizes vowels which are phonetically creaky and breathy at the same time, but also breathy vowels which 'become creaky and vice versa. 'Peripheral' refers to vowels specified by [High] or [Low] (See Rice (1993), Hall (2007) for evidence that peripheral vowels might form a natural class to the extension of mid vowels). Thus creaky [ḛ] gets [ɛ̰], not [ɛ̤] which would be the minimal realization of the affix grid mark.

The constraint in (46) captures the diphthongization of high vowels to glide-low vowel sequences ([i] ⇒ [jɛ] and [u] ⇒ wɔ). • ⇐ [+h] ensures that the [High] feature node which is deassociated from the stem vowel to raise its sonority under grid mark affixation. shows up as a glide on an epenthetic root node preceding the vowel.

(46) **Constraint Triggering Diphthongization**

$\overset{\bullet}{\underset{[+h]}{\Uparrow}}$ Assign ∗ to every [+/–high] node which is not dominated by at least 1 root node in P

The two additional constraints of the Comparative Markedness type in (47) are crucial for restricting possible outputs. $^{*}_{N}$(ɔ̰)$_L$ captures the fact that [o̰] does not lower to [ɔ̰] but to [a̰]) if it is not preceded by [w], a behavior which would be also expected in analogy to the lowering of [ḛ] to [ɛ̰]. The background assumption I will presuppose in the following is that [ɔ̰] in the configuration [wɔ̰] is free to form a LABIAL span with the glide whereas it results in a unary span in all other environments leading to a necessary violation of $^{*}_{N}$(ɔ̰)$_L$. Crucially the constraint is also not violated by the only case where agreement lowering actually produces [ɔ̰], the diphthongization of [ṵ] to [wɔ̰]. However the restriction of ɔ̰ to the context of a preceding [w] obviously holds only for derived forms (cf. *no:*ŋ, 'take:3SG', (Reid 2010:77)). $^{*}_{N}V_{-l}V_{-l}$ bans sequences of glides and vowels where the vowel is not low. Since glides are generally high in

Tok Reel this leads to a violation of the OCP constraint $*V_{-l}V_{-l}$. ${}^{*}_{N}V_{-l}V_{-l}$ is crucial to account for the generalization that the lowering diphthongization of [i] and [u] does not produce glide-mid vowel sequences (*[je]/[wo]) but lowers to low vowels instead ([jɛ]/[wɔ]) which is not excluded by any of the constraints introduced so far. Again there are underived forms which freely violate the constraint (cf. *kwó:ɲ*, 'bury:3SG', (Reid 2010:77)), therefore it must also be of the New Comparative Markedness type.[6]

(47) **Comparative Markedness Constraints on Possible Outputs**

a. ${}^{*}_{N}$(ɔ̰)$_L$	Assign ∗ to every Cɔ̰ which forms a unary LAB span in P, but not in M
b. ${}^{*}_{N}V_{-l}V_{-l}$	Assign ∗ to every $V_{-l}V_{-l}$ sequence in P which is in P, but not in M

(48) shows the derivation for the simplest case of lowering chain-shifting - affixation of a floating sonority grid mark to a breathy mid vowel ([e̤] or [o̤]). Associating the affixal grid mark to the grid of the stem vowel raises the sonority value of the vowel and is necessarily accompanied by making the vowel creaky (i.e. deassociating the vowel from [s.g] and associating it with an epenthetic [c.g]) (48-c). Adding additional epenthetic grid marks (48-a,b,d) is blocked by Dep x:

(48) **Lowering of Breathy Mid Vowels to Creaky** ([e̤] ⇒ [ḛ])

Input: [son:x^3 COR sg] (e̤) + $\mathbf{x_{son}}$

	● ↑ x	${}^{*}_{g}V_g$	● ⇑ [+h]	${}^{*}_{N}V_{-l}V_{-l}$	${}^{*}_{N}$(ɔ̰)$_L$	Dep x
a. [son:x^6 COR Low sg cg] (ɛ̰)		*!				**
b. [son:x^5 COR Low sg] (ɛ̤)						*!
☞ c. [son:x^4 COR sg cg] (ḛ)						
d. [son:x^3 COR sg] (e̤)	*!					

For the creaky mid vowel [ḛ], minimal lowering, i.e., raising its sonority value by 1 would result in the breathy low vowel [ɛ̤] (49-c) which in I-structure violates ${}^{*}_{g}V_g$ because it is associated to tho glottal features. The minimal repair licensed by the constraint ranking is epenthesizing a further x, resulting in creaky [ɛ̰] (49-a):

[6] ${}^{*}_{N}V_{-l}V_{-l}$ is also optionally violated by chain-shifting vowel-lowering in the AP (cf. footnote 4), e.g. *bṳ̀:l*, 'roast/AP:3SG' ⇒ *bwɔ̤̀:l-èj*, 'roast/AP:2PL' vs. *kṳ́::t*, 'blow/AP:3SG' ⇒ *kwó̤::t-èj*, 'blow/AP:2PL' (Reid 2010:80). A potential explanation is that the AP in Thok Reel is Stem-Level (the typical stratum assignment for AP in Western Nilotic, see chapter 7 on consonants for more discussion) whereas the shifting pattern analyzed here and triggered by agreement affixes is Word-Level. As a consequence, the [wo] patterns generated at the Stem Level would count as 'old' (morphological structure) at the Word Level and not violate ${}^{*}_{N}V_{-l}V_{-l}$.

(49) **Lowering of Mid [ḛ] to Low [ɛ̰] ([ḛ] ⇒ [ɛ̰])**

Input: [son:x[4] COR cg] (ḛ) + $\mathbf{x_{son}}$

		● ↑ x	$\overset{*}{_g}V_g$	● ⇑ [+h]	$^*_N V_{-l}V_{-l}$	$^*_N(\text{ɔ̰})_L$	DEP x
☞	a. [son:x[6] COR Low cg] (ɛ̰)						*
	b. [son:x[7] COR Low cg] (a̰)						**!
	c. [son:x[5] COR Low cg sg] (ɛ̤)		*!				
	d. [son:x[4] COR cg] (ḛ)	*!					

Affixation of x to the corresponding back/round vowel [o̰] after [w] is completely parallel. Note that it is crucial here that [ɔ̰] in the output forms a labial span with the preceding [w] because it would otherwise violate $^*_N$(ɔ̰)$_L$:

(50) **Lowering of [o̰] to [ɔ̰] after [w]**

Input: $_{\text{LAB}}$(w [son:x[4] LAB cg]) (wo̰) + $\mathbf{x_{son}}$

		● ↑ x	$\overset{*}{_g}V_g$	● ⇑ [+h]	$^*_N V_{-l}V_{-l}$	$^*_N(\text{ɔ̰})_L$	DEP x
☞	a. $_{\text{LAB}}$(w [son:x[6] LAB Low cg]) (wɔ̰)						*
	b. $_{\text{LAB}}$(w [son:x[7] LAB Low cg]) (wa̰)						**!
	c. $_{\text{LAB}}$(w [son:x[5] LAB Low cg sg]) (wɔ̤)		*!				
	d. $_{\text{LAB}}$(w [son:x[4] LAB cg]) (wo̰)	*!					

[ɔ̰] is blocked as an output for [o̰] after all other segments since by assumption it cannot form a labial span with any other segment (or with a following [w]). Thus output [ɔ̰] incurs a fatal violation of $^*_N$(ɔ̰)$_L$, and further lowering to [a̰] (51-b) becomes optimal since $^*_N$(ɔ̰)$_L$ dominates DEP x:

(51) **Lowering of [o̰] to [a̰] after other Segments**

Input: n [son:x[4] LAB cg] (no̰) + $\mathbf{x_{son}}$

		● ↑ x	$\overset{*}{_g}V_g$	● ⇑ [+h]	$^*_N V_{-l}V_{-l}$	$^*_N(\text{ɔ̰})_L$	DEP x
	a. n [son:x[6] LAB Low cg] (ɔ̰)					*!	*
☞	b. n [son:x[7] LAB Low cg] (a̰)						**
	c. n [son:x[5] LAB Low cg sg] (ɔ̤)		*!				
	d. n [son:x[4] LAB cg] (o̰)	*!					

For underlying high Vs, $\overset{*}{_g}V_g$ can only be satisfied if they become mid or low vowels. (cf. (52-e)). However simple lowering of the vowel would leave the [+h] feature to which it is associated afloat, violating • ⇐ [+h] (52-c). The victorious solution is to add an epenthetic vocalic segment which hosts [+h], and emerges as a prevocalic glide because this is the only phonotactic option the language has for two tautosyllabic [–cons] segments.[7] Crucially, glide

[7]Reid (2010:47-48) claims that glides in Thok Reel are consonants, not vowels, and that the structures derived in (52) are not proper diphthongs. In fact, her arguments show convincingly that glides cannot be moraic vowels.

and vowel must also share LAB to avoid violation of $^{*}_{N}$(ɔ̰)$_L$. Glide insertion has the side effect that lowering the stem vowel itself to a mid vowel (here: [o̤]) is not sufficient (52-c) since the glide-V combination would otherwise violate $^{*}_{N}V_{-l}V_{-l}$. Note also that one of the DEP X violations in (52-a,b) traces back to the epenthetic grid mark of the glide.

(52) **Lowering and Diphthongization of High Vowels** ([ṳ] ⇒ [wɔ̤])

Input: [son:x^1 Lab sg] (ṳ) + $\mathbf{x_{son}}$

		● ↑ x	$^{*}_{g}V_g$	● ⇑ [+h]	$^{*}_{N}V_{-l}V_{-l}$	$^{*}_{N}$(ɔ̰)$_L$	DEP X
☞ a. $_{\text{LAB}}$(w [son:x^5 LAB High Low sg])	(wɔ̤)						****
b. w [son:x^5 LAB High Low sg]	(wɔ̤)					*!	****
c. w [son:x^3 LAB High sg]	(wo̤)				*!		*
d. [son:x^3 LAB High sg]	(o̤)			*!			*
e. [son:x^4 LAB High sg cg]	(o̰)		*!	*			**
f. [son:x^2 LAB High sg cg]	(ṵ)		*!				
g. [son:x^1 LAB High sg]	(ṳ)	*!					

However in the approach to phonological representation adopted here, the standard analysis of glides is that they are [–cons] segments which are not associated to μs, and in fact the interaction of prevocalic glides and following vowels in diphthongization and differential lowering of [o̰] suggests that this account straightforwardly extends to Thok Reel. Interestingly enough, Reid's argumentation seems to show that post-vocalic glides in the language behave more consonant-like than their prevocalic counterparts (no true consonant may follow a post-vocalic glide) which might be connected to the fact that postvocalic [w] cannot form a LABIAL span with [ɔ̰] which would allow to circumvent $^{*}_{N}$(ɔ̰)$_L$ violations.

6.4 Mayak: [ATR]-Harmony and Chain-Shifting Vowel Raising

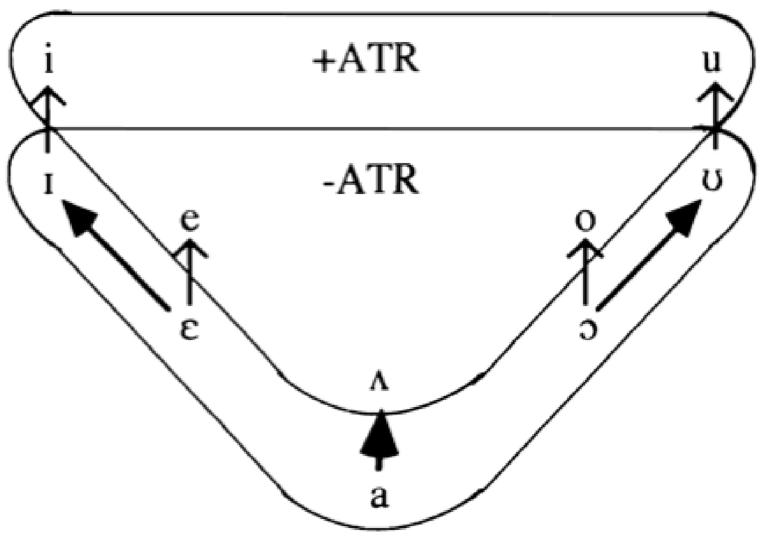
Mayak exhibits a fascinating case of divergence. As shown scrutinously by Andersen (1999b), the language has a completely regular process of [ATR]-harmony where (among other changes), non-low vowels become [+ATR] before high [+ATR] vowels. A straightforward instance for this pattern is the S-oriented past tense (2 in (53)). On the other hand, many affixes trigger slightly different changes in preceding stem vowels (cf. the AP present tense, 3 in (53)): Whereas high vowels also get [+ATR] with these affixes, mid-Vs are raised to [–ATR] vowels, and [–ATR] vowels also get [+ATR].

(53) **Mayak: [ATR]-Harmony and Chain-Shifting Mutation** (Andersen 1999b:16)

	Basic Root Vowel	S-oriented Present	S-oriented Past Tense	AP Present	AP Past	
	[ɪ]	ʔɪt̪	ʔið-u	ʔit̪-ir	ʔit̪-uð-i	'shape'
	[ɛ]	ɗɛc	ɗɛj-u	ɗɪj-ɪr	ɗij-uð-i	'grind'
[⊦]	[a]	ʔam	ʔam-u	ʔʌm-ɪr	ʔʌm-uð-i	'eat'
	[ɔ]	kɔc	koj-u	kʊj-ɪr	kuj-uð-i	'take'
	[ʊ]	gʊt̪	guð-u	gut̪-ɪr	gut̪-uð-i	'untie'
	[i]	tiŋ	tiŋ-u	tiŋ-ir	tiŋ-uð-i	'hear'
[⊣]	[ʌ]	nʌk	nʌɣ-u	nʌk-ɪr	nʌk-uð-i	'beat'
	[u]	t̪uc	t̪uj-u	t̪uc-ir	t̪uc-uð-i	'send'

Andersen calls this second process "Vowel-Quality Alternation" and argues that is purely morphological, whereas vowel harmony is truly a phonological process. (54) shows the differences between the two processes graphically (thin arrows show [ATR]-harmony, thick arrows Vowel-Quality Alternation):

(54) **[ATR]-Harmony and Vowel-Quality Alternation** (Andersen 1999b:17)



What makes a morphological analysis of the Vowel Quality Alternation especially tempting is not only that it involves two distinct changes, raising along the [high] dimension and along

[ATR], but that these two changes are in complementary distribution - vowels which become [+ATR] ([a] → [ʌ]) do not change to [+high], whereas mid vowels which are turned into [+high] vowels refrain from becoming [+ATR] (e.g. [ɛ] → [ɪ] → *[i]). An analysis in terms of vowel ([ATR]) harmony seems to be excluded not only because VQA changes are not strictly predictable ([a] does not always get [ʌ] before high vowels), but also because the affixes triggering VQA do not consistently exhibit [+ATR]. Thus it is hard to claim that the affixal [i] in present AP forms (53) is [+ATR] because it shows up as [–ATR] [ɪ] after underlying mid vowels and Mayak does not have general assimilation of [+ATR] to [–ATR] Vs (see section 6.4.1).

The Vowel Quality Alternation is also not amenable to an analysis in terms of chain-shifting by the affixation of an abstract sonority grid mark, although it is parallel to the Thok Reel case in changing along the dimension of height and is phenomenologically clearly of the chain-shifting type (thus [ɛ] becomes [ɪ], whereas [ɪ] becomes [i]). The problem with a grid-affixation account for Mayak is that it predicts the generalization in (55):

(55) **Unidirectionality of Chain-Shifting:** True chain-shifting mutation of vowels along the sonority dimension is strictly lowering (is monotonously sonority-increasing)

This follows from the approach developed in section 6.3 because affixation of a grid mark always leads to an increase in sonority, and the Concatenativist Hypothesis restricts morphological operations to the addition of phonological material. Hence the Mayak data seem to provide effective counterevidence to the Hypothesis and the framework of Generalized Nonlinear Affixation.

All these apparent problems notwithstanding, I will show here that Mayak vowel alternations are amenable to a purely phonological analysis. In particular, I propose that the major process of vowel harmony is [ATR] harmony at the Word Level as discussed in detail in subsection 6.4.1, whereas VQA is a Stem-Level phenomenon which follows from the conspiracy of three factors: regressive [high]-harmony which changes mid-vowels to [+high] before high vowels, regressive [ATR]-harmony which also extends to the low vowel, and the generalized blocking of [+ATR] mid vowels, which is a much more general pattern in Mayak. This will be taken up in detail in subsection 6.4.2.

6.4.1 Mayak Word-Level Harmony

Mayak shows both regressive and progressive vowel harmony for [ATR]. Before high [+ATR] affix vowels, non-low [–ATR] root vowels get [+ATR]. The low vowel [a] remains unaffected:

(56) **Mayak Regressive [ATR] Harmony** (Andersen 1999b:6)

	Underlying Root Vowel	Present Tense	Past Tense	
	[ɪ]	ʔɪt̪	ʔið-u	'shape'
	[ɛ]	ɗɛc	ɗɛj-u	'grind'
[⊢]	[ɔ]	kɔc	koj-u	'take'
	[ʊ]	gʊt̪	guð-u	'untie'
	[a]	ʔam	ʔam-u	'eat'
	[i]	tiŋ	tiŋ-u	'hear'
[⊣]	[ʌ]	nʌk	nʌɣ-u	'beat'
	[u]	t̪uc	t̪uj-u	'send'

Low suffixal [ʌ] as in the 1SG suffix -*ʌr* doesn't trigger [ATR] harmony (57):

(57) **Mayak Regressive Non-Harmony with [ʌ]** (Andersen 1999b:8)
(Past Tense Forms with Subject Suffixes)

	Underlying Root Vowel	1SG	2SG	3SG	
[⊦]	[ɪ]	d̪ɪːm-b-ʌr	d̪iːm-b-ir	d̪ɪːm-b-ɛr	'weed'
	[ɛ]	tɛːg-ʌr	teːg-ir	tɛːg-ɛr	'spear'
	[ɔ]	pɔːg-ʌr	poːg-ir	pɔːg-ɛr	'wash'
	[ʊ]	ɟʊːɟ-ʌr	ɟuːɟ-ir	ɟʊːɟ-ɛr	'find'
	[a]	caːb-ʌr	caːb-ir	caːb-ɛr	'cook'
[⊣]	[i]	wiːn-ɖ-ʌr	wiːn-ɖ-i r	wiːn-ɖ-ɛr	'cook'
	[ʌ]	ʔʌːb-ʌr	ʔʌːb-ir	ʔʌːb-ɛr	'catch in the air'
	[u]	puːr-d̪-ʌr	puːr-d̪-ir	puːr-d̪-ɛr	'hoe'

After high [+ATR] root vowels, high [–ATR] suffix vowels such as 1SG -ɪ get also [+ATR]. Suffixal mid and low vowels remain in this context unaffected (cf. the 3SG suffix -ɛ) :

(58) **Mayak Progressive [ATR] Harmony on High Vowels** (Andersen 1999b:10)
(Non-possessed and singular possessive forms of nouns)

	Underlying Root Vowel	Non poss.	1SG	2SG	3SG	
[⊦]	[ɪ]	ŋɪn	ŋɪn-ɪ-k	ŋin-u-k	ŋɪn-ɛ-k	'eyes'
	[ɛ]	lɛk	lɛk-ɪ-k	lek-u-k	lɛk-ɛ-k	'teeth'
	[a]	pal	pal-ɪ	pal-u	pal-ɛ	'navel'
	[ɔ]	wɔŋ	wɔŋ-ɪ	woŋ-u	wɔŋ-ɛ	'eye'
	[ʊ]	t̪ʊk	t̪ʊɣ-ɪ	t̪uɣ-u	t̪ʊɣ-ɛ	'outer mouth'
[⊣]	[i]	ʔic	ʔiʄ-i	ʔiʄ-u	ʔiʄ-ɛ	'ear'
	[u]	ʔuŋ	ʔuŋ-i	ʔuŋ-u	ʔuŋ-ɛ	'knee'
	[ʌ]	ʔʌm	ʔʌm-ɪ	ʔʌm-u	ʔʌm-ɛ	'thigh'

There is however one suffix with a low vowel which also undergoes progressive [+ATR] harmony, the singulative affix *-at* (Andersen assumes that this is due to a different process which he calls 'progressive ATR' spreading):

(59) **Mayak: Exceptional Progressive [ATR] Harmony on SG *-at*** (Andersen 1999b:10)

		Singular	**Plural**	
a.	[ɪ]	rɪm-at̪	rɪm	'blood'
b.	[a]	daːl-at̪	daːl	'flower'
c.	[ʊ]	kʊm-at̪	kʊm	'egg'
d.	[i]	ʔin-ʌt̪	ʔin	'intestine'
e.	[ʌ]	ʔʌːw-ʌt̪	ʔʌːp	'bone'
f.	[uu]	ruːj-ʌt̪	ruːc	'worm'

Taken together, Andersen identifies three distinct vowel harmony processes in Mayak: 1. progressive [+ATR]-harmony triggered and undergone by high vowels, 2. regressive [+ATR]-harmony triggered by high vowels and undergone by non-low vowels, and 3. [+ATR]-spreading from peripheral (high or low) vowels to singulative *-at*. In the following, I will develop a unified OT-analysis for all three processes. A crucial observation before we start is that, in the terms of Andersen, Mayak does not have underlying [+ATR] mid vowels. The crucial evidence for this is that [+ATR] mid vowels at the Word Level occur only if they precede a high [+ATR] vowel. For the time being, I assume that Stem- and Root-Level phonology ensure that all morphological elements which enter the Word-Level evaluation have only [–ATR] mid vowel, the concrete implementation of this claim will be taken up in subsection 6.4.2.

The three crucial constraints which capture the dependence of [ATR]-harmony on vowel height are formulated in (60). $*[-h])_{\dashv}$ formalizes the generalization inherent in both Mayak progressive and regressive vowel harmony that the suffixal vowel involved is [+high], and $*(.V^{\textcircled{s}}_{-h}.)_{\dashv}$ captures the fact that in both processes, [+ATR] spreads from a [+h] vowel (a *sponsor* of a span for the feature *F* is the • which is associated morphologically to *F*, cf. Cassimjee and Kisseberth 1998). $[-l] \rightarrow [_{\dashv}]$ restricts the targets of [ATR]-harmony to non-low Vs:

(60) **Constraints on Mayak Vowel Harmony**

a.	$*[-h])_{\dashv}$	Assign ∗ to every non-unary [+ATR] span whose rightmost • is not [+hi] in I
b.	$*(.V^{\textcircled{s}}_{-h}.)_{\dashv}$	Assign ∗ to every non-unary [+ATR] span whose sponsor is not [+hi] in I
c.	$[-l] \downarrow [_{\dashv}]$	Assign ∗ to every [–low] vowel which does not dominate [+ATR] in I

While all three constraints in (60) hold without exceptions in progressive and regressive [ATR]-harmony, they are violated (or irrelevant in the case of (61-c)) for [+ATR]-spreading to singulative *-at*. See below for further discussion.

(61) shows the ranking I assume for the Mayak Word Level, and illustrates regressive [ATR]-harmony of a non-low stem V with a high suffix-V. Dep $[_{\vdash\dashv}]$ and $V \rightarrow [_{\vdash\dashv}]$ are again at the top of the ranking whereas $\text{Max}^{\bullet\downarrow}_{\vdash\dashv}$ is dominated by all other relevant constraints .

Spreading of [+ATR] is driven by the desire of the non-low stem vowel to be specified as $[_{\dashv}]$ – due to $[-l] \rightarrow [_{\dashv}]$ which crucially dominates $\text{Max}^{\bullet\downarrow}_{\vdash\dashv}$. Since both, the rightmost vowel and the sponsor of the resulting $[_{\dashv}]$-span, are [+h], spreading is unproblematic for higher-ranked $*[-h])_{\dashv}$ and $*(.V^{\textcircled{s}}_{-h}.)_{\dashv}$:

(61) **Mayak Regressive [ATR] Harmony with Non-Low Stem Vs**

Input:

```
[⊢]   [⊣]
 |     |
lɛp    u
```

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.$V^{®}_{–h}$.)⊣	[–l] → [⊣]	Max ↓ (⊢⊣)
☞ a. [⊢] [⊣] ǂ / | lep u						*
b. [⊢] [⊣] | | lɛp u					*!	

The low stem vowel [a] vacuously satisfies [–l] → [⊣], hence regressive spreading/harmony is excluded by Max ↓ (⊢⊣):

(62) **Mayak Regressive [ATR] Non-Harmony with Low Stem V ([a])**

Input:

```
[⊢]   [⊣]
 |     |
am     u
```

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.$V^{®}_{–h}$.)⊣	[–l] → [⊣]	Max ↓ (⊢⊣)
a. [⊢] [⊣] ǂ / | ʌm u						*!
☞ b. [⊢] [⊣] | | am u						

Low-vowel suffixes don't spread [+ATR] since the resulting span would violate both, *[–h])⊣ and *(.$V^{®}_{–h}$.)⊣:

(63) **Mayak Regressive [ATR] Non-Harmony with Suffix [ʌ]**

```
         [⊦]   [⊣]
          |     |
Input:   tɛːg   ʌr
```

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.V°–h.)⊣	[–l] → [⊣]	Max
a. [⊦] ǂ [⊣] tɛːg ʌr			*!	*		*
☞ b. [⊦] [⊣] tɛːg ʌr					*	

If both, stem and suffix V, are [+hi], there is also progressive [ATR]-harmony (64). Again spreading is driven by [–l] → [⊣] and the resulting [⊣]-span satisfies both *[–h])⊣ and *(.V°–h.)⊣:

(64) **Mayak Progressive [ATR] Harmony: [+hi] root + [+hi] suffix**

```
         [⊣]   [⊦]
          |     |
Input:   ʔuŋ    ɪ
```

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.V°–h.)⊣	[–l] → [⊣]	Max
☞ a. [⊣] [⊦] ǂ ʔuŋ i						*
b. [⊣] [⊦] ʔuŋ ɪ					*!	

On the other hand, progressive [+ATR]-spreading to a low (or mid-) vowel is excluded because it would result in a violation of *[–h])⊣ which is ranked above Max:

(65) **Mayak Progressive [ATR] Non-Harmony with [–hi] Suffix**

Input: ʔuŋ [⊣] ɛ [⊢]

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.V$^{®}_{–h}$.)⊣	[–l] → [⊣]	Max$^{•}_{⊢⊣}$
a. ʔuŋ [⊣] e (spread, [⊢] delinked)			*!			*
☞ b. ʔuŋ [⊣] ɛ [⊢]					*	

Similarly a low-vowel stem cannot spread [+ATR] to the suffix because this would fatally violate *(.V$^{®}_{–h}$.)⊣ (recall that there are no [+ATR] mid-vowel stems in Mayak which could induce spreading):

(66) **Mayak Progressive [ATR] Non-Harmony with [–hi] Root**

Input: ʌm [⊣] ɪ [⊢]

	Dep [⊢⊣]	V → [⊢⊣]	*[–h])⊣	*(.V$^{®}_{–h}$.)⊣	[–l] → [⊣]	Max$^{•}_{⊢⊣}$
a. ʌm [⊣] i (spread, [⊢] delinked)				*!		*
☞ b. ʌm [⊣] ɪ [⊢]					*	

Let us finally turn to exceptional [+ATR]-spreading to the singulative suffix *-at*. I follow Andersen in ascribing the exceptionality of this affix to the fact that its vowel is underlyingly unspecified for [ATR]. As a consequence, undominated V → [⊢⊣] enforces assignment of a [ATR]-value to it. Since this cannot be provided by epenthesis as in (67-b) which would violate equally undominated Dep [⊢⊣], progressive spreading applies even though this violates *[–h])⊣ and *(.V$^{®}_{–h}$.)⊣ (67-a):

(67) **Mayak: Exceptional Progressive [ATR] Harmony with Singulative *-at***

[⊣]
|
Input: ʔʌːw At

	Dep [⊢⊣]	V ↓ [⊢⊣]	*[–h])$_{⊣}$	*(.V$^{Ⓢ}_{–h}$.)$_{⊣}$	[–l] ↓ [⊣]	Max$^{•}_{⊢⊣}$↓
☞ a. [⊣] linked to ʔʌːw, dashed to ʌt: ʔʌːw ʌt			*	*		
b. [⊣] linked to ʔʌːw, [⊢] dashed to ʌt: ʔʌːw ʌt		*!				
c. [⊣] linked to ʔʌːw: ʔʌːw At	*!					

6.4.2 Mayak Stem-Level Harmony

Whereas Andersen claims that VQA is a "grammatical process", i.e., triggered morphologically by arbitrary affixes, I will show here that it derives from general phonological harmony processes which only differ from the Word-Level phonology described in the last subsection, by constraint ranking. In fact, there are good reasons to analyze VQA as the result of vowel harmony, which becomes obvious if we turn our attention away from the verbal cases of VQA, where the affixes inducing it are by all deleted under hiatus with more peripheral Word-Level affixes, and turn to the nominal domain, where VQA is virtually always accompanied by overt affixes.[8]

Consider first the plural affix *-it* which according to Andersen exhibits VQA (68). Raising of [–ATR] stem vowels to [+ATR] in all of these forms is a straightforward case of regressive [+ATR] spreading. See subsection 6.4.3 below for discussion of vowel shortening in the data in (68). Note also that Andersen doesn't cite any examples of *-it* with mid-vowel stems).

(68) **A [–ATR] Stem-Level Affix: PL *-it*** (Andersen 2000:38)

	SG	PL	
a.	maːc	mʌj-it̪	'fire'
b.	pʌːm	pʌm-it̪	'mountain'
c.	mɪːŋ	miŋ-it̪	'deaf person'
d.	kɪːn	kin-it̪	'mat'

To be sure, the type of [ATR]-harmony triggered by *-it* slightly differs from the one we have diagnosed for Word-Level [ATR]-harmony, but if *-it* is taken to be a Stem-Level affix, the divergence between *-it* and comparable Word-Level affixes such as the past marker *-u* (cf. (56)) can be derived simply from different constraint rankings at Word and Stem Level. Crucially, not only *-it*, but all overt Mayak affixes which trigger VQA are [+ATR] – at least in the contexts

[8] Andersen discusses only three examples in passim where nouns without overt affixes are accompanied by VQA. I assume that these are exceptional (suppletive) cases.

where they actually trigger [ATR]-raising – as can be easily verified by checking through (69), (70) and (71), a fact which is purely accidental if VQA is interpreted as a morphological process, but could not be otherwise if it is due to V-harmony.

Let us now have a look at another nominal number affix for which Andersen gives data instantiating the [–high –low] ⇒ [+high –low] component of VQA, the PL suffix *-uk/-ʊk* (69):

(69) **A [–ATR] + Floating [+ATR] Stem-Level Affix: PL *-uk/-ʊk*** (Andersen 2000:37)

	SG	**PL**	
a.	mɛːk	mɪɣ-ʊk	'spider'
b.	jaːŋ	jʌŋ-uk	'crocodile'
c.	naːc	nʌj-uk	'calf'
d.	gɔːc	gʊj-ʊk	'bowl'
e.	d̪ir	d̪ir-uk	'shield'
f.	mʌːl	mʌl-uk	'leg of calf'
g.	bul	bul-uk	'stomach'
h.	puːl	pul-uk	'well,pool'
i.	cɪːma	cim-uk	'knife'
j.	bart̪a	bort̪-uk	'slave, servant'
k.	pura	pur-uk	'cloth'
l.	wʊrʊt	wʊr-ʊk	'hare'

Raising of stem vowels in the context of *-uk/-ʊk* can be understood as a standard case of height harmony: Mid vowels ([ɛ] and [ɔ]) are raised to high ([ɪ] and [ʊ]) in the context of other high vowels.[9] Again this analysis cannot be rebutted by adducing Word-Level affixes such as *-u* which don't trigger height harmony on root vowels if height harmony is assigned to the Stem Level.

In fact, there is independent evidence that the affixes triggering VQA also differ in other respects from Word-Level affixes. *First,* they typically trigger shortening of stem vowels (cf. the examples in (69-a,b,c,f,h,i)), a process which is apparently never found with Word-Level affixes. *Second,* the AP in Mayak which is cited by Andersen as the typical case for a morphological exponent of VQA in the verbal domain, also exhibits Stem-Level properties in its effects on stem consonants (cf. chapter 7). *Third,* whereas Word-Level affixes such as plural *-ni* may attach to nouns of any length (70) (recall that verb roots in Mayak are strictly monosyllabic whereas noun stems may contain up to 4 syllables), the combination of a Stem-Level number affix and its base is always maximally bisyllabic.[10]

(70) **A Word-Level Affix Attaching to Polysyllabic Stems: PL *-ni*** (Andersen 2000:39)

	SG	**PL**	
a.	girint̪i	girint̪i-ni	'hippopotamus'
b.	almaːlaga	almaːlaga-ni	'spoon'
c.	rʊːɗ-a	rʊːɗ-a-ni	'my grandfather'
d.	baːb-a	baːb-a-ni	'my father'

[9]That low vowels are opaque to vowel height harmony is a phenomenon found in many languages; see e.g. Beckman (1997) on Shona.

[10]Combinations of verb stems and Stem-Level affixes are always bisyllabic because verb stems in Mayak are always monosyllabic, and Stem-Level affixes subsyllabic or monosyllabic.

The bisyllabicity restriction on Stem-Level affixes is especially striking with the only VQA-triggering and stem-V shortening affix which actually attaches to bisyllabic bases, the infix *-u-,-ʊ-*, which adheres to bisyllabicity by overwriting the second stem vowel (71):

(71) **A [–ATR] + Floating [+ATR] Stem-Level Affix: PL *-u-/-ʊ-*** (Andersen 2000:39)

	SG	PL	
a.	kɪlkat̪	kilkut̪	'broom'
b.	mɛlɣat̪	mɪlɣʊt̪	'shelf'
c.	rɛːkat̪	rɪkʊt̪	'pot type'
d.	kamal	komul	'girl'
e.	nanaːn	nʌnun	'snake'
f.	kawɪl	kowul	'sheep'
g.	d̪ʌld̪ʌːk	d̪ʌld̪uk	'fox'
h.	mɔrcɔŋ	mʊrcʊŋ	'horse'
i.	d̪ɔŋɔl	d̪ʊŋʊl	'cock'
j.	gʊɗɔn	gʊɗʊn	'bull'
k.	kut̪ɛr	kut̪ur	'pig'

The analysis of Mayak vowel harmony processes in the following is tentative simply because Andersen provides very few examples for most affixes. I depart from the observation that the affixes inducing VQA differ in interesting detail. Thus, plural *-d̪in/-d̪ɪn* (72) apparently differs from plural *-it* in two respects: It occurs in a [+ATR] and a [–ATR] variant according to the [ATR] specification of the stem vowel ((72-a) vs (72-e)), and it doesn't induce [+ATR] raising (72-c). This dissociation of [+high]-raising and [+ATR]-raising further supports the assumption that VQA must be decomposed into different phonological harmony processes

(72) **A [–ATR] Stem-Level Affix: *-d̪in/-d̪ɪn*** (Andersen 2000:38)

	SG	PL	
a.	d̪ɔːl	d̪ʊːl-d̪ɪn	'anus'
b.	gɛːl	gɪl-d̪ɪn	'lion'
c.	ʔɪːr	ʔɪr-d̪ɪn	'thief'
d.	jɔːm	jʊm-d̪ɪn	'monkey species'
e.	run	run-d̪in	'year'

I assume that the vowel of *-d̪in* is underlyingly [⊦] and undergoes [ATR] harmony similarly to the one we have observed for Word-Level affixes, whereas plural *-it* is specified [+ATR] which accounts for the fact that it never surfaces as *-ɪt*. Finally there seems to be a third class of Stem-Level affixes, instantiated by plural *-uk/-ʊk* and *-u-/-ʊ-* which surface sometimes as [+ATR] and sometimes as [–ATR] according to the context, but nonetheless trigger [+ATR]-raising on low and high vowels. I analyze these affixes as containing [–ATR] vowels accompanied by exponents consisting of a floating [+ATR]. (73) summarizes the representations and effects of all three affix types:

(73) **Stem-Level Affix Types in Mayak**

	Representation	Context-Dependent [ATR]-Realization	[high]-raising [ɛ] ⇒ [ɪ]	[ATR]-raising [a] ⇒ [ʌ]
a. -d̪in/-d̪ɪn	[⊢] │ ɪ /\\ [+h] [–l]	+	+	–
b. -it	[⊣] │ i /\\ [+h] [–l]	–	+	+
c. -uk/-ʊk -u-/-ʊ-	[⊣] [⊢] │ ʊ /\\ [+h] [–l]	+	+	+

The analysis employs the constraints in (74) which were already used for Mayak Word-Level harmony and are extended here to range over F (i.e., [ATR] and [h]). Thus DEP F abbreviates DEP [⊢⊣], DEP [h]. DEP F which is again undominated will not be explicitly shown in the following tableaux.

(74) **Constraints on [h] and [⊢⊣]**

a. DEP F — Assign ∗ to every F which is in M but not in P

b. *[-h])$_F$ — Assign ∗ to every non-unary F span whose right-most vowel is [–h] in I

c. MAX$\dot{\downarrow}_F$

The constraints in (75) trigger and further constrain [ATR]-harmony; they are all crucially undominated at the Stem-Level. V → [⊣], an extended version of [–l] → [⊣] (75-a) triggers [⊢⊣]-spreading and accounts for the fact that regressive [⊣] spreading at the Word Level also affects the low vowel [a]. *E$_⊣$ (75-b) implements the ban on [+ATR] mid vowels already observed in subsection 6.4.1. It has two crucial effects: First, In the output of the Stem-Level there are no phonetic mid-vowels which accounts for the fact that Mayak doesn't have such segments apart from those which are derived by regressive [ATR]-harmony triggered by Word-Level affixes. Second, Vs which are [–h–l] in the input to the Stem-Level will not become [+ATR] at this stratum even if they finnish as high vowels ([ɛ] may become [ɪ], but not [e] or [i]). This holds because *E$_⊣$ is an I-Structure constraint. DE$\dot{\uparrow}_⊣$ (75-c) has the effect that a floating affix [⊣] can only associate to the affix vowel if it also associates to a stem V.

(75) **Additional Constraints on [⊢⊣]**

a.	V ↓ [⊣]	Assign ∗ to every V which does not dominate a [⊣] in I
b.	*E̤ (E with [⊣])	Assign ∗ to every • which dominates [–h], [–l] and [⊣] in I
c.	DE•↑⊣	Assign ∗ to every [ATR] node which is dominated through an epenthetic | by a tautomorphemic • but not by a heteromorphemic •

Finally, there are two constraints which are specifically referring to [h]. (76-a) is the constraint which triggers [h]-harmony on mid-vowels, and the undominated constraint in (76-b) blocks rightward spreading of [+h]:

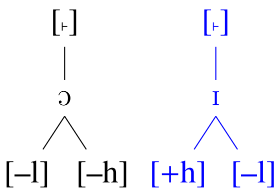
(76) **Additional Constraints on [h]**

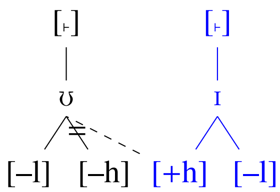
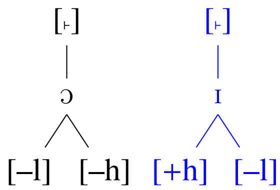
a.	[–l] ↓ [+h]	Assign ∗ to every V which dominates [–l] but not [+h] in I
b.	MAX•↓h]	Assign ∗ to every vowel which is right-peripheral on its tier and dominates F in M, but not in P

I will start the discussion of single cases with *-d̪in/dɪn*. With a mid-vowel stem, the [+h] of the affix vowel spreads to the base vowel to satisfy [–l] → [+h]. No [+ATR]-raising takes place since *-d̪in* is specified [⊢], and DEP F (not shown in the tableau) is undominated:

(77) **[High]- Raising: Left-Spreading of [+h]** (jɔm-d̪ɪn ⇒ jʊm-d̪ɪn)

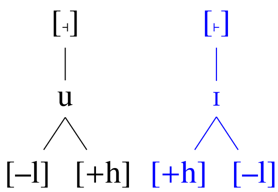
Input:

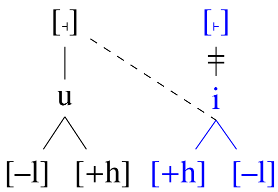
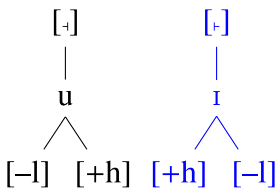


	*[-h])$_F$	MAX•↓h]	*E⊣	DE•↑⊣	[–l] ↓ [+h]	V ↓ [⊣]	MAX•↓F
☞ a. 						*	*
b. 					*!	*	

-*d̪in* doesn't trigger any changes in other stem-Vs. [+ATR]-raising is excluded since the affix does not contain an underlying [⊣], and low vowels do not undergo [+h]-raising because they vacuously fulfill [–l] → [⊣], thus the constraint doesn't induce a violation of $\text{Max}^{\bullet}_{\downarrow F}$. However, the vowel of -*d̪in* itself becomes [+ATR] after [+ATR] vowels to satisfy V → [⊣]:[11]

(78) **Context-dependent [ATR]-Realization: Right-Spreading of [⊣]**
(run-d̪ɪn ⇒ run-d̪in)

Input: 

	*[-h])F	$\text{Max}^{\bullet}_{\downarrow h}$]	*E⊣	DE•↑⊣	[–l] ↓ [+h]	V ↓ [⊣]	$\text{Max}^{\bullet}_{\downarrow F}$
☞ a. 							*
b. 						*!	

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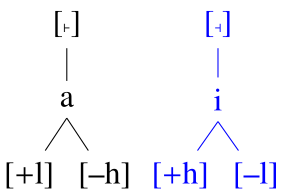
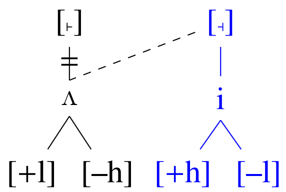
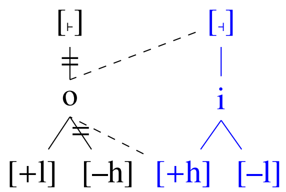
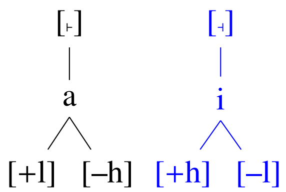
[11] Andersen doesn't provide data where -*d̪in* becomes [+ATR] after the low [+ATR] vowel ʌ, but since -*uk* and -*u*- do so I assume that this behavior extends to -*d̪in*. There are no input [+ATR] mid vowels in stems because *E⊣ is undominated at the Root Level.

Let us turn now to the behavior of *-it* which is underlyingly specified as [⊣]. If preceded by a low (or high) [⊢] stem, the [⊣] of the affix spreads to the stem-V, resulting in [+ATR]-raising triggered by V → [⊣]. (79-b) illustrates the fact that [+h]-raising never affects low vowels because the $\text{Max}^{\bullet}_{\downarrow F}$-violation for [h] is not justified by a higher-ranked markedness constraint:

(79) **Leftwards Spreading of [⊣]** (maac-it ⇒ mʌc-it)

Input:

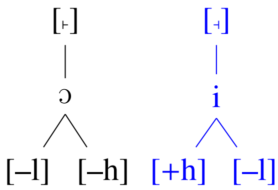


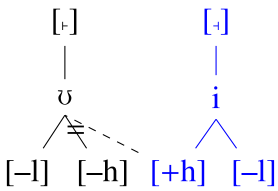
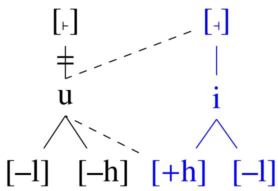
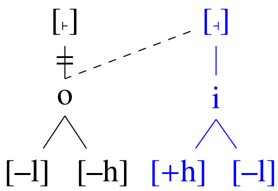
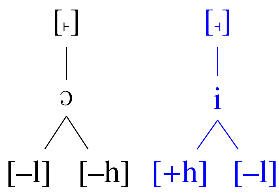
	Dep F	*[-h])$_F$	$\text{Max}^{\bullet}_{\downarrow h}$]	*E$_{⊣}$	$\text{DE}^{\bullet}_{\uparrow ⊣}$	[–l] ↓ [+h]	V ↓ [⊣]	$\text{Max}^{\bullet}_{\downarrow F}$
☞ a. 								*
b. 								**!
c. 							*!	

Andersen doesn't provide an example where *-it* attaches to a mid-vowel stem. However the prediction made by the analysis here is that the stem-vowel raises to high as with other VQA affixes. This is shown for the hypothetical noun root *ʔɔ*t* in (80):

(80) **L-Spreading of [+h]/No L-Spreading of [⊣]** (*ʔɔt-it ⇒ *ʔʊt-it)

Input:



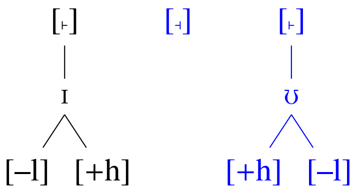
	Dep F	*[-h])$_F$	Max$_h$]	*E	DE	[–l] ↓ [+h]	V ↓ [⊣]	Max$_F$
☞ a. 							*	*
b. 				*!				*
c. 				*!		*		*
d. 						*!	*	

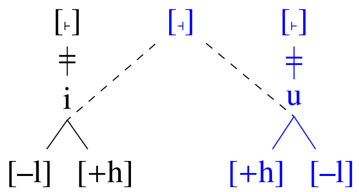
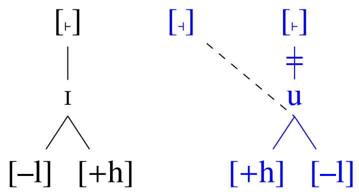
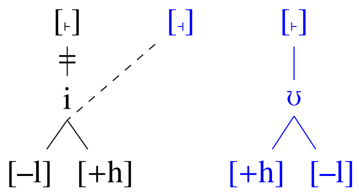
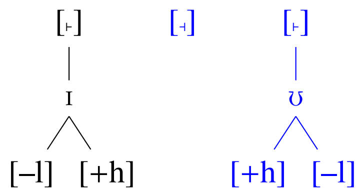
The output of (80) would actually undergo regressive [+ATR]-spreading at the Word-Level resulting in ʔʊ*t-it*. This is also the prediction which results from Andersen's detailed description of the relevant empirical generalizations.

Affixes with a floating [⊣] induce [+ATR]-raising on both affix and peripheral (non-mid) stem vowels by association of the floating feature to satisfy V → [⊣]:

(81) **Association of Floating [⊣]** (cɪɪm-⊣-ʊk ⇒ cim-uk)

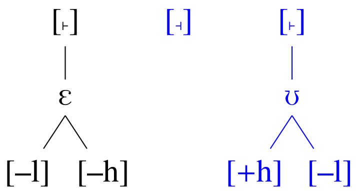
Input:

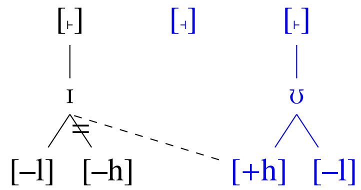
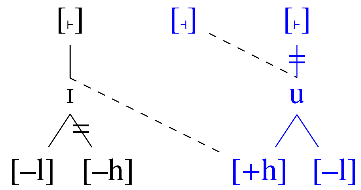
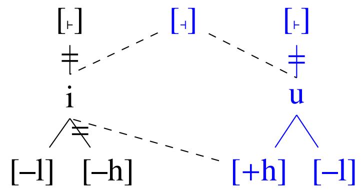
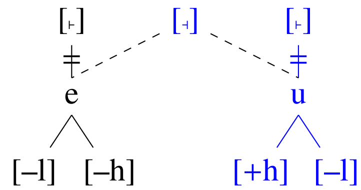
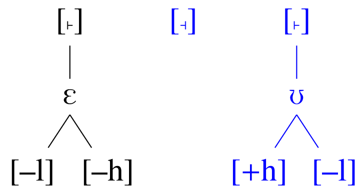


	DEP F	*[-h])$_F$	MAX$^{\bullet}_{\downarrow h}$]	*E$_{⊣}$	DE$^{\bullet}_{\uparrow ⊣}$	[–l] ↓ [+h]	V ↓ [⊣]	MAX$^{\bullet}_{\downarrow F}$
☞ a. 								**
b. 					*!		*	*
c. 							*!	*
d. 							*!*	

Importantly, with mid-vowel stems, we get [+h]-raising, but not [+ATR]-raising. The crucial candidate is (82-c) which exhibits both processes, but is blocked since the stem vowel notwithstanding the phonetic deassociation is still associated to [–h], [–l], and [⊣], and hence violates *E$_{\dashv}$. The essential role of DE$^{\bullet}_{\uparrow\dashv}$ becomes obvious in (82-b), where it blocks association of the floating [⊣] to the affix vowel only:

(82) **L-Spreading of [+h]/Non-Association of Floating [⊣]** (mɛk-⊣-ʊk ⇒ mɪɣ-ʊk)

Input: 

	Dep F	*[-h])$_F$	Max$^{\bullet}_{\downarrow h}$]	*E$_{\dashv}$	DE$^{\bullet}_{\uparrow\dashv}$	[–l] ↓ [+h]	V ↓ [⊣]	Max$^{\bullet}_{\downarrow F}$
☞ a. 							**	*
b. 					*!		*	*
c. 				*!				*
d. 				*!		*!		*
e. 						*!	**	

6.4.3 Further Stem-Level Processes

The VQA is typically accompanied (or, more generally, the affixes triggering VQA are accompanied) by shortening of the stem vowel and truncation of non-initial stem material, as shown by the examples in (83) (repeated from above):

(83) **Vowel Shortening and Truncation under Stem-Level Affixation**

	SG	PL	
a.	mɛːk	mɪɣ-ʊk	'spider'
b.	jaːŋ	jʌŋ-uk	'crocodile'
d.	gɔːc	gʊj-ʊk	'bowl'
c.	ʔɪːr	ʔɪr-d̪ɪn	'thief'
d.	jɔːm	jʊm-d̪ɪn	'monkey species'
c.	rɛːkat̪	rɪkʊt̪	'pot type'
j.	bart̪a	bort̪-uk	'slave, servant'
k.	pura	pur-uk	'cloth'
l.	wʊrʊt	wʊr-ʊk	'hare'
b.	mɛlɣat̪	mɪlɣʊt̪	'shelf'

Here I suggest that both effects are a consequence of μ-maraudage by floating vocalic root nodes similar to the effects Zimmermann (2011) diagnoses for Piro. The crucial assumption is that at the Root Level, lexical roots are aligned to PWords by Rt ≈ PW, whereas affixes do no project higher prosodic structure (i.e. syllables, feet or PWords) due to lower-ranked markedness constraints against prosodic nodes (*π). As a consequence, affixes also discard eventually underlying μs to satisfy μ → π, while moras are licensed in lexical root due to the independently required higher prosody, and retained to avoid violation of Max μ. This is shown in (84) and (85):

(84) **Lexical Root at the Root Level**

Input: $\text{m}\varepsilon_{\mu\mu}\text{k}$

	Rt ≈ PW	π ↑ μ	*π	Max μ
☞ a. $[(\text{m}\varepsilon_{\mu\mu}\text{k})]$			*	
b. $\text{m}\varepsilon_{\mu\mu}\text{k}$	*!	*!		*!
c. mɛk	*!			*!

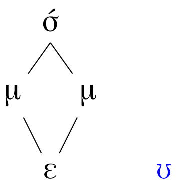
(85) **Stem-Level Affix at the Root Level**

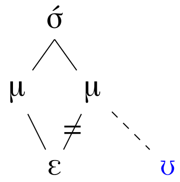
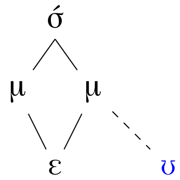
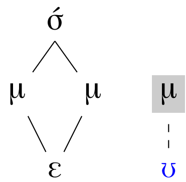
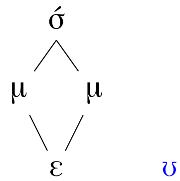
Input: $\upsilon_{\mu\mu}$

	RT ≈ PW	π ↑ μ	*π	MAX μ
a. [($\upsilon_{\mu\mu}$)]			*!*	
b. $\upsilon_{\mu\mu}$		*!		*!
☞ c. υ				**

At the Stem Level, this asymmetric distribution leads to μ-maraudage triggered by undominated μ ← • as shown in (86). The affix V cannot remain completely undominated by a μ-node (86-d), but epenthesis of a μ is excluded by (likewise undominated) DEP μ (86-c). Thus it has to establish association to one of the μs of the base V. Epenthesis of μ– • is crucially governed by $^{*}_{\mathrm{V}}\breve{\mu}_{\mathrm{V}}$ and $^{*}_{\mathrm{V}}\underline{\mu}_{\mathrm{V}}$. $^{*}_{\mathrm{V}}\breve{\mu}_{\mathrm{V}}$ (87-a) blocks association to two vowels for unstressed μs (i.e., moras which are not dominated by the syllable which bears main stress in a PWord, indicated here by an acute on the syllable symbol) will only become relevant below, but $^{*}_{\mathrm{V}}\underline{\mu}_{\mathrm{V}}$ (87-b) excludes the possibility that a mora dominates two vowels in phonetic representation (86-b) thus leading to deassociation of the original μ–• association, i.e., shortening of the stem vowel (86-a):

(86) **Root with Long Vowel + Affix at the Stem Level**

Input: 

	$\mu \uparrow V$	DEP μ	$^{*}_{V}\breve{\mu}_{V}$ $^{*}_{V}\underline{\mu}_{V}$	MAX $\acute{V}$	$\mu \Uparrow V$	MAX$^{\mu}_{\uparrow}$
☞ a. 						*
b. 			*!			
c. 		*!				
d. 	*!					

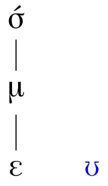
(87) **Constraints on Multiple μ-Dominance**

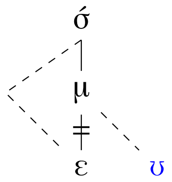
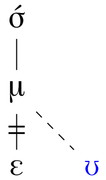
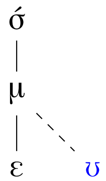
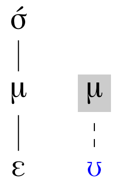
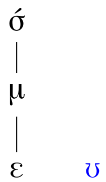
a. $^{*}_{V}\breve{\mu}_{V}$ Assign ∗ to every unstressed μ which dominates two Vs in I

b. $^{*}_{V}\underline{\mu}_{V}$ Assign ∗ to every μ which dominates two Vs in P

For bases with short vowels, the ranking leads to a kind of Duke-of-York gambit as shown in (88). The mora of the base associates to the suffix V, but is saved for phonetic representation by association to the tautomorphemic σ-node (88-a). This is where the ranking MAX V́ ≫ $\mu \Leftarrow$ V becomes crucial. The base vowel violates the requirement that vowels should be dominated by a mora in P-structure to avoid deletion of the main-stressed vowel (88-b):

(88) **Root with Short Vowel + Affix at the Stem Level**

Input: 

	$\mu \uparrow V$	DEP μ	$*_V\breve{\mu}_V$ $*_V\underline{\mu}_V$	MAX V́	$\mu \Uparrow V$	MAX$^{\mu}_{\uparrow}$
☞ a. 					*	*
b. 				*!		*
c. 			*!			
d. 		*!				
e. 	*!					

The ranking developed so far also derives most aspects of truncation in suffixed Stem-Level forms. For concreteness, and since this is the affix showing the clearest evidence for truncation of unstressed vowels, I will demonstrate this point with the infix *-u/-ʊ*.[12] The relevant data are repeated in (89):

(89) **A [–ATR] + Floating [+ATR] Stem-Level Affix: PL *-u-/-ʊ-*** (Andersen 2000:39)

	SG	PL	
a.	kɪlkat̪	kilkut̪	'broom'
b.	mɛlɣat̪	mɪlɣʊt̪	'shelf'
c.	rɛːkat̪	rɪkʊt̪	'pot type'
d.	kamal	komul	'girl'
e.	nanaːn	nʌnun	'snake'
f.	kawɪl	kowul	'sheep'
g.	d̪ʌld̪ʌːk	d̪ʌld̪uk	'fox'
h.	mɔrcɔŋ	mʊrcʊŋ	'horse'
i.	d̪ɔŋɔl	d̪ʊŋʊl	'cock'
j.	gʊɗɔn	gʊɗʊn	'bull'
k.	kut̪ɛr	kut̪ur	'pig'

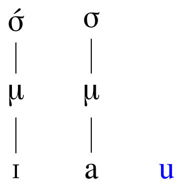
Truncation of unstressed stem syllables (I assume that Root-Level stress in roots is always on the first syllable) follows now crucially from ${}^{*}_{V}\breve{\mu}_{V}$ and the impossibility of crossing association lines between mora and segment tier, captured by the constraint in (90):

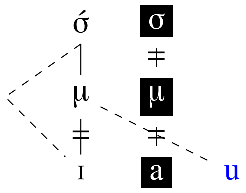
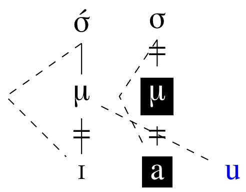
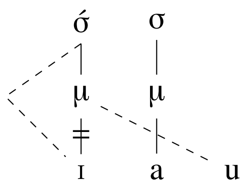
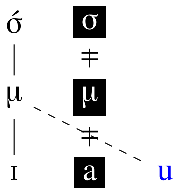
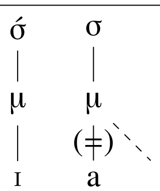
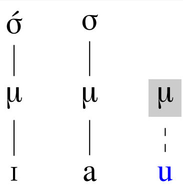
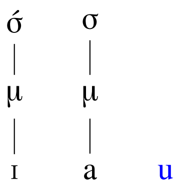
(90) $*\times$ Assign $*$ to every triple of root nodes (R_1, R_2, R_3) in P such that:
(i) $R_1 \prec R_2 \prec R_3$
(ii) R_1 and R_3 are dominated by the μ node M_1, R_2 is dominated by the μ node M_2
(iii) $M_1 \neq M_2$

(91) illustrates truncation for (90-a) *kɪlkat*. Again the affix vowel marauds the mora of the first base syllable. It cannot do the same with the mora of the second syllable (91-e) because this would violate ${}^{*}_{V}\breve{\mu}_{V}$, and the vowel of the second syllable must be deassociated/deleted to avoid a violation of the no-crossing constraint as in (91-c). The [a] can also not be saved by direct re-association to its syllable (in parallel to the behavior of the stressed vowel) because this would result in a phonetic vowel not dominated by a phonetic mora violating $\mu \Leftarrow V$, and in contrast to [ɪ], [a] is not protected by MAX V́ (91-b):

[12]The other cases of truncation (e.g. (83)-j,k,l) are also suggestive but not unambiguous because the second syllable found in the singular might also be analyzed as a singulative affix.

(91) **Bisyllabic Root + Affix at the Stem Level** (*kɪlkat* ⇒ *kilkut*)

Input: 

	$*\underline{\times}^{\mu}_{\uparrow}$	$\mu \uparrow V$	Dep μ	$*_V\breve{\mu}_V$ / $*_V\underline{\mu}_V$	Max V́	$\mu \Uparrow V$	$\text{Max}^{\mu}_{\uparrow}$
☞ a. 						*	*
b. 						**!	*
c. 	*!					*	*
d. 				*!		*	*
e. 				*!			(*)
f. 			*!				
g. 		*!					

Chapter 7

Defective Root Node Affixation

7.1 Introduction

All Western Nilotic languages show different types of consonant mutation in the sense that the final consonants of lexical roots (nouns or verbs) undergo phonological modifications in specific morphological environments. Consonant mutation shows an amazing range of subtle differences not only between different languages, as shown by a selection of stopping patterns in (1), but also between specific morphological contexts in the same language, as is clear from the full list of mutation patterns in Päri (called "grades" by Andersen 1988) shown in (2):

(1) **Stopping Patterns in Western Nilotic**

Input	a. **Dholuo** (Noun Plural)	b. **Mayak** (Passive)	c. **Päri** (Benefactive)	d. **Anywa** (Modified Noun)
p,t,k	p,t,k	p,t,k	p,t,k	pp,tt,kk
m,n,ŋ	mb,nd,ŋg	mp,nt,ŋk	mb,nd,ŋg	pp,tt,kk
l	nd	lt	nd	tt
r	c	rt	ɟɟ	ɟɟ
w	p	–	ww	ww
j	ɟ	–	jj	jj

(2) **Grades of Consonant Mutation in Päri**

1°	2.0°	2.1°	3.0°	3.1°	4.0°	4.1°	5°
p	b		p		m:		mb
t̪	d̪		t̪		n̪:		n̪d̪
t	d		t		n:		nd
c	**j**		c		ɲ:		ɲɟ
k	**Ø**		k		ŋ:		ŋg
m	m		mb		m:		mb
n̪	n̪		n̪d̪		n̪:		n̪d̪
n	n		nd		n:		nd
ɲ	ɲ		ɲɟ		ɲ:		ɲɟ
ŋ	ŋ		ŋg		ŋ:		ŋg
r	r	d	j:	t	r:	n:	j:
l	l	d	nd	t	n:	n:	nd
j	j		j:		j:	ɲ	j:
w	w		w:		w:	m: (w:)	w:
Bare Stems	CP LOC		BEN		INC		FQ
		AP		AP CF		AP CP:BEN	
2SG, FC	1SG,3SG,1PI		1PE, 2PL,3PL				

In this chapter, I will analyze four languages in detail: Mayak, Dholuo, Päri, and Anywa under the basic idea that different languages exhibit different constraint rankings accounting for overall differences in their mutation possibilities, whereas single mutation patterns in specific languages differ only by specific phonological inputs. In particular, I will argue that the triggers of consonant mutation in all cases discussed here are simply suffixal consonantal segments (or segments which may at least act as consonants), i.e. root nodes which for some reason cannot be realized without causing major trouble for the phonological shape of the final consonant of their base and/or for their own makeup.[1] The canonical morphophonological environment for mutation looks as in (3), where C_2 is the consonantal element which triggers mutation of the root C_1:

(3) $[CVC_1]_{Root}$ $[\text{-}C_2V]_{Suffix}$

In the cases discussed in this chapter, there are usually two related types of defectivity which cause problems in this configuration. **First**, the defective phonotactic possibilities of word-internal coda+onset clusters in most WN languages which are extremely limited. There are no complex onsets and codas (which is true more generally), and at the phonological level where consonant mutation applies, they typically obey the CODACONDITION in (4) Itô (1988):

(4) CODACONDITION Assign $*$ to every PL which isn't dominated by a prominent prosodic position (a segment at the edge of a PWord or in σ-onset)

Second, many affixal (C_2) consonants are defective in the sense that they lack specific features underlyingly, usually the major PL-feature which results in sharing the PL-feature of the stem

[1] See de Lacy (2008), Bye and Svenonius (2011) for the claim that consonant mutation is due to defective root affixation in general.

(C_1). Functionally it makes good sense to lack PL-features if you are affixed in an environment where realization of PL-features is restricted, but it necessarily has the effect that the defective consonant has no constant invariable pendant in the output leading descriptively just to the phenomena usually called "consonant mutation".

In the analysis I propose here, either type of defectivity (or their combination) might lead to one of three possible results for the involved consonants

1. C_1 is deleted, C_2 is realized
   (and possibly realizes features marauded from C_1)

2. C_2 is deleted, C_1 is realized
   (and possibly realizes some features of C_1)

3. Both, C_1 and C_2 are realized and share (some) features

I will argue that the first two options occur in the AP of Päri (grade 2.1 of (2)), where the AP suffix *-d* leads to the deletion of stem-final liquids (option 1), but is itself deleted after all other classes of sounds. Option 3 is shown by the pervasive pattern of nasal+stop combinations in (1), and the double consonants in the Anywa modified noun forms (cf. (1)). Note that I am crucially arguing for an analysis where the phonetically long consonants usually called 'geminates' in the descriptive sources (e.g. Reh 1993) are not geminates in the technical sense of Hayes (1989) (cf. also Topintzi 2008 for recent discussion), i.e. doubly linked single consonants/root nodes associated in coda position of (to the mora of) a preceding syllable and in onset position of a following syllable. Instead, they instantiate two independent consonantal root nodes, and share segmental features. This is in line with much recent research on long consonants which shows that many cases of such segments are of this basic type (Muller 2001, Topintzi 2008). In fact, Western Nilotic doesn't exhibit geminates (or other long Cs) anywhere outside of consonant mutation, and as far as I know, there is no phonological evidence for the geminate status of long consonants in this context. Crucially, "gemination" in the languages discussed here is also independent of vowel length. On the other hand, analyzing long Cs as double consonants allows a unified account for patterns such as the Päri BEN, which leads to long Cs for glides (and I argue stops), but to nasal+stop combinations for nasals and [l].

The analysis of C-mutation as defective root node affixation also has clear advantages over an approach which invokes floating features. First, it straightforwardly accounts for the fact that most mutation patterns at least in part lead to longer phonological structures, as just discussed.

The most common defective segments in Western Nilotic consonant mutation are obstruents or stops (two sets which are more or less coextensive in most languages) not specified for any other features. However some languages (e.g. Anywa) entertain also an impressive variety of sonorant elements. Often the defective •s are specified for [±vc], thus Mayak has two mutation-inducing obstruents which differ only in voicing. AP morphemes typically contain a stop which is specified for coronal PL (cf. the Päri AP in (2) where stem-final [r] is replaced by alveolar [t] although [r] is palatal in Päri, as shown e.g. by its alternation with [ɟ] in the AP). Finally defective segments may show other types of underspecification. Thus I will argue in section 7.3.2 that the Dholuo antipassive suffix consists of a consonant which is specified just like that, [+cons] and nothing else, resulting in the "consonantization" of [–cons] stem codas, i.e. glides.

Whereas the analysis of mutation as C-affixation is fairly straightforward in more transparent cases such as the Mayak passive ((1)-b), the bold claim entertained here is that all more opaque mutation effects derive from general phonological constraints triggered by the specific constellation of a coda+onset cluster and PL-sharing. Thus the fact that the stem-final liquids in the Päri BEN harden follows from the fact that only nasals and plosives may share PL with a following plosive in the language. Similarly, an intricate set of voicing alternations in Dholuo (well known under the label of vowel "exchange" or "polarity") which is concomitant to stopping in noun plurals ((1)-b) will be derived by standard constraints on the licensing and sharing of [±voice]. Containment is again a crucial ingredient to this and related analyses. Thus the impression of voicing polarity in Dholuo crucially derives from the assumption that phonetically invisible ("deleted") segments may both be triggers and intervenors in processes of inter-obstruent voicing assimilation.

A second important point which the analyses provided in this chapter demonstrate is that a mutation analysis by means of defective-root affixation is perfectly compatible with the Containment assumption even though the latter is incompatible with coalescence of segments, the standard means to derive mutation-by-root-node affixation in Correspondence-theoretic approaches (de Lacy 2008, Bye and Svenonius 2011).

The chapter starts with Mayak, a language where most cases of 'consonant mutation' result in double consonants exposing relatively faithfully the shape of the underlying consonants (section7.2). Dholuo (section 7.3) forms a marked counterpoint: For most input segments, mutation leads to stopping, not to doubling which will be captured as PL-based downward maraudage. Moreover I will show that this analysis is crucial in deriving the apparent morphophonological "voicing exchange" in the language. The constraints and representations established with the simpler systems of Mayak and Dholuo will then prove crucial in deriving the vast amount of different mutation patterns analyzed in detail in sections 7.4 and 7.5 respectively.

7.2 Mayak Verbs

Consonant mutation in Mayak (Andersen 1999a), as summarized in (5), shows in an especially clear way that the borderline between consonant mutation and sandhi processes in Western Nilotic is delusive. In particular, a major effect of mutation patterns, especially in the antipassive (5-e), is not triggering a change in consonants (apart from turning [l] into [t]), but blocking an otherwise expected regular process of intervocalic phonological lenition (5-b) – with Andersen I assume that the shape of root-final consonants in word-final position (5-a) is roughly the underlying one:

(5) **Consonant Mutation in Mayak**

a. **Word-final C**	**b. Intervocalic Lenition**	**c. Passive Mutation**	**d. Past/ Object Mutation**	**e. Antipassive Mutation**
p	w	p	b	p
t̪	ð	t̪	d̪	t̪
t	ɗ	t	d	t
c	j	c	ɟ	c
k	ɣ	k	g	k
m	m	mp	mb	m
ɲ	ɲ	ɲc	ɲɟ	ɲ
ŋ	ŋ	ŋk	ŋg	ŋ
l	l	lt̪	ld̪	t
r	r	rt̪	rd̪	r

I will analyze the antipassive as affixation of a voiceless coronal stop which is deleted in most contexts under the pressure of restrictions on the licensing of consonantal PL, but keeps exerting effects on the preceding stem consonant. Thus my discussion of Mayak departs from an analysis of intervocalic consonant lenition in the language (subsection 7.2.1) and the possible combinations of consonants (subsection 7.2.2). Subsection 7.2.3 discusses the stopping of nasals in passive and object-oriented past mutation (5-c,d) by affixation of a placeless stop, and shows how the addition of a defective segment which gets phonetically invisible blocks intervocalic lenition. Finally, in subsection 7.2.4, I show that the analysis developed so far predicts almost consistent deletion of a coronal stop in suffix position, which captures the antipassive pattern. Subsection 7.2.5 shows how general phonological constraints and the underlying voicing values of mutation affixes determine the voicing of stem-final plosives.

7.2.1 Intervocalic Lenition

In intervocalic lenition, root-final oral stops are replaced by [+continuant] consonants between adjacent vowels, voiced fricatives (6-a,b), the implosive [ɗ̪] (6-c), and the approximants [j] and [w] (6-d,e), whereas sonorants are unaffected (6-f-i). (6) illustrates this with singular and plural forms of nouns (note that in (6-b,e,g,h) the singular is derived by affixation from the monomorphemic plural form):

(6) **Intervocalic Lenition in Nouns** (Andersen 1999a:83)

	SG	PL	
a.	jɪɪt̪	jɪɪð-ak	'scorpion'
b.	leɣ-it̪	lɛk	'tooth'
c.	kut	kuɖ̞-ak	'spider'
d.	kac	kaj-ak	'leopard'
e.	ʔiw-it̪	ʔip	'arrow'
f.	run	run-ak	'year'
g.	gim-it̪	gɪm	'cheek'
h.	kol-it̪	kɔl	'cloud'
i.	d̪ir	d̪ir-ak	'cloud'

While lenition is blocked in most verb forms with vowel-initial suffixes by the mutation morphology which I will discuss in the following sections, it shows up in subject-oriented past-tense forms:

(7) **Intervocalic Lenition in Verbs** (Andersen 1999a:82-83)

	Unmarked	Past/Subj	
a.	lɛp	lew-u	'open'
b.	mɛt̪	með-u	'beat'
c.	mat	maɖ̞-u	'suck'
d.	kac	kaj-u	'bite'
e.	t̪ak	t̪aɣ-u	'wash'
f.	nan	nan-u	'bite'
g.	kal	kal-u	'steal'
h.	ʔu:r	ʔu:r-u	'cook'

In morpheme- (and word-)final position, the non-liquid continuants emerging in Intervocalic Lenition and the corresponding stops are effectively in complementary distribution whereas both types of sounds occur internally to morphemes in crucially identical positions (e.g. *kɪlkat̪*, 'broom' vs. *mɛlɣat̪*, 'shelf'; *kawɪl*, 'sheep' (Andersen 2000:39) vs. *ra:pi*, 'pot type' (Andersen 1999a:72)).[2]

In the following, I will take for granted that the Mayak constraint ranking guarantees that final non-liquid continuants are blocked at the Root Level. I assume that intervocalic lenition is triggered only at the Stem Level by the following constraint which requires that intervocalic obstruents share the continuancy of the surrounding vowels ('obstruent root node' means 'root node associated to [–son]'):

(8) **(VOV)$_{\textbf{[+cont]}}$** Assign $*$ to every intervocalic obstruent root node which does not share [+cont] with the adjacent vowels in I

This constraint is crucially violated by intervocalic oral stops (10-f) which leads to the mutation of plosives to approximants or fricatives (10-a) (brackets indicate here the [+cont] span). Due to Containment neither 'deletion' of one of the relevant segments (9-e) in an underlying VOV sequence, nor changing the obstruent into a non-continuant sonorant (10-d) repairs the constraint violation since the obstruent is morphologically still associated to [–son] and sur-

[2]Note also that [w,j] occur word-/morpheme-initially whereas [ɣ,ð] don't.

rounded by root nodes linked to [–cons]).[3] Insertion of an intervening consonant obviates of the $(VOV)_{[+cont]}$ violation, but is generally barred in Mayak by high-ranked Dep •. Finally, changing place of articulation (10-b) (which would avoid a Max [son] violation) is ruled out by the constraint in (9) which functions in (10) as a faithfulness constraint since it is violated by adding an association line for PL to a consonant which is already associated for PL (and the morphological association line cannot be fully removed due to Containment):

(9) ${}_{\text{PL}}^{*}C_{\text{PL}}$ Assign ∗ to every consonantal root node which is associated to more than 1 PL node in I

(10) **Intervocalic Lenition**

Input: lɛp-u

	Dep •	Max [nas]	${}_{\text{PL}}^{*}C_{\text{PL}}$	$(VOV)_{[+cont]}$	Max [son]
☞ a. l(ew-u)					*
b. l(eð-u)			*!		
c. lep k -u	*!				
d. lem-u				*!	
e. le p -u				*!	
f. lep-u				*!	

For stem-final sonorants, $(VOV)_{[+cont]}$ is vacuously satisfied, such that they do not show mutation.

7.2.2 The phonotactics of Mayak Consonant Clusters

As in all Western Nilotic languages, the possibilities of combining consonants in Mayak are very limited. There are neither complex onsets nor complex codas, and also consonant combinations at syllable boundaries are severely restricted. (11) shows the licit combinations as summarized by Andersen (1999a:75):

(11) **Licit Consonant Clusters in Mayak**

	p	t̪	t	c	k	b	d̪	d	ɟ	g	ɣ
p					pk						
t̪					t̪k						
t					tk						
c					ck						
k											
m	mp				mk	mb	md̪				mɣ
n			nt		nk		n̪d̪	nd			nɣ
ɲ				ɲc	?		?		ɲɟ		ɲɣ
ŋ					ŋk		?		ŋg		ŋɣ
l		lt̪			lk		ld̪				lɣ
r		rt̪			rk		rd̪				rɣ

In fact, I will argue that at the Stem Level (the level comprising verbal derivation and all cases of consonant mutation discussed here), the options for consonants under syllable contact are

[3]In addition, mutation of [t] to [r] (the only non-continuant sonorant which is never the output of lenition or mutation) is blocked by high-ranked Dep [rhot], a constraint which I will show to hold throughout WN.

even more limited, namely that only homorganic clusters are allowed. All heterorganic clusters are the result of affixing verbal agreement or nominal plural markers which seem to be part of the Word-Level phonology of the language. Thus consider the list of examples Andersen gives for the patterns in (11) split into homorganic (12) and heterorganic clusters (13):[4].

(12) **Homorganic Heterosyllabic C-Clusters in Mayak** (Andersen 1999a:75-76)

a.	[rd̪]	ʔuːrd̪ir	'it was cooked'
b.	[rt̪]	bart̪a	'slave, servant'
c.	[lt̪]	wɛlt̪ɪr	'it is being bought'
d.	[ld̪]	kald̪in	'gardens'
e.	[mp]	ʔampɪr	'it is being eaten'
f.	[mb]	ʔambɪr	'it was eaten'
g.	[nt]	nantɪr	'it is being bitten'
h.	[n̪d̪]	run̪d̪in	'years'
i.	[nd]	nandir	'it was bitten'
j.	[ɲc]	t̪aːɲcɪr	'it is being squeezed'
k.	[ɲɟ]	t̪aːɲɟɪr	'it was squeezed'
l.	[ŋk]	ʔaŋkat̪ɛ	'door'
m.	[ŋg]	ʔiŋgʌc	'spirit, ghost'

All verbal forms with non-homorganic clusters involve the inflectional affixes *-kɛr*, '3PL' (13-a) and participial *-kɔn* (surfacing as -ɣɔ*n* after sonorants) (13-b). Under the asumption that verbal inflection is Word-Level morphology, these are irrelevant for the Stem-Level phonology. The nominal cases are more heterogeneous. The nouns in (13-c) contain the singulative suffix -ɔ*n*, whereas those in (13-d) are by all likelihood monomorphemic: This is the explicit analysis of Andersen (2000) for *kilkat*, and *kurkut/*ʔɪrɣɔ*t̪* do not contain any of the productive singulative affixes listed by Andersen in his systematic discussion of number affixes in Mayak. (13-e) contains the plural affix *-d̪ɪn/-d̪in*, but is probably irregular since Andersen (2000:38) observes that this affix is only found productively with stems ending in [l] or [r].

(13) **Heterorganic Heterosyllabic C-Clusters in Mayak** (Andersen 1999a:75-76)

a.	(i)	[pk]	caːpkɛr	'they are cooking it'
	(ii)	[mk]	ʔamkɛr	'they are eating it'
	(iii)	[nk]	nɔnkɛr	'they are folding it'
b.	(i)	[t̪k]	mɛt̪kɔn	'beaten'
	(ii)	[tk]	ʔʌtkɔn	'pulled'
	(iii)	[nɣ]	mɛnɣɔn	'thatched'
	(iv)	[ɲɣ]	t̪ʊɲɣɔn	'work'
	(v)	[ɲɣ]	ɗuːŋɣɔn	'smoked'
	(vi)	[mɣ]	d̪ɪmɣɔn	'weeded'
c.	(i)	[ck]	wɪckɔn	'whip'
	(ii)	[lɣ]	wɛlɣɔn	'rib'
d.	(i)	[lk]	kɪlkat	'broom'
	(ii)	[rk]	kurkut	'maize'
	(iii)	[rɣ]	ʔɪrɣɔt̪	'theft'
e.		[md̪]	ɟʊmd̪ɪn	'monkeys'

[4]Note crucially that all nouns (and inflected noun forms) with heterosyllabic non-homorganic C-clusters which Andersen (2000) cites fall into the groups exemplified in (13)

Thus the generalization which emerges from the data in (13) is that heterorganic C-clusters fall essentially into three groups:

1. Clusters produced by Word-Level phonology (13-a,b)
2. Clusters deriving from word-final clusters in noun stems (e.g. *wɪck* in *wɪck-ɔn* (13-c))
3. Clusters in monomorphemic roots (13-d)

Thus the only heterorganic clusters at the Stem Level are those inherited from the Root Level. Stem-Level morphology never creates new heterorganic clusters. I suggest that this morphotactic generalization is derived as follows. The Root Level allows heterorganic C-clusters, while Stem-Level phonology has the undominated coda condition in (14) ("prominent prosodic position" refers to a segment at the edge of a PWord or in σ-onset)

(14) $_{\text{N}}$CODACONDITION Assign ∗ to every PL which isn't dominated by a prominent prosodic position in P but is dominated by a prominent prosodic position in M

(14) is the coda condition of Itô (1988) in a Comparative-Markedness version restricted to "new" violations. Thus monomorphemic *kɪlkat* doesn't violate (14) because at the Stem Level, the coronal PL-feature of the medial [l] is dominated by a non-prominent segment (in the coda of a word-internal syllable) in P *and* M (it is an "old" CODACONDITION violation).[5] On the other hand, under the assumption that (13-e) is productively derived, the labial PL of the root-final [m] in *ɟʊm-d̪ɪn* is in a prominent position in M (since the Root Level phonology has built a PWord on the nominal root which is visible in the input to the Stem Level), but not in P (the output of the Stem Level) since the Stem-Level PWord dominates the entire word form, and violates (14). The irregular nature of *ɟʊmd̪ɪn* may thus be simply captured by the assumption that it is listed as a monomorphemic item which undergoes Root Level and Stem level as a whole just as *kɪlkat*.

7.2.3 Stopping and "Gemination" in Passive and Past/Obj

Present Passive[6] and past tense object-oriented forms exhibit mutation patterns which are almost identical (Andersen 1999a:84,89):

(15) **Stopping in Mayak Present Passive and Past/Obj Forms**

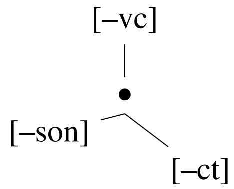
	Unmarked	**Pres/Pass**	**Past/Obj**	
a.	lɛp	lɛpɪr	lɛbɪr	'open'
b.	mɛt̪	mɛt̪-ɪr	mɛd̪-ɪr	'beat'
c.	mat	matɪr	madɪr	'suck'
d.	kac	kacɪr	kaɟɪr	'bite'
e.	t̪ak	t̪akɪr	t̪agɪr	'wash'
f.	nan	nantɪr	nandɪr	'bite'
g.	kal	kalt̪ɪr	kald̪ɪr	'steal'
h.	ʔu:r	ʔu:rt̪ir	ʔu:rd̪ir	'cook'

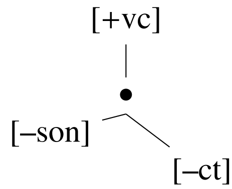
[5]Similarly, the PL-feature of [c] in *wɪck-ɔn* already violates the CODACONDITION in M because the [c] is non-final in the PWord erected by the Root-Level phonology over the lexical root *wɪck*, and hence doesn't incur a 'new' violation relevant for (14).

[6]The 1st person inclusive affix *-ini* induces the same mutation pattern as the present passive.

In both mutation patterns, Intervocalic Lenition is blocked, nasals are replaced by homorganic nasal-stop combinations, and liquids by a sequence liquid-dental stop. However, the resulting stops are voiceless in passive forms, but voiced in past/obj forms.

I interpret the passive and past/object morpheme as defective stops, i.e. [–son–cont] root nodes not associated to PL nodes, but to voicing features (in short: Passive ↔ C̥, Past/Obj ↔ C̬):

(16) Pres/Pas ↔ 

Past/Obj ↔ 

I will postpone discussion of the different voicing specifications for these segments to subsection 7.2.5 and discuss here only the present passive pattern which apart from voicing transfers to past/obj inflection. Following Andersen, I interpret the mutated stops in passive past and past object forms as virtual geminates (Ségéral and Scheer 2001). More specifically I interpret them as **double consonants** at the Stem Level which undergo systematic coalescence/shortening at the Word Level. Hence mutation at the Stem Level looks as follows:

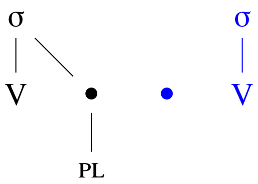
(17) **Consonant Mutation in Mayak at the Stem Level**

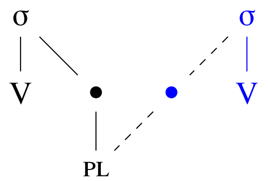
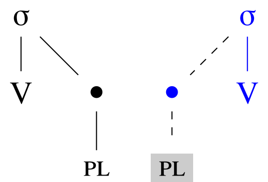
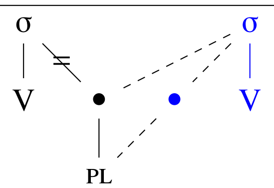
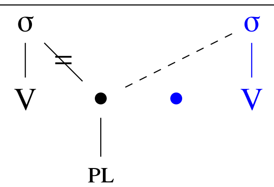
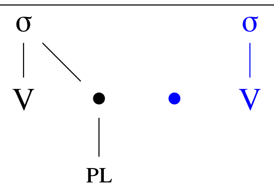
a. **Word-final C**	**b. Intervocalic Lenition**	**c. Passive Mutation**	**d. Past/ Object Mutation**	**e. Antipassive Mutation**
p	w	pp	bb	p
t̪	ð	t̪t̪	d̪d̪	t̪
t	ɗ	tt	dd	t
c	j	cc	ɟɟ	c
k	ɣ	kk	gg	k
m	m	mp	mb	m
ɲ	ɲ	ɲc	ɲɟ	ɲ
ŋ	ŋ	ŋk	ŋg	ŋ
l	l	lt̪	ld̪	t
r	r	rt̪	rd̪	r

PL-sharing of both consonants surfacing as coda and onset follows straightforwardly from the constraint ranking • → PL, $*_{\sigma}[CC/*CC]_{\sigma} \gg$ MAX • as shown in (19). Note also that I will assume tacitly in the following (for Mayak as well as for all other Western Nilotic languages under discussion) the undominated constraint in (18) inhibiting PL-sharing of consonants and true vowels, i.e. vowels in the nucleus position of a syllable:

(18) $*(V.C)_{PL}$ Assign $*$ to every vowel (i.e., every [-cons] • which heads a σ) which shares PL with another • in I

(19) **C Doubling in Mayak**

Input: 

	Ons	• ↓ PL	*[CC]	Max •	Dep PL
☞ a. 					
b. 					*!
c. 			*!		
d. 		*!		*	
e. 	*!	*		*	

The constraint Onset gets crucial for derived stems such as the multiplicative and the centrifugal which are vowel-final, where the present passive suffix (and the 1PIn suffix which behaves in a completely parallel way) shows up with initial t̪ (cf. *gɛp*-*ɪr*, 'it is being beaten' vs. *gɪ:wii-t̪ɪr*, 'it is being beaten' (multiplicative), and *ʔip-ir*, 'it is being shot' vs. *ʔip-i-t̪ir*, 'it is being shot' (centrifugal, Andersen 1999a:87). Since undominated *(V.C)$_{PL}$ blocks PL-sharing between consonants and vowels, we expect deletion of C̥, but this would lead to an onset-less syllable which is avoided by inserting an epenthetic PL specified as COR-[+distributed] (20-b):

(20) **Vowel-final Stems**

Input: ʔip-i-C̥ir

	ONS	• ↓ PL	*[CC]	MAX •	DEP PL
a. ʔip-i-C̥ir	*!				
☞ b. ʔip-i-t̪-ir					*
c. ʔip-i-C̥ir		*!			

Embracing the assumption that the consonants of passive and past/object forms show doubling in stops immediately accounts for the fact that these forms do not exhibit intervocalic lenition. Since the constraint enforcing lenition on stops (8) penalizes the configuration in (21-a) (an intervocalic stop), stops in doubling mutation occur in the configuration in (21-b) where neither $Stop_1$ nor $Stop_2$ is intervocalic.

(21) a. Vowel Stop Vowel
b. Vowel $Stop_1$ $Stop_2$ Vowel

Thus the immunity of passive and past/object forms to lenition is not a case of geminate inalterability under this analysis, but follows simply from the fact that consonant sequences are not subject to processes applying to single Cs.

7.2.4 Antipassive: Simplex Liquid Stopping

Antipassive provides an example of a minimal kind of mutation. In fact, descriptively the only effects of the antipassive morpheme are to block otherwise expected intervocalic lenition and to replace stem-final [l] by [t]:[7] (22) shows the abstract pattern, and (23) gives concrete examples

(22) **Antipassive Mutation**

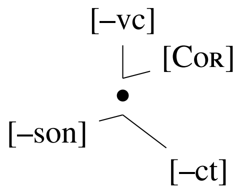
Word-final C	**Intervocalic C**	**C in Antipassive Forms**
p	w	p
t̪	ð	t̪
t	ɗ	t
c	j	c
k	ɣ	k
m	m	m
ɲ	ɲ	ɲ
ŋ	ŋ	ŋ
l	l	**t**
r	r	r

[7] I won't account here for the marginal possibility that [c] lenites to [j] in antipassive forms. Clearly this would require to assume special conditions on lenition for palatals.

(23) **Antipassive Mutation (Examples)** (Andersen 1999a:92)

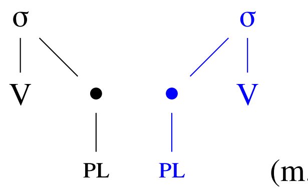
	Unmarked	Pres/Pass	Past/Obj
a.	lɛp	lɪpɪr	‘open’
b.	mɛt̪	mɪt̪ɪr	‘beat’
c.	mat	mʌtɪr	‘suck’
d.	kac	kʌcɪr (kʌɟɪr)	‘bite’
e.	t̪ak	t̪ʌkɪr	‘wash’
f.	nan	nʌnɪr	‘bite’
g.	kal	kʌt̪ɪr	‘steal’
h.	ʔuːr	ʔurir	‘cook’

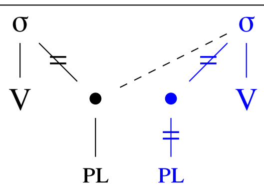
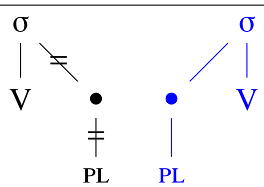
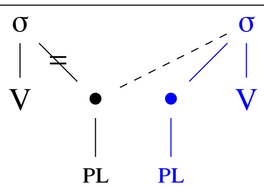
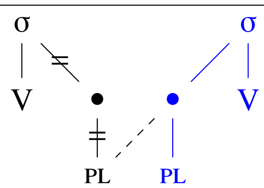
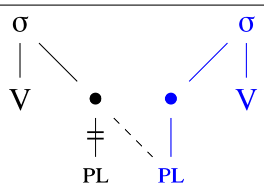
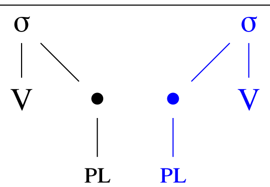
I assume that the antipassive morpheme is an alveolar voiceless stop which becomes overt after laterals (triggering their deletion) and induces voicelessness in stem-final obstruent:

(24) Antipassive ↔ 

That the morpheme is deleted in most phonological contexts follows from the constraints already motivated, especially the restrictions on possible consonant clusters, and faithfulness constraints on segmental features which favor other consonants: Max [Lab], Max [Dor], Max [+nas], Max [rhot], Max [+dist]. The crucial difference between antipassive and the past/passive morphemes is that it is already specified for pl which leads to the fatal consequence that neither both intervocalic consonants nor both consonantal pl nodes can be realized, as shown in (25). Straightforward realization of both segments associated to their original pl nodes (25-f) is ruled out because the pl of the first C is not linked to an onset (or the word-final position). Any reassociation of a pl node to the other consonantal •, results in a violation of $_{PL}^{*}C_{PL}$ (25-d,e), and linking both segments (and by transitivity both pl nodes) to the onset of the affix syllable (25-c) is blocked by $*_{\sigma}$[CC/*CC]$_{\sigma}$. Thus the only options we are left with are to delete the stem C and its pl node, or to delete the affix C and its pl node:

(25) **Lateral Stopping/[t]-Deletion in the Mayak Antipassive**

Input:  (m.t)

	${}_{\text{N}}$COD COND	*[CC]	${}^{*}_{\text{PL}}\text{C}_{\text{PL}}$	MAX ${\bullet}_{+n,+r}$	MAX ${\bullet}_{-s}$	MAX ${\bullet}_{\text{LAB,DOR}}$	MAX ${\bullet}_{-a}$
☞ a.  (m.)							
☞ b.  (.t)							
c.  (.mt)		*!					
d.  (.tp)			*!				
e.  (.t)			*!				
f.  (m.t)	*!						

Deleting the stem C is what we find with stem-final liquids (where the affix *-t* shows up faithfully), while the affix C is deleted after all other stem-final Cs. In the following, I will show in detail how the ranking of faithfulness constraints ranked below ${}^{*}_{\text{PL}}\text{C}_{\text{PL}}$ in (25) derives the correct deletion site for every subcase:

(26) **Deletion of Affix [t] after Stem Nasal (Antipassive)**

Input: (n.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
☞ a. (n.)					*		
b. (.t)				+n!			

(27) **Deletion of Affix [t] after Stem [r] (Antipassive)**

Input: (r.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
☞ a. (r.)					*		
b. (.t)				+r!			

(28) **Deletion of Affix [t] after Stem [k] (Antipassive)**

Input: (k.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
☞ a. (k.)					*		
b. (.t)					*	dor!	

(29) **Deletion of Affix [t] after Stem [t̪] (Antipassive)**

Input: (t̪.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
☞ a. (t̪.)					*		
b. (.t)					*		+dist!

(30) **Deletion of Affix [t] after Stem [c] (Antipassive)**

Input: (c.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
☞ a. (c.)					*		
b. (.t)					*		-ant!

(31) **Deletion of Stem [l] before Affix [t] (Antipassive)**

Input: (r.t)

	$_N$Cod Cond	*[CC]	*$_{PL}$C$_{PL}$	Max ●$_{+n,+r}$	Max ●$_{-son}$	Max ●$_{Lab,Dor}$	Max ●$_{-ant,+dist}$
a. (l.)					*!		
☞ b. (.t)							-ant

Due to the fact that (VOV)$_{[+cont]}$ ((8)) is an I-constraint, it also directly effects blocking of intervocalic lenition in AP forms even though these show no overt affix consonants. A structure such as iptir induces no violation of $(\text{VOV})_{[+\text{cont}]}$, hence faithfulness constraints guarantee straightforwardly that the medial stop consonant is maintained.

7.2.5 Voicing of Obstruents

Mayak obstruents show a voicing contrast in onsets, but are always voiceless in word-final and root-final position. As a consequence, root-final obstruents never show a contrast for voicing. As we will see, voicing of overt or hidden obstruent clusters (which are all heterosyllabic and heteromorphemic) reflects consistently the underlying voicing of the second (affixal) obstruent. I derive these facts from the following constraints:

(32) **Constraints Governing [±vc] in Mayak**

a. $*\underline{[\pm vc]})_{PW}$ Assign ∗ to every PWord-final • associated to a [±vc] node in P

b. $\bullet \Downarrow [\pm vc]$ Assign ∗ to every •, not associated to a [±vc] node in P

c. *PD Assign ∗ to every pair of adjacent obstruents which don't share [±vc] in I

d. $*\underline{D}$ Assign ∗ to every obstruent • which dominates [+vc] in P

Voicing at the Root Level: The tableaux (33) to (37) illustrate the possibilities for voicing at the Root Level. In morpheme-initial position, underlying voicing (33) or voicelessness (34) is maintained, whereas segments which are underlyingly unspecified for [±vc] (35) get voiceless by emergence of the unmarked for $*\underline{D}$ (I write unvoiced obstruents in the following tableaux using the IPA diacritic (e.g. p̥), and obstruents unspecified for [±vc] by the symbol for the voiceless stop (e.g. (p))):

(33) **Word-internal Survival of Underlying [+vc]**

Input: bil

	$*\underline{[\pm vc]})_{PW}$	*PD	$\bullet \Downarrow [\pm vc]$	$\text{MAX}_{\bullet\downarrow[vc]}$	$*\underline{D}$
a. p̥il				*!	
b. pil			*!	*	
☞ c. bil					*

(34) **Word-internal Survival of Underlying [–vc]**

Input: p̥il

	$*\underline{[\pm vc]})_{PW}$	*PD	$\bullet \Downarrow [\pm vc]$	$\text{MAX}_{\bullet\downarrow[vc]}$	$*\underline{D}$
☞ a. p̥il					
b. pil			*!	*	
c. bil				*!	*

(35) **Assignment of [–vc] to Underlyingly Unspecified Obstruent**

Input: pil

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX •↓[vc]	*D
☞ a. p̥il					
b. pil			*!		
c. bil					*!

On, the other hand, in morpheme-final position, voicing/voicelessness of stops is neutralized to non-specification for [voice] Steriade (1999):

(36) **Final Deassociation of [+vc]**

Input: ca:b

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	. . .
☞ a. ca:p			*	
b. ca:p̥	*!		*	
b. ca:b	*!			

(37) **Final Deassociation of [–vc]**

Input: ca:p̥

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	. . .
☞ a. ca:p			*	
b. ca:p̥	*!			
b. ca:b	*!			

The affixes -C̥, -t̥ and -C̆ do not undergo deletion of their [±vc] specification since they cannot project moras, and hence also no syllables and PWords, thus escaping violation of *[±vc])$_{PW}$.[8]

Voicing at the Stem Level: The same ranking as at the Root Level holds at the stem level. Since passive and object/past are specified for voice whereas stem-final obstruents aren't, *PD enforces that the latter adjusts in voicing to the affix:[9]

[8]The same result would trivially hold if on e takes the obstruents as parts of segmental affixes (-C̥ir, -t̥ir and -C̆ir): the morpheme-initial obstruents would be explicitly specified for [±vc] just as demonstrated for obstruent-initial roots.

[9]Apparently Mayak doesn't have obstruent clusters at the Root Level. Cf. the discussion of possible hetero-syllabic clusters in the language in section 7.2.2

(38) **[±vc] Assimilation in Passive Forms**

Input: lɛp-C̥ir

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX$\overset{\bullet}{\downarrow}_{[vc]}$
☞ a. lɛ(p̥-p̥)ir				
b. lɛ(b-b)ir				*!
c. lɛp-p̥ir		*!	*	

(39) **[±vc] Assimilation in Past/Obj Forms**

Input: lɛp-C̬ir

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX$\overset{\bullet}{\downarrow}_{[vc]}$
a. lɛ(p̥-p̥)ir				*!
☞ b. lɛ(b-b)ir				
c. lɛp-bir		*!	*	

Since *PD is an I-constraint, this analysis carries over straightforwardly to the antipassive affix which is “deleted” (not in P):

(40)

Input: lɛp-t̥ir

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX$\overset{\bullet}{\downarrow}_{[vc]}$
☞ a. lɛ(p̥-t̥)ir				
b. lɛ(b-d)ir				*!
c. lɛp-t̥ir		*!	*	

The account of voicing developed here also accounts for some further subtleties of intervocalic lenition, namely the fact that neither affix-initial nor root-internal obstruents undergo lenition (recall the form *ʔip-i-t̪ir*, ‘it is being shot’ (centrifugal) (Andersen 1999a:87) from above). Under the assumption that the constraints on voicing are ranked above the constraints governing lenition discussed in section 7.2.1, it follows that affixal *-i-t-ir* remains unlenited since this would imply changing the [±vc] value of the affix-initial consonant:[10] as shown in (41):

[10] All consonants resulting from lenition are [+voiced]. if this doesn’t fall out independently from constraints on the segment inventory of Mayak, it might be ensured by an undominated constraint which requires that [+cont] spans coincide with [+vc] spans.

(41) **Non-Lenition of Intervocalic Affix Obstruent**

Input: . . .i-t̥-ir

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX$_{\bullet \to [vc]}$	LENITION CONSTRAINTS
a. . . .(i-ð-i)r				*!	
☞ b. . . .i-t̥ir					*

Compare this to the case of a root-final obstruent which regularly undergoes lenition since it is not protected by MAX$_{\bullet \to [vc]}$, and • ⇒ [vc] actually enhances lenition which results in a [+vc] specification:

(42) **Lenition of Intervocalic Root-final Obstruent**

Input: lep-u

	*[±vc])$_{PW}$	*PD	• ⇓ [±vc]	MAX$_{\bullet \to [vc]}$	LENITION CONSTRAINTS
☞ b. l(e-wu)					
c. lep-u			*!		*

Finally, the analysis also predicts that there is no intervocalic lenition root-internally as shown by examples such as *rɛ:kat̪*, 'pot type' and *gutumat*, 'fishing spear' (Andersen 2000:38,39). The *k* of *rɛ:kat̪* is predicted to be [–voiced] at the Root Level because it is not adjacent to a PWord, and retains its voicing at the Stem Level, just as the *t* of *-t-ir* in (41).

7.3 Dholuo

Whereas Mayak consonant alternations wear the traces of concatenation virtually on their face, Dholuo has a much more mutation-like flavor. In the nominal plural (43-a) there is consistent stopping, but only after stem-final nasals and after [l] which in effect mutates to a nasal, this leads to consonant clusters. With [r], [w] and stops we get a stop with the point of articulation of the original sound (recall that [r] counts as palatal throughout Western Nilotic). Antipassive morphology exhibits a minimal subset of this stopping pattern. Only the glides [w] and [j] turn into the stops [p] and [c]. All other sounds remain unaffected:

(43) **Mutation Patterns in Dholuo**

	a. **Plural**	b. **Antipassive**
/p,t,t̪,c,k/	p,t,t̪,c,k	p,t,t̪,c,k
/m,n,ɲ,ŋ/	mb,nd,ɲj,ŋg	m,n,ɲ,ŋ
/l/	nd	l
/r/	c	r
/j/	c	c
/w/	p	p

In fact, (43) reveals only half the truth about Dholuo. In the plural also stem-final stops alternate in a way which has become famous under the name, “voicing polarity” (or “exchange”). Stem-final obstruents in Plural forms seem to have systematically the opposite value for [±voice] of that they exhibit in the singular (44):

(44) **Voicing Exchange [–voice] → [+voice]**

	sg	**pl**		
a.	bat	bed-e	‘arm’	(Okoth-Okombo 1982:30)
b.	lut̪	lud̪-e	‘walking stick’	(Okoth-Okombo 1982:30)
c.	ɐri:p	ɐri:b-e	‘milky way’	(p. 128)
d.	guok	guog-i	‘dog’	(Okoth-Okombo 1982:30)

(45) **Voicing Exchange [+voice] → [–voice]**

	sg	**pl**		
a.	ki:dí	kí:t-ê	‘stone’	(p. 128)
b.	ɔkɛ̂:bɛ	okɛ́:p-ɛ̂	‘tin can’	(p. 127)
c.	cogo	cok-e	‘bone’	(Okoth-Okombo 1982:30)

For the moment, I postpone discussion of this alternation to subsection 7.3.3, where I will show that polarity is only apparent and follows from general phonological processes and the structures accounting for manner alternations which I will discuss in the following section.

7.3.1 Sonorant Doubling and Stopping in Plural Nouns

(46) and (47) illustrate the manner alternations from (43). That exactly the same alternations happen with consonant- and vowel-final nouns is a point which will become crucial in the analysis of voicing alternations in nouns (section 7.3.3) . Note also that the stem vowel of the noun is deleted under affixation of the plural affix:

(46) **Class Alternations in Consonant-final Nouns**

	sg	**pl**		
a.	iːm	iːmb-e	'ram'	(p. 129)
b.	têːn	teːnd-e	'neck rest'	(p. 129)
c.	pɪ́ːɲ	pɪːɲɟ-ɛ	'country'	(p. 129)
d.	waːŋ	wɐ́ːŋg-ê	'eye'	(p. 129)
e.	buːl	buːnd-e	'drum'	(p. 129)
f.	bʊːr	bʊːc-ɛ	'ulcer'	(p. 128)
g.	ɔːr	ɔ́ːc-ɛ̂	'brother-in-law'	(p. 128)

(47) **Class Alternations in Vowel-final Nouns**

	sg	**pl**		
a.	jaːmɔ	jéːmb-ê	'wind'	(p. 129)
b.	pɪːnɔ	pɪ́ːnd-ɛ̂	'wasp'	(p. 129)
c.	ɲɪːɲɔ	ɲɪ́ːɲɟ-ɛ̂	'iron'	(p. 129)
d.	lɔːŋɔ	lɔ́ːŋg-ɛ̂	'hernia'	(p. 129)
e.	hʊːla	hʊ́ːnd-ɛ̂	'wax'	(p. 129)
f.	gaːra	géːc-ê	'leg bell'	(p. 128)
g.	gɐːri	géːc-ê	'vehicle'	(p. 128)

The analysis departs from the assumption that Dholuo plural stopping is morphologically identical to past/obj and passive affixation in Mayak: it is affixation of a stop which is unspecified for PL at the point where it enters the input of stem-level phonological evaluation. What is different is that Dholuo is much more restricted in the options it allows for Cs to share PL. Whereas PL-sharing seems to be possible in Mayak at least for any sonorant followed by an obstruent, the only configuration where it applies in Dholuo is a nasal followed by a stop. I capture this by the constraints in (48) and (49), where only (48) is specific to PL-sharing, and derives together with Ito's (1988) CODACONDITION (see subsection 7.1 for more discussion) the empirical generalization for word-internal codas in many languages that PL in word-internal codas is only licensed in nasals sharing PL with a following stop. The second constraint is an OCP-type constraint which seems to hold for the stem-level phonology for Dholuo more generally (i.e. outside of PL-sharing configurations):[11]

(48) $\underline{(\text{N.T})_{\text{PL}}}$ Assign $*$ to every pair of heteromodal •s which share PL and are not of the form $(\text{nasal.stop})_{\text{PL}}$ in P

(49) $*\bullet_M\bullet_M$ Assign $*$ to every pair of adjacent homomodal Cs in I

Since these constraints have similar effects and basically the same position in the overall ranking, I will abbreviate the subranking $\underline{(\text{N.T})_{\text{PL}}} \gg$ in the following as $\underline{\text{NT}}$. As I will show in section 7.4.3, (48), but not (49) also holds without exception in Päri. The constraint in (50) penalizes PL-nodes with more than one ancestor nodes which is crucial to capture downward maraudage (cf. section 2.3.5):

[11] Thus I assume that affixes which freely violate it such as the pronominal affixes and possessor markers are word-level affixes. two segments are *homomodal* if they have the same values for all manner features, and *heteromodal* if they differ in the value of at least one manner feature

(50) $\overset{\odot}{_{*}}$PL$^{\odot}$ Assign ∗ to every PL-node which is dominated by more than two ancestor nodes through an uninterrupted path of phonetic association lines in I

Two more constraints are essential to derive the full set of data by restricting the possibilities of underlying Cs to adapt to the just discussed conditions on PL-sharing by adjusting manner features. $*_{-s}C_{+s}$ is the generalized version of a constraint usually silently assumed at P: A consonant cannot be associated to conflicting values of [son]. In its generalized version it not only penalizes mixed sonorant/obstruent sounds but also functions as a kind of faithfulness constraint: Every sound which changes its value for [±son] will violate it. $*_{-t}C_{+t}$ works analogously for [±cont]:

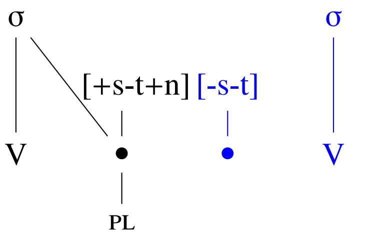
(51) $*_{-s}C_{+s}$ Assign ∗ to every C which is associated to [+son] and [–son] in I

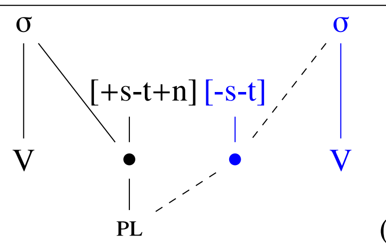
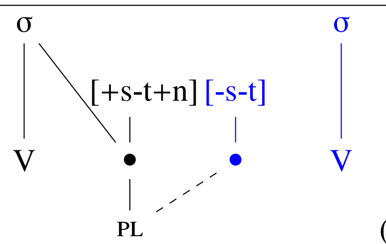
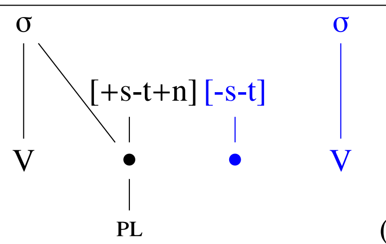
(52) $*_{-t}C_{+t}$ Assign ∗ to every C which is associated to [+son] and [–son] in I

Now the simplest case is affixation to a stem ending in a nasal. The PL-less affix-• associates to the PL-feature of the nasal to avoid a • → PL violation as in (53-c). Downward association of the floating • to PL entails upward integration of • into prosodic structure because otherwise $\underset{*}{\odot}$PL$^{\odot}$is fatally violated (53-b). Since both involved segments in the winning candidate differ for some manner features and form a nasal+stop sequence, this complies with all relevant constraints on PL-sharing (53-a). FAITH MAN stands generically for all other faithfulness constraints on manner which do not become effective in consonant mutation:

(53) **Doubling under •-Affixation to . . .N**

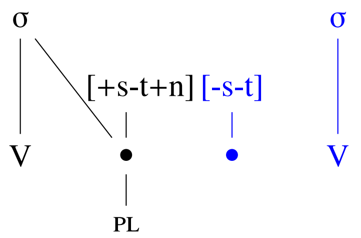
Input:

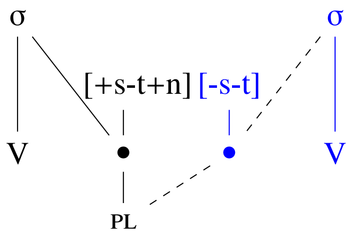
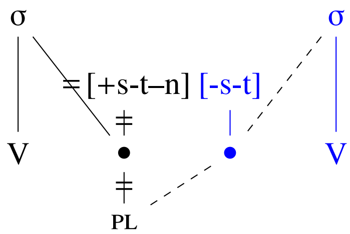
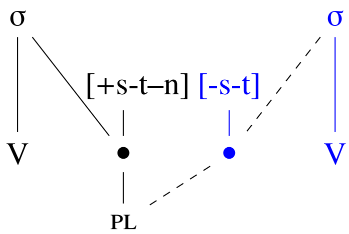
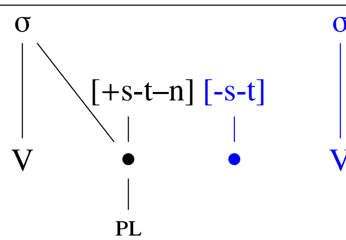


	• → PL	$\underset{*}{\odot}$PL$^{\odot}$	NT	$*_{-s}C_{+s}$ $*_{-ct}C_{+ct}$	MAX •	FAITH MAN
☞ a.  (mb)						
b.  (m)		*!			*	
c.  (m)	*!				*	

Affixation to an [l]-final stem involves some more complications. PL-sharing of the affix stop with [l] as it stands is excluded because [l] is not a nasal (54-c). Deleting the lateral would violate MAX • which is ranked above FAITH MAN (54-b). Hence the liquid gets a nasal which involves neither deletion nor changing [cont] or [son], but only low-ranked faithfulness constraints (54-a):

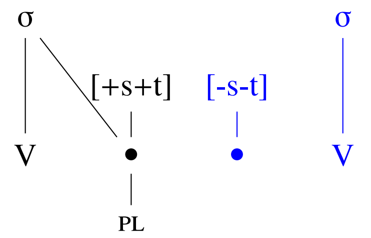
(54) **Doubling under •-Affixation to . . .[l]**

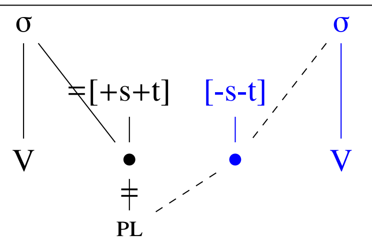
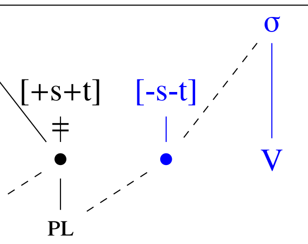
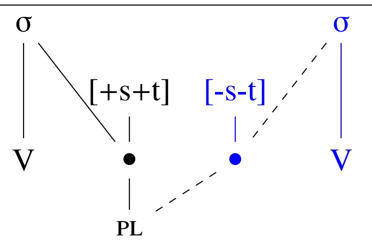
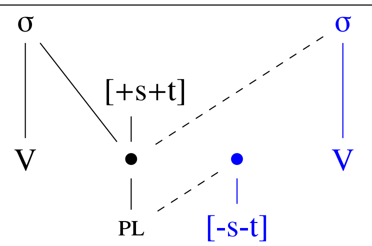
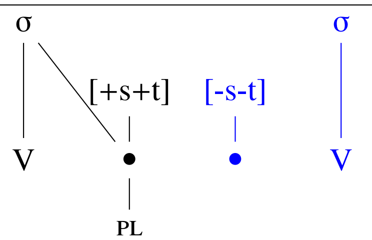
Input: 

	• ↓ PL	$\overset{\odot}{*}$PL$^{\odot}$	NT	$*_{-s}C_{+s}$ $*_{-ct}C_{+ct}$	MAX •	FAITH MAN
☞ a.  (nd)						*
b.  (t)					*!	
c.  (ld)			*!			
d.  (l)	*!				*	

Stem-final [r] is more difficult to fix. Again, PL-sharing of the affix stop and surface [r] is excluded due to $\underline{(N.T)}_{PL}$ (55-c), but nasalizing [r] would imply changing [cont] to [–cont] and leads to a fatal violation of $*_{-t}C_{+t}$ (55-b). Hence one of the segments has to be left unrealized in the output. Since • → PL is undominated, and the only way for the affix stop to dominate a PL-node is in P, hence through the gateway of phonetic realization, the stem C must give way, resulting in PL-maraudage (55-a):

(55) **Stopping under •-Affixation to r**

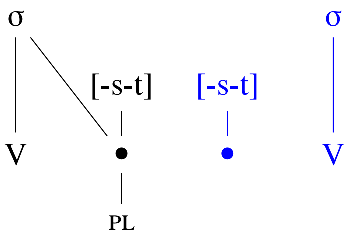
Input: 

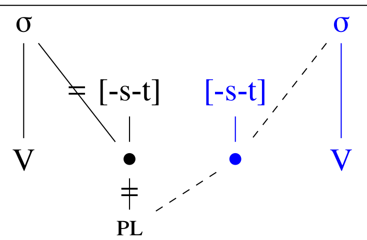
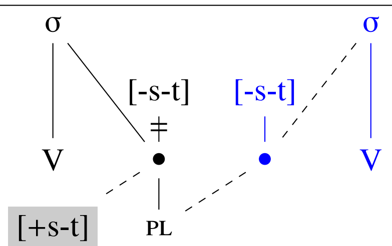
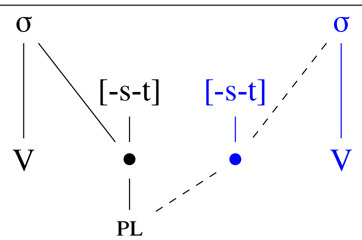
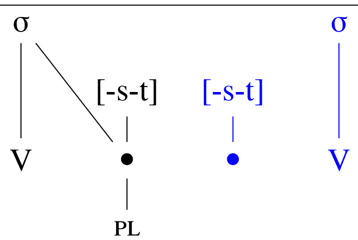
	• ↓ PL	$*^{\odot}\text{PL}^{\odot}$	NT	$*_{-s}C_{+s}$ $*_{-ct}C_{+ct}$	MAX •	FAITH MAN
☞ a.  (c)					*	
b. [+s-t]  (ɲɟ)				*!		*
c.  (rc)			*!			
d.  (r)		*!			*	
e.  (r)	*!				*	

Since the necessity to delete [r] under •-affixation depends crucially on its specification as [+cont], the same output is also derived for stem-final [w] and [j].

The constraint ranking predicts that PL-maraudage is also at work with stem-final oral stops even though survival of the stem stop would result in exactly the same phonetic result. PL-sharing of two oral stops (56-c) is excluded because this implies a fatal violation of $*\bullet_{M}\bullet_{M}$. Adjusting the manner for the stem stop is ruled out by $*_{-s}C_{+s}$ (56-b), and deleting the stem stop (56-a) is preferred over leaving the affix stop unrealized (56-d) due to high-ranked $\bullet \rightarrow$ PL. While PL-maraudage seems to be phonetically without any effect, we will see in section 7.3.3 that it has important consequences for voicing alternations.

(56) **Stopping under •-Affixation to . . . T**

Input: 

	$\bullet \rightarrow$ PL	$*\odot$PL$\odot$	<u>NT</u>	$*_{-s}C_{+s}$ $*_{-ct}C_{+ct}$	MAX •	FAITH MAN
☞ a.  (p)					*	
b.  (mb)				*!		*
c.  (pp)			*!			
d.  (p)	*!			*		

7.3.2 Glide Stopping in the Antipassive

What makes glide stopping problematic – and therefore theoretically interesting – is the fact that it also involves stopping which makes it appealing to characterize it by a PL-less • specified [–son–cont]. However it is easy to see that – given the constraint ranking developed so far,– this would predict that it also stops other segments and combines freely with nasals resulting in nasal+stop clusters. Specifying the defective root node for PL (i.e.[LAB]) is also problematic since Dholuo doesn't seem to adhere to the CODACONDITION in any strict way. What I propose here is to capture the fact that AP stopping is restricted to the only two [–cons] segment in stem-final position derives from the fact that the AP contains a defective root node which is specified [+cons], but lacks all other manner features. For stem-final segments which are [+cons] themselves, this results in phonetically vacuous manner maraudage (the affix-• maraudes the [son] and [cont] values of the stem-final C), but for stem-final glides it leads to stopping in a way to be detailed below.

(57) and (58) illustrate glide stopping for AP and the verbal noun:

(57) **Manner Alternations in Verbs: AP**

a. kawɔ pɛ:sa	'to accept money'	ké:pó	'to accept in general'	(p. 67)
b. buwo ɲat̪î	'to bully a child'	bú:pó	'to act in a bullying'	(p. 67)
c. tɔ:wɔ	'to discolor'	tó:pó	'to discolor something'	(p. 74)

(58) **Glide Stopping in Verbs: Verbal Nouns**

a. hɛ:wɔ	'to beat/excel'	hɛ́:p	'ability to excel'	(p. 97)
b. cwɔ́wɔ	'to inject'	cwɔ:p	'injection'	(p. 98)
c. ŋa:wɔ	'to hang up'	ŋá:p	'hanging up'	(p. 100)

(59) and (60) illustrate that other sonorants do not show any alternations:

(59) **Non-Alternation with other Sonorants: AP**

a. kʊɲɔ bu:r	'to dig a hole'	kú:ɲò	'to dig'	(p. 67)
b. nɪŋɔ wa:ŋ	'to close one eye'	ní:ŋò	'to wink'	(p. 68)
c. cɪɛlɔ rí:ŋò	'to roast meat'	cíé:lò	'to do the roasting'	(p. 68)
d. gʊrɔ	'to trim, whittle'	gú:rò	'to do the trimming'	(p. 68)

(60) **Non-Alternation with other Sonorants: Verbal Nouns**

a. di:no	'to plug a hole'	di:n	'act of plugging'	(p. 97)
b. pi:mo	'to measure'	pi:m	'act of measuring'	(p. 97)
c. pu:ro	'to cultivate'	pu:r	'cultivation'	(p. 97)
d. ga:lɔ	'to delay'	ga:l	'delay'	(p. 97)

Note also that the alternation of *w* and *p* in VNs cannot be related to a general phonological process since word-final *w* in bare nouns and in the infinitive of intransitive roots is well-documented:

(61) **Free Forms with Final *w***

a. ŋêw	'peg'	(p. 128)
b. lǎ:w	'cloth'	(p. 128)
c. tɔ:w	'to be discolored'	(p. 74)
d. ciew	'to wake up'	(p. 74)

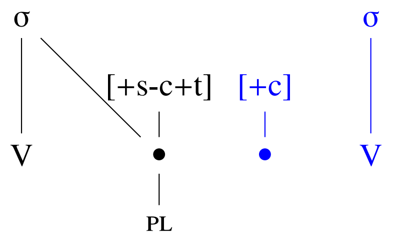
To account for these data we need to take into account some more constraints on •s unspecified for manner features which are vacuously satisfied by all Dholuo structures considered so far (since all input root nodes were already fully specified for manner). Apart from DEP constraints for [son] and [cont], there are also undominated SPEC constraints for both features (• → s(on) and • → (con)t), and a constraint restricting manner sharing to •s pairs of consonantal (or pairs of vocalic elements):

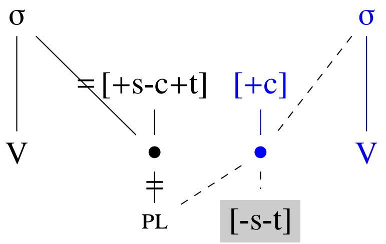
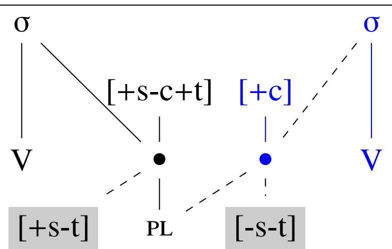
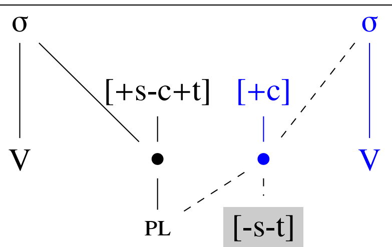
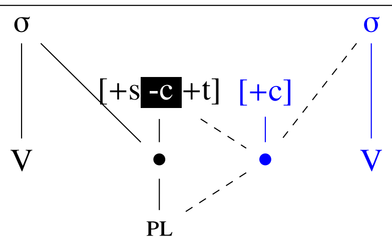
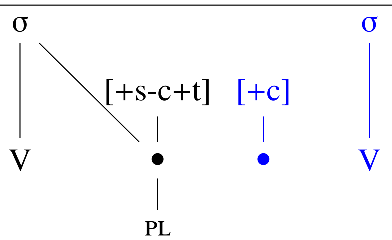
(62) $*\{+c.–c\}_{M}$ Assign ∗ to every ordered pair ($\bullet_1$,$\bullet_2$) which share manner features such that $\bullet_1$ is associated to [αcons] and $\bullet_2$ is associated to [–αcons] in I

(63) shows how these constraints together with the ones already discussed derive stopping of stem-final root segment under the assumption that the first affix segment is a • specified as [+cons], but not for PL, [cont], and [son] (or any other feature). The defective $\bullet_{+c}$ cannot share manner with the final stem [w] because it is specified [+cons], and the latter [–cons] so that manner sharing would result in a violation of $*\{+c.–c\}_{M}$ (63-d). As in the plural mutation, realization of both, affix and stem segment together is excluded by a conspiracy of constraints on PL sharing and faithfulness: The stem-final [w] in its unmodified form cannot share PL with the defective affix-• (63-c) because this is excluded by $\overline{(N.T)_{PL}}$, and it cannot transform into a nasal (63-b) since this implies a change of [cont] violating $\overline{*_{-t}C_{+t}}$. Again the only way out is to delete one of the segments, and the ranking • → {P,s,t} → MAX • decides in favor of the affix C:

(63) **Glide Stopping in the AP**

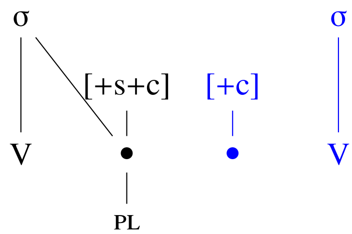
Input:



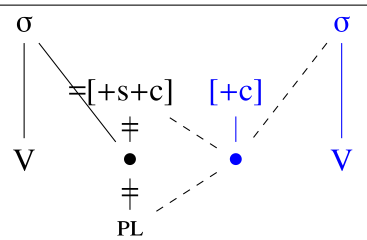
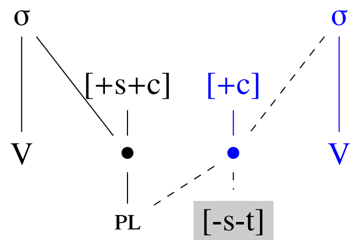
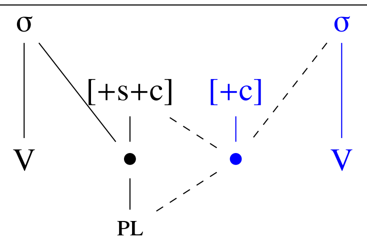
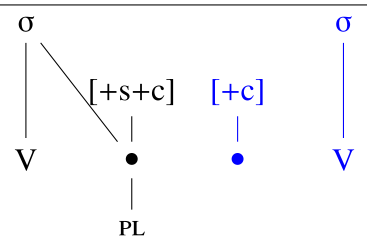
	• → P,s,t	*{+c.–c}$_M$	(N.T)$_{PL}$	*•$_M$•$_M$	*$_{-s}$C$_{+s}$ *$_{-t}$C$_{+t}$	Dep s,t	Max •
☞ a.  (p)						**	*
b.  (mb)					*!	**	
c.  (wb)			*!			**	
d.  (w)		*!					*
e.  (w)	*!**						

All stem-final segments apart from the glides are specified as [+cons] – (64) illustrates this case for a stem-final [m]. As a consequence, the affix-$\bullet_{+c}$ can freely share features with these without violating $*\{+c.–c\}_M$. However, two overt, but adjacent and homomodal segments are still ruled out by $*\bullet_M\bullet_M$ (64-c). On the other hand, generating a sequence of two Cs in the shape of the canonical nasal+stop template and is excluded even after an underlying nasal (which doesn't require to adjust the stem C) because it would imply insertion of a [-son] feature for the affix C. Since Dep s,t is ranked above Max •, deletion of the stem segment is chosen instead (64-a). In effect, the affix-• assumes the shape of the stem-final C which itself is deleted instantiating one more case of feature maraudage. However, as with plural mutation we will see below that this process has visible consequences for the voicing of obstruents to be discussed in subsection 7.3.3.

(64) **String-vacuous Manner Maraudage with Consonants**



Input: (m.$\bullet_{+c}$)

	$\bullet \rightarrow$ P,s,t	$*\{+c.–c\}_M$	$\underline{(N.T)}_{PL}$	$*\bullet_M\bullet_M$	$*_{–s}C_{+s}$ $*_{–t}C_{+t}$	Dep s,t	Max •
☞ a.  (m)							*
b.  (mb)						*!*	
c.  (mm)				*!*			
d.  (m)	*!**						

7.3.3 Voicing Alternations in Nouns

A Fuller Picture of the Data: While the claim that Dholuo plurals (cf. the discussion of (44) above) systematically exchange the voicing of stem-final obstruents (cf. e.g. Alderete, Alderete 1999, 2001) captures two important patterns in Dholuo plural formation, it predicts other types of alternations which are not or only marginally attested in the language, and excludes other patterns which are well-documented. First, there are no nouns following the hypothetical alternation in (65), where a noun ends in a voiced stop in the singular which becomes unvoiced in the plural (all following Dholuo data are from Tucker 1994, except where otherwise noted):

(65) *bad (sg.) bet-e (pl.)

In fact, Tucker (p. 97) explicitly states that "the voiced consonants b, dh, d, j, g, and y [b,d̪, d, ɟ, and g] cannot occur finally in the free forms of short stems". A second pattern which is predicted to occur regularly according to Alderete's analysis are vowel-final roots which have a voiceless stop in the singular and a voiced one in the plural. This pattern is exemplified by the nouns in (66):[12]

(66) **Vowel-final [–vc] → [+vc] Alternations**

	sg	pl		
a.	agɔ:kɔ	agɔ́g-ɛ̂	'chest'	(p. 491)
b.	koti	kod-e	'coat'	(English; Okoth-Okombo 198254)
c.	ongeti	onged-e	'blanket'	(English; Okoth-Okombo 198254)

However, the example in (66-a) is the only example of this type in Tucker's grammar and the noun has a second plural variant without voicing (*agɔ́k-ɛ̂*, p.491). (66-b) and (66-c) are loanwords cited in Okoth-Okombo (1982). Thus the status of this pattern is at most marginal in Dholuo.

On the other hand, many noun roots which take *-e* as their plural suffix have final stops which do not alternate for voicing. (67) contains cases with vowel-final, and (68) with consonant-final singular forms:

(67) **Vowel-final Non-alternating Roots with [–vc] Stop**

	sg	pl		
a.	cu:pɐ	cú:p-ê	'bottle'	(Swahili; p. 130)
b.	ɔt̪î:t̪ɔ	ɔt̪î:t̪-ɛ̂:	'small thing'	(p. 130)
c.	osi:kí	osí:k-ê	'stump'	(p. 130)
d.	ɔkɔ̂:cɔ	ɔkɔ̂:c-ɛ̂	'neck rest of sisal trunk'	(p. 130)

(68) **Consonant-final Non-alternating Roots with [–vc] Stop**

	sg	pl		
a.	í:p	i:p-e	'tail'	(p. 130)
b.	ŋu:t	ŋú:t-ê	'neck'	(p. 130)
c.	la:k	lé:k-e	'tooth'	(p. 130)
d.	bǎ:t̪	bɐ́:t̪-ê/bé:t̪-ê	'side'	(p. 130)

[12]In the following, the source language for loan words is indicated after examples.

In addition, there is one word with a voiced stop in the singular which gets not unvoiced in the plural:

(69) ŋu:di (sg.) ŋu:d-e (pl.) ‘neck of meat’ (p. 131)

(70) summarizes the voicing alternation patterns found in Dholuo and the extent to which they are documented in the data:

(70) **Voicing Patterns in Dholuo**

		singular	**plural**	
V-final Root	a.	[–voice]	[+voice]	**well-attested**
	b.	[–voice]	[–voice]	
	c.	[+voice]	[–voice]	**marginal**
	d.	[+voice]	[+voice]	
C-final Root	e.	[–voice]	[+voice]	**well-attested**
	f.	[–voice]	[–voice]	
	g.	[+voice]	[+voice]	**not attested**
	h.	[+voice]	[–voice]	

The analysis I propose reflects the different status of these patterns by providing an analysis based on general phonological constraints for the well-attested patterns (70–a,b,e,f), while the marginal patterns (70–c,d) are derived by morphological particularities of the involved roots. In particular, I propose that nouns which are underlyingly voiceless do never alternate. This accounts for the vowel- and consonant-final roots which have a voiceless final stop in singular and plural (70–b,f). All alternating roots have underlyingly a voiced final consonant. What happens with consonant-final roots (70–e) which are underlyingly voiced is straightforward word-final devoicing. Accordingly the noun *bat* has the underlying form *bad* which surfaces in the plural, while *d* is devoiced in word-final position to *t*. What causes final devoicing is the constraint *[±vc])$_{PW}$ which I have already used at the Root Level for Mayak. In contrast to Mayak, Root Level obstruent voicing remains contrastive, i.e. stem segments must be specified for [±vc], in all positions, but this specification may be either [+vc] or [–vc]. At the Stem Level, the evaluation cycle of plural affixes, we have the ranking exemplified in (71) which effectively leads to the deletion of [±vc] features in word-final position which is eventually interpreted as voicelessness phonetically (presumably at the Word Level).

This is exactly what happens to the singular form of the noun root *arib*, whose final obstruent is specified underlyingly as [+vc]:

(71) **Input:** ɐrib, ‘milky way’

	*[±vc])$_{PW}$	DEP [vc]	*PD	MAX ↓ [vc]	*D
☞ a. ɐrip				*	
b. ɐrip̥	*!	*		*	
c. ɐrib	*!				*

In the plural, the stem-final C itself is deleted while the defective affix stop marauds its PL-feature (cf. subsection 7.3.1). Now crucially the affix C is unspecified for [±vc].[13] The I-

[13] I assume that the Root Level of Dholuo has the undominated constraint ALIGNPW,R,[vc], R Assign ∗ to every PWord, whose right edge does not coincide with the right edge of a [±vc] span (i.e., a segment dominating a [±vc]

structure constraint *PD requires that adjacent obstruents share voicing, hence the affix C emerges as [+vc]:

(72) **Input:** ɐrib-C-e, 'milky way' (pl.)

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	$\text{MAX}\overset{\bullet}{\downarrow}_{[vc]}$	$*\underline{D}$
☞ a. ɐri(b-b)e					
b. ɐrib-be		*!			*
c. ɐrib-pe			*!		

In contrast to (71), a vowel-final noun root whose final obstruent is voiced does not undergo devoicing in the singular for the trivial reason that the voiced obstruent is not word-final and doesn't violate $*\underline{[\pm vc]})_{PW}$ if it surfaces, hence the maximally faithful candidate (73-c) outranks all candidates with changes in voicing specifications (73-a,b):

(73) **Input:** kidi, 'stone'

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	$\text{MAX}\overset{\bullet}{\downarrow}_{[vc]}$	$*\underline{D}$
a. kiti				*!	
b. kit̥i	*!	*		*	
☞ c. kidi					*

Now in the corresponding plural form, the root-final V is deleted just as the root-final stop. Due to containment, in I-Structure (the relevant substructure for *PD), the representation is roughly *kidite* or *kidide* which both cannot violate *PD simply because they do not contain two adjacent obstruents. As a consequence, (74-a), where the affix C simply remains without a voicing specification fares equally well for *PD as (74-c) where it shares [vc] with the underlying stem obstruent. Since (74-c) in addition violates the general markedness constraint against voiced obstruents, (74-a) remains victorious, and the affix C gets devoiced (again this means "unspecified for [±vc]" at the Stem Level which is later on interpreted as phonetic voicelessness):

(74) **Input:** kidi-Ce, 'stone' (pl.)

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	$\text{MAX}\overset{\bullet}{\downarrow}_{[vc]}$	$*\underline{D}$
☞ a. kidi-te					
b. kidi-de		*!			*
c. ki(di-de)					*!

node). Under the asumption that lexical roots in Dholuo obligatorily project PWords whereas affixal exponents don't, it follows that stem-final segments at the Stem Level are either [+vc] or [–vc], whereas affixes are free to be underspecified for [±vc].

Now consider noun roots whose final obstruent is voiceless. If the root doesn't contain a final vowel, we get again neutralization of the word-final laryngeal feature in the singular (75):

(75) **Input:** ip̥, 'tail'

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*$\underline{D}$
☞ a. ip				*	
b. ib	*!	*			*
c. ip̥	*!				

In the plural, there is again [vc]-agreement of the defective affix C with the stem obstruent undergoing PL-maraudage, resulting in a voiceless stop:

(76) **Input:** ip̥-Ce, 'tail' (pl.)

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*$\underline{D}$
☞ a. i(p̥-p̥)e					
a. ip̥-p̥e			*		
b. i(b-b)e		*!			*

Thus there is a subtle difference between the stem-final obstruents here: in the singular, it is without [±vc] specification, whereas it is specified as [–vc] in the plural. However this difference is neutralized at the Word Level where both are interpreted as phonetically voiceless.

Finally, vowel-final roots, whose final obstruent is underlyingly [–vc] are treated completely in parallel to their pendants with final [+vc] obstruents. Their [vc] specification is maintained in the singular because $*\underline{[\pm vc]})_{PW}$ is not violated due to faithfulness constraints:

(77) **Input:** osik̥i, 'stump'

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*$\underline{D}$
☞ osik̥i					
osigi				*!	
osi(gi)				*!	

In the plural, the PL-marauding affix remains again underspecified due to the intervening non-overt stem vowel:

(78) **Input:** osik̥i-Ce, 'stump (pl.)'

	$*\underline{[\pm vc]})_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*$\underline{D}$
☞ osik̥i-ke					
osik̥i-ge		*!			*
osi(k̥i-k̥e)		*!			

Thus even though plural morphology induces slight representational changes (non-specification for [vc] vs. specification as [–vc]), underlyingly [–vc] obstruents in the final position surface as phonetically voiceless in all noun roots.

7.3.4 Voicing Alternations in Verbs

Before we turn to voicing alternations in Dholuo verbs, some more words on their morphological makeup is at place: Prototypically, Dholuo verb roots have three different forms: a (usually consonant-final) intransitive (79-i), transitive (79-ii), and antipassive (an intransitive form derived from the transitive form) (79-iii). Many verb roots show a voicing alternation: They have a root-final voiced obstruent in the transitive which corresponds to a voiceless obstruent in the transitive. Note also that AP forms are consistently [+ATR] whereas the ATR value of intransitive/transitive forms is lexically dependent on the root:

(79) **Verbs with three Variants (Voiced Stop in the Applicative)**

	(i) **Intransitive**	(ii) **Transitive**	(iii) **Antipassive**		
a. ɲo:c	'to be weak'	ɲo:ɟo	ɲó:có	'to weaken'	(p. 74)
b. cɪɛk	'to get ripe'	cɪɛgɔ	cíékó	'to ripen'	(p. 74)
c. bo:t̪	'to be insipid'	bo:d̪ o	bó:t̪ó	'to make insipid'	(p. 74)
d. kuot	'to swell'	kuodo	kúótó	'to cause to swell'	(p. 74)

However as in nominal voicing alternations, there are also roots whose stem-final obstruent is voiceless throughout (80):

(80) **Consistently Voiceless Stops in Qualitative Formation**

(i) **Transitive**		(ii) **Antipassive**		
a. bupo ji	'to hit with a large soft object'	bú:pó	'to do this kind of hitting'	(p. 67)
b. lut̪ o la:w	'to dip a cloth'	lú:t̪ó	'to dip in general'	(p. 67)
c. keto pí:ɲ	'to put down'	ké:tó	'to put in general'	(p. 67)
d. roco ŋa:tɔ	'to frustrate a person'	ró:có	'to be frustrating'	(p. 67)
e. pɔkɔ rabwɔ̂:n	'to peel a potato'	pó:kó	'to do the peeling'	(p. 67)

This distribution follows straightforwardly from the analysis developed so far if we assume that transitives are derived from intransitives by affixation of *-O*, a back round vowel unspecified for [⊢⊣] , whereas antipassives derive from transitive forms by suffixation of -$\bullet_{+c}$ o resulting in glide hardening (and tensing of the root vowel) as discussed in subsection 7.3.2. This is shown in the following three tableaux for example (79-c): In the intransitive, there is again straightforward word-final devoicing (parallel to the devoicing in *arib*, cf. example (71)):

(81) **Input:** bod, 'to be insipid' (intransitive)

	*[±vc])$_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*D̲
☞ a. bot				*	
b. bot̥	*!	*			
b. bod	*!				*

Voicing is again retained in intervocalic position (thus this is parallel to the plural form of *arib*, cf. ex. (72))

(82) **Input:** bod-O, 'to make insipid' (transitive)

	*[±vc])$_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*D̲
a. boto				*!	
☞ b. bodo					*

Finally, in antipassive formation, the stem obstruent is deleted with the defective affix-• taking over its PL. As in the plural of vowel-final nouns (cf. ex. (74)), voicing assimilation between the PL-sharing obstruent fails to be triggered due to the intervening vowel (in this case the deleted transitive suffix) resulting in a voiceless affix obstruent:

(83) **Input:** bod-O-Co, 'to make insipid' (antipassive)

	*[±vc])$_{PW}$	DEP [vc]	*PD	MAX $\overset{\bullet}{\downarrow}_{[vc]}$	*D̲
☞ a. bodO-to					
b. bodO-de		*!			*
c. bo(Oo-de)					*!

7.4 Päri

Päri shows a similar, but much richer array of mutation morphology than Mayak. Andersen (1988) lists 5 different 'grades' which partially have slightly different subgrades (e.g. 2.0° and 2.1°) resulting in 8 distinct patterns as shown in (84):[14] Grade 1.0° which appears before the 2SG suffix *-i* and the focus marker *-a* is the form of root-final consonants also found in forms without any suffix. As in Mayak (and Anywa) voicing is not distinctive in root-final Cs of verbs, and is fully determined by the phonological and morphological context.

(84) **Grades of Consonant Mutation in Päri**

<table>
<tr><th>1°</th><th>2.0°</th><th>2.1°</th><th>3.0°</th><th>3.1°</th><th>4.0°</th><th>4.1°</th><th>5°</th></tr>
<tr><td>p</td><td colspan="2">b</td><td colspan="2">p</td><td colspan="2">m:</td><td>mb</td></tr>
<tr><td>t̪</td><td colspan="2">d̪</td><td colspan="2">t̪</td><td colspan="2">n̪:</td><td>n̪d̪</td></tr>
<tr><td>t</td><td colspan="2">d</td><td colspan="2">t</td><td colspan="2">n:</td><td>nd</td></tr>
<tr><td>c</td><td colspan="2">j</td><td colspan="2">c</td><td colspan="2">ɲ:</td><td>ɲɟ</td></tr>
<tr><td>k</td><td colspan="2">Ø</td><td colspan="2">k</td><td colspan="2">ŋ:</td><td>ŋg</td></tr>
<tr><td>m</td><td colspan="2">m</td><td colspan="2">mb</td><td colspan="2">m:</td><td>mb</td></tr>
<tr><td>n̪</td><td colspan="2">n̪</td><td colspan="2">n̪d̪</td><td colspan="2">n̪:</td><td>n̪d̪</td></tr>
<tr><td>n</td><td colspan="2">n</td><td colspan="2">nd</td><td colspan="2">n:</td><td>nd</td></tr>
<tr><td>ɲ</td><td colspan="2">ɲ</td><td colspan="2">ɲɟ</td><td colspan="2">ɲ:</td><td>ɲɟ</td></tr>
<tr><td>ŋ</td><td colspan="2">ŋ</td><td colspan="2">ŋg</td><td colspan="2">ŋ:</td><td>ŋg</td></tr>
<tr><td>r</td><td>r</td><td>d</td><td>j:</td><td>t</td><td>r:</td><td>n:</td><td>j:</td></tr>
<tr><td>l</td><td>l</td><td>d</td><td>nd</td><td>t</td><td>n:</td><td>n:</td><td>nd</td></tr>
<tr><td>j</td><td colspan="2">j</td><td colspan="2">j:</td><td>j:</td><td>ɲ</td><td>j:</td></tr>
<tr><td>w</td><td colspan="2">w</td><td colspan="2">w:</td><td>w:</td><td>m: (w:)</td><td>w:</td></tr>
<tr><td>Bare Stems</td><td>CP
LOC</td><td></td><td>BEN</td><td></td><td>INC</td><td></td><td>FQ</td></tr>
<tr><td></td><td></td><td>AP</td><td></td><td>AP:CF</td><td></td><td>AP:CP
AP:BEN</td><td></td></tr>
<tr><td>2SG
FC</td><td>1SG
3SG
1PI</td><td></td><td>1PE
2PL
3PL</td><td colspan="3"></td><td></td></tr>
</table>

[14]Andersen actually distinguishes grade 1.0° in forms without any suffixes and grade 6.0° before 2SG and focus suffix. I collapse these patterns here because they are systematically identical.

7.4.1 Assumptions

In my implementation of Päri consonant mutation, I will make the following analytic assumptions:

- **Stem-Level and Word-Level Morphology:** All relevant mutation morphology in Päri is Stem Level. The only exceptions are the 2SG and focus marker which I analyze as Word-Level affixes which don't trigger mutation (see section 7.4.2 for more discussion)

- **Intervocalic Lenition** The output of 2.0/2.1° mutation at the Stem Level for [c] and [k] are voiced stops ([ɟ] and [g]). Intervocalically singleton [ɟ] and [g] are lenited to [j] and Ø at the Word Level, a process which can be observed in a similar way in the better described phonological system of Anywa (Reh 1993:,) see section 7.5.1 for discussion). Similarly, the mutated [r] in grade 3° is an instance of [ɟ:] at the Stem Level which is lenited to [j:] at the Word Level. Again the same process can be observed in Anywa.

- **Intervocalic Ø (Hiatus):** Andersen (1988:72-77) discusses three different sources of hiatus between stem and suffix vowels: phonemic [w], phonemic [j], and phonemic Ø, which however alternates with palatal and dorsal consonants. As already remarked, I assume that all these cases result from intervocalic lenition at the Word Level. Thus intervocalic hiatus is barred at the Stem Level.

- **Combinations of Derivational Affixes:** Morphologically, only one derivational process may apply to a given lexical verb. The only exception is the antipassive, apparently the most frequent derivational process, which may be subject to further derivation. I assume that this is due to the fact that antipassive forms are lexically listed and hence treated as simplex verb roots for other derivational processes. Underived verbs are "inherently centrifugal" (Andersen 1988:91), thus there are apparently no derived transitive centrifugal forms apart from antipassive centrifugal forms.[15]

- **The Final Derivational Element:** Päri suffixes the vocalic element *-i* at the end of each derived verbs (hence morphologically sandwiched between the derivational affix or the antipassive stem and eventually following inflectional suffixes). I will call this element final in the following the "final derivational element" (FDE) . The final derivational element is often phonetically invisible because it is deleted before following inflectional suffixes (all inflectional affixes attached to verbs are vowel-initial), but results in the generalization that derived verbs are always followed by a vocalic suffix (Andersen 1988:79-81).[16]

- **Antipassive Allomorphy:** All instances of antipassive (grades 2.1°, 3.1°, and 4.1°) show the same exponent which roughly effects stopping of liquids to [d/t]. The phonological exponent of grade 3.1° (centrifugal) is homophonous to the one of the benefactive (grade 3.0°). the difference between grade 3.1° and grade 3.0° boils down to the fact that the CF in grade 3.1° applies to AP forms (which hence contains no liquids since these have already been stopped by AP mutation). However CP and BEN show a specific and

[15] Andersen doesn't discuss differences between bare AP forms and AP:CF forms.

[16] Andersen obviously assumes that *-i* is a kind of default/dummy vowel serving the satisfaction of a morphological constraint that requires derived verbs to be followed by an inflectional affix. Whereas the function of the final derivational element is not entirely clear, it seems much more natural to assume that it is affixed to *all* derivational stems and deleted under standard phonological conditions than to posit morphological constraints on the interaction of derivational and inflectional affixes.

identical (morphologically conditioned) allomorph in the context of AP stems which accounts for grade 4.1° which is apparently unrelated to the simplex CP and BEN mutation observed in grades 2.0° and 3.0°.

- **Gemination of Oral Stops:** The stops in grades 3.0°/3.1° are virtual geminates just as the similar patterns in Mayak. As Andersen (1988:71) shows, length contrasts in Päri obstruents are ultimately neutralized in the context of preceding vowels : "Voiceless stops are short after long or diphthongal stem vowels, and long after short stem vowels" (Andersen 1988:71). I assume that this is due to Word-Level processes and that at the Stem Level all stem-final obstruents in grades 3.0°/3.1° are geminates where all other stops are singletons.

- **Geminates as Double •s:** Geminates are again double consonants sharing PL (and possibly other features), not multiply linked root nodes

(85) shows the relevant mutation types I posit for Päri based on these assumptions (I have omitted grade 3.1° here because it is simply the result of applying grade 3.0° to grade 2.1° inputs):

(85) **Relevant Types of Consonant Mutation in Päri**

1°	2.0°	2.1°	3°	4.0°	4.1°	5°
p	b	b	pp	mm	mm	mb
t̪	d̪	d̪	t̪t̪	n̪n̪	n̪n̪	n̪d̪
t	d	d	tt	nn	nn	nd
c	ɟ (j)	ɟ (j)	cc	ɲɲ	ɲɲ	ɲɟ
k	g	g	kk	ŋŋ	ŋŋ	ŋg
m	m	m	mb	mm	mm	mb
n̪	n̪	n̪	n̪d̪	n̪n̪	n̪n̪	n̪d̪
n	n	n	nd	nn	nn	nd
ɲ	ɲ	ɲ	ɲɟ	ɲɲ	ɲɲ	ɲɟ
ŋ	ŋ	ŋ	ŋg	ŋŋ	ŋŋ	ŋg
r	r	d	ɟɟ (j:)	rr	–	ɟɟ (j:)
l	l	d	nd	ll	–	nd
j	j	j	jj	jj	ɲɲ	jj
w	w	w	ww	ww	mm	ww
FC	LOC CP	AP	BEN	INC	AP:CP AP:BEN	FQ

7.4.2 Voicing of Obstruents

Where Mayak neutralizes [±vc] distinctions of root-final obstruents, Päri goes one step further and does so also for the obstruents triggering consonant mutation. As a consequence, at the Stem Level, voicing of stem-final obstruents (and "geminate"-clusters) can be completely predicted by their phonological environment.[17] Especially the following observations hold (see below for a discussion of the Word-Level affixes FC and 2SG):

[17]Recall that in Mayak distinctive (non-)voicing of past/obj and pass lead to a voicing contrast in the respective verb forms.

- Word-final obstruents are voiceless
- The constituents of stop clusters are voiceless
- Singleton stops between sonorant consonants are voiced

I assume that voicing specifications at the Root Level are derived completely in parallel to Mayak, hence final obstruents of root morphemes are systematically underspecified for [±vc] whereas all other obstruents are obligatorily specified [+vc] or [–vc]. The Word-Level phonology conserves [±vc]-specifications of the Stem-Level by the virtue of high-ranked faithfulness constraints. Thus all voicing alternations connected to consonant mutation apply at the Stem Level. Stem-Level voicing is governed by the ranking • ⇒ [±vc], $\underline{\text{(ROR)}}_{[+vc]}$ ≫ *$\underline{\text{D}}$ where $\underline{\text{(ROR)}}_{[+vc]}$ is a constraint requiring inter-sonorant voicing of obstruents:

(86) $\underline{\text{(ROR)}}_{[+vc]}$ Assign ∗ to every obstruent root node which is right-adjacent to sonorant S_1 and left-adjacent to sonorant S_2 and does not share [+vc] with S_1 and S_2 in P

(87) shows representative forms for the behavior of stops in different contexts (grade 4° doesn't contain stem-final obstruents).[18]

(87) **Representative Forms for Voicing** Andersen (1988)

a.	a-jap C-open	'open'	(p.90)	1°
b.	nʌk break-FOC	'break (FC) '	(p.99)	1°
c.	a-jʌb-i C-open(-CP)-FDE	'open'	(p.90)	2.0°
d.	a-ja:mb-i C-open(-CP)-FDE	'open (FQ) '	(p.89)	5.0°
e.	a-jʌpp-i C-open(-BEN)-FDE	'open (BEN) '	(p.92)	3.0°

Simple stems without suffixes such as ((87)-a) are derived as in (88). The requirement to specify [±vc] and the ban on voiced obstruents lead to word-final devoicing:

(88) **Word-final Obstruent Devoicing**

Input: jap ((87)-a)

	• ⇓ [±vc]	$\underline{\text{(ROR)}}_{[+vc]}$	*$\underline{\text{D}}$	FAITH [vc]
☞ a. jap̥				*
b. jab			*!	*
c. jap	*!			

Crucially, forms with the Word-Level suffixes FC *-a* and 2SG *-i* (cf. (87)-b) have exactly the same Stem-Level derivation since they exhibit a suffix-less stem at the Stem-Level, and the

[18] *a-* is a marker for completive aspect.

Word-Level doesn't affect obstruent voicing (in particular it does not trigger inter-sonorant voicing).

(89) shows intervocalic voicing as in ((87)-c), but ((87)-d) where the stem-final stop is preceded by a nasal works in completely the same way:

(89) **Intervocalic Voicing of Simple Obstruent**

Input: jap-i ((87)-c)

	• ⇓ [±vc]	$\underline{\text{(ROR)}}_{[+vc]}$	*$\underline{\text{D}}$	Faith [vc]
a. jap̥-i		*!		
☞ b. j(ab-i)			*	
c. jap-i	*!	*!		

Double ("geminate") stops are immune to inter-sonorant voicing (they do not induce a violation of $\underline{\text{(ROR)}}_{[+vc]}$) since neither the first nor the 2nd component of the cluster is phonetically located between two sonorants, hence there is emergence of specification for [-vc].

(90) **Intervocalic Devoicing of Double Obstruent**

Input: japp-i ((87)-e)

	• ⇓ [±vc]	$\underline{\text{(ROR)}}_{[+vc]}$	*$\underline{\text{D}}$	Faith [vc]
☞ a. jap̥p̥-i				**
b. j(abb-i)			*!*	**
c. japp-i	*!*			

Note that this is exactly parallel to the immunity of double consonants to intervocalic lenition in Mayak. There is however an important difference to the Mayak case. I will argue in subsection 7.4.7 that the Päri antipassive is also triggered by affixation of a coronal stop *-t* which is phonetically deleted in most stems. The corresponding affix in Mayak, although behaving in the same way, still blocks intervocalic lenition, whereas Päri *-t* does not impinge inter-sonorant voicing. This is due to the fact that the trigger constraint in the first case (VOV)[+ct] is an I-constraint whereas $\underline{\text{(ROR)}}_{[+vc]}$ applies in P.

7.4.3 The Basic Mechanics of PL-Sharing and Adjustment

General Morphotactics: As Mayak, Päri doesn't have complex syllable margins. The restriction Päri imposes on heterosyllabic consonant clusters are even stricter than in Mayak. Andersen (1988:69) states that only (i) "nasal plus homorganic voiced stop and (ii) geminate sonorants" are possible. Since I assume here that voiceless stops in this position are actually also geminates (two stops sharing a PL-node, cf. subsection 7.4.1), there is one more type (iii) voiceless geminate stops. Thus independently of morphological affiliation, heterosyllabic consonant clusters must share PL. I attribute these facts to undominated CODACON and $*_{\sigma}[CC/*CC]_{\sigma}$, abbreviated in the following as *[CC]. That in contrast to Mayak not even monomorphemic heterorganic C-clusters are possible follows from the use of the general P-Structure version of CODACOND, instead of $_{N}$CODACOND. Intervocalic hiatus is blocked by the constraint in (91):[19]

(91) $*\underline{PL_{\nu}}\underline{PL_{\nu}}$ Assign $*$ to every pair of P-adjacent PL nodes which are linked to different σ-nuclei

Restrictions on PL-Association: As Dholuo, Päri does not countenance PL-sharing of liquids and following stops, and as in Dholuo, in cases where such a combination would be expected, especially in liquid-final grade 3° forms, the stem-final consonant is repaired.Where Päri parts companionship with Dholuo is by freely allowing PL-sharing between homomodal segments, i.e. segments with exactly the same manner features (of course homomodal segments which additionally share place of articulation are identical in all respects). Thus Päri just as Dholuo changes the sequence [l.T] into [n.d], but [r.T] into [ɟɟ], a configuration not licit in Dholuo. I assume that this follows from the fact that $\underline{(N.T)}_{PL}$ is undominated in Päri whereas $*\bullet_M\bullet_M$ is ranked too low to show any effects. The constraint in (92) may be understood as a highly general containment-based formulation of the ban on nasal rhotics

(92) $*_{r}PL_{n}$: Assign $*$ to every PL which is associated to [+rhot] and [+nas] segments in I

Whereas the P-version of this constraint would just block segments which are phonetically nasal and rhotic, the I-version in (92) also blocks changing nasals into rhotics (or vice versa).[20] It is defined with respect to a PL node instead to a segmental root so that it also penalizes cases where two segments in a feature-sharing relationship form a kind of partial complex segment such that one of them is linked (morphologically or phonetically) to [+nasal], and the other one (morphologically or phonetically) to [+rhotic]. Undominated $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{Man}}{\uparrow}}$ constraints restrict the sharing of manner features to segmental root nodes which also share PL– see subsection 7.4.4 for discussion. $*\times\underset{\text{PL}}{\overset{\bullet}{\downarrow}}$ penalizes multiple association of consonantal PL across other segments,

[19] I choose this formulation of the anti-hiatus constraint to exclude onset-less syllables and onset-PL-less syllables with one stroke. Anyway an adequate treatment of hiatus and vowel deletion in the language requires a much broader empirical database than is currently available. Note also that Andersen (1988:72ff) discusses cases of phonetic surface hiatus which seem to result from the intervocalic weakening of dorsals and palatals. Since I assume that this type of lenition is a Word-Level process in Päri (cf. the discussion in subsection 7.4.1), this doesn't affect the validity of the analysis for the Stem-Level phonology provided here.

[20] Thus a process such as r ⇒ n would induce a violation because the coronal feature is linked to a root node which is associated (morphologically to [+rhotic]) and (accidentally the same) root node which is linked (phonetically) to [+nasal].

and will be discussed in detail in subsection 7.4.8.

Faithfulness: I assume that Päri has undominated DEP [lat], DEP [rhot], and DEP [–cons] which effectively blocks any mutation resulting in a liquid or glide if the sound is not an underlying liquid (or glide) or in a feature sharing relationship with an underlying liquid/glide. That MAX [+nas] is undominated can be straightforwardly read of the table in (85): Each stem-final nasal results in a consonant (cluster) which contains at least one nasal, and the [+nasal] of grade 4.1° (the only mutation exponent comprising this feature value, cf. table (95)) results in nasal clusters across the board.

(93) **Undominated Constraints in Päri**

General Morphotactics:	$\underline{\text{CodCon}}$, $*[\underline{\text{CC}}]$, $*\underline{\text{PL}}_{\nu}\underline{\text{PL}}_{\nu}$
Association of PL:	$\bullet \rightarrow \text{PL}$, $\underline{(\text{N.T})}_{\text{PL}}$, ${}_{\text{PL}}^{*}\text{C}_{\text{PL}}$, ${}^{\odot}_{*}\text{PL}^{\odot}$, $*_{\text{r}}\text{PL}_{\text{n}}$, $\underline{\text{SHR}}_{\overset{\text{PL}}{\uparrow}\text{MAN}}$, $*\times\overset{\bullet}{\underset{\text{PL}}{\downarrow}}$
Faithfulness:	DEP [lat], DEP [rhot], DEP [–cons], MAX [+nas]

(94) shows the overall structure of the constraint ranking constraint ranking I assume for Päri manner alternations at the Stem-Level, where (iii) and (iv) have further internal ranking of constraints:

(94) **Päri Stem-Level Constraint Ranking:**

(i) Undominated Constraints (94)
$\gg$
(ii) MAX •
$\gg$
(iii) Other Faithfulness Constraints on Manner Features
$\gg$
(iv) Other Faithfulness Constraints on Segmental Root Node

The effects of (i) and (ii) will be discussed in this subsection. The constraints under (iii) and their ranking regulate which manner features surface in cases of [coda.onset]-clusters generated by mutation, and will be discussed in detail in subsections 7.4.4, 7.4.5, and 7.4.6. The constraints under (iv) show only effects in the AP mutation which is the topic of subsection 7.4.7.

(95) shows representative mutation inducing affixes of Päri. The AP entry is basically the same as in Mayak. Nasalization is triggered by a [+nasal] • in grade 4.1°, but more indirectly by [+son] in grade 4.0°. Grade 5° combines the representations of 4.0 and 3.0 - it has two defective root nodes which derives the fact that it induces sonorant-obstruent clusters for root-final stops. Grade 2.0° affixes lack any defective root nodes. The voicing effects they involve are triggered by the phonological context through inter-sonorant voicing triggered by the affix vowel for the 1SG and by the FDE (or an eventually overwriting inflectional vowel) for LOC.[21] Note that the BEN exponent in (95-b) blocks the BEN exponent (95-c) purely morphologically by the Elsewhere Principle:

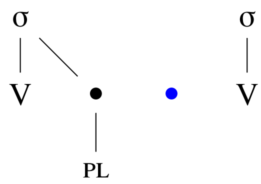
[21]Thus ultimately LOC triggers voicing by morphologically requiring affixation of the FDE which then leads to phonological voicing of stem-final obstruents.

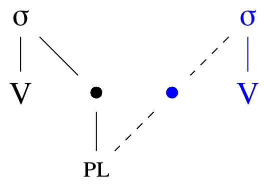
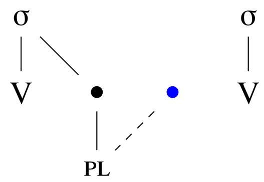
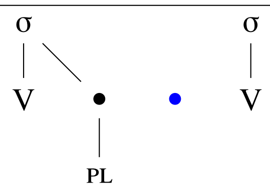
(95) **Underlying Representations of Morphemes Inducing C-Mutation**

a. INC	↔	+son | •	4.0°
b. BEN / AP__	↔	+nas | •	4.1°
c. BEN	↔	–son | •	3.0°
d. 2PL	↔	–son | • u	3.1°
e. FQ	↔	+son –son | | • •	5°
f. AP	↔	[–son] [Cor] \\ / •	2.1°
g. LOC h. 1SG	↔ ↔	Ø -ε	2.0°

For most grades, PL-sharing is now derived in a way very similar to Mayak. A single placeless C root node is suffixed to the root adopts the PL-feature of the root-final C, and forms then a homorganic coda-onset cluster with it due to the limited phonotactic possibilities of the Stem-Level phonology:

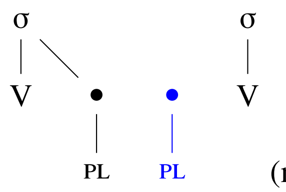
(96) **Simple Doubling in Päri (3° and 4°)**

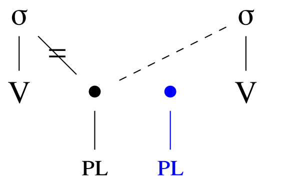
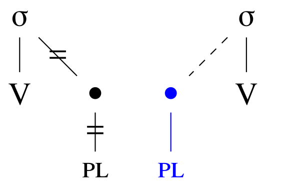
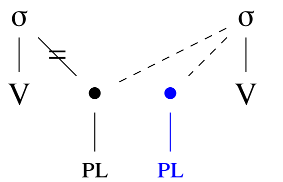
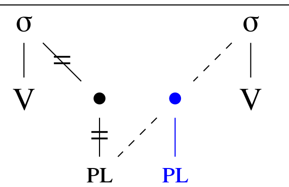
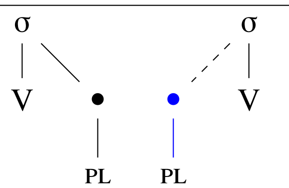
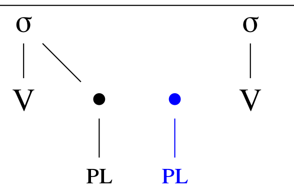
Input: 

	*[CC]	• ↓ PL	$^{\odot}_{*}\text{PL}^{\odot}$	MAX •
☞ a. 				
b. 			*!	*
c. 		*!		*

Singleton liquid stopping in the AP is again derived from the CODACONDITION and $\overset{*}{_{PL}}C_{PL}$ as in (97). The faithfulness constraints depicted in (97) will be discussed in detail in subsection 7.4.4.

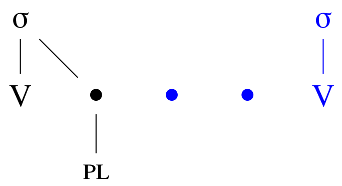
(97) **Liquid Stopping in Päri (2.1° Antipassive)**

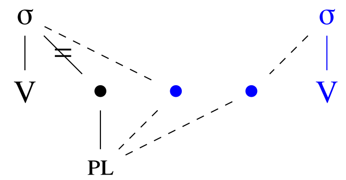
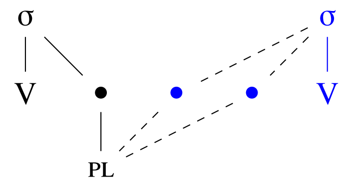
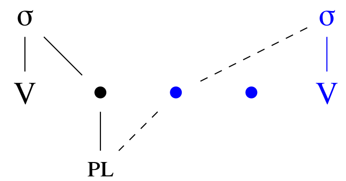
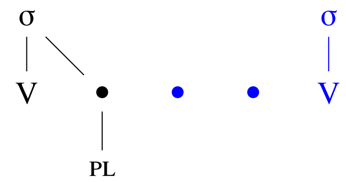
Input:  (m.t)

	ONS	CODCON	*[CC]	$\overset{*}{_{PL}}C_{PL}$	• ↓ PL	$\overset{\odot}{_{*}}PL^{\odot}$	MAX •	...
☞ a.  (m.)							*	
☞ b.  (.t)							*	
c.  (.mt)			*!					
d.  (.tp)				*!			*	
e.  (m.t)		*!						
f.  (m.)	*!						*	

Due to the high ranking of • → PL and ${}^{*}_{\text{PL}}\text{C}_{\text{PL}}$, the two defective root nodes of the FQ lead to deletion of the stem-final consonant. Intuitively Päri morphotactics leaves only space for two consonants, but • → PL can only be satisfied if both affix-•s are phonetically visible (are in P) and share the PL-feature of the stem-final C

(98) **Maraudage in Päri (5°))**

Input: 

	*[CC]	• ↓ PL	${}^{\odot}_{*}\text{PL}^{\odot}$	Max •
☞ a. 				*
b. 	*!			
c. 		*!		*
d. 		*!*		**

7.4.4 The Mechanics of Manner Sharing and Obstruent Affixation (3°)

In Mayak, obstruent affixation leads to C.O clusters whose second member is consistently an oral stop, whereas Dholuo doesn't countenance any manner sharing apart from the (N.T) configuration. In Päri, the distribution of manner is much more complex. Consider for example (99) which summarizes the changes induced by grade 3.0° for representative stem Cs:

(99) **Consonant Mutation in Grade 3.0°**

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in Grade 3.0°	pp	mb	ɟɟ	nd	jj	ww

(100) BEN ↔ $\begin{array}{c}\text{–son}\\ | \\ \bullet\end{array}$

Whereas the plosive quality after nasals is obviously contributed by the affix (Päri has nasal.nasal clusters in grade 4°, hence the orality of the stop cannot be directly due to a general phonological process), the affix stop takes over the manner features of the final stem segment after approximants. Conversely, if the stem C is lateral, it takes over [-cont] from the affix C, mutating into a nasal. This is only one case of a pervasive pressure on PL-sharing coda+onset clusters throughout Nilotic to also share manner features.

I will implement the fact that the sharing of manner features among consonants is closely tied ("parasitic") to the sharing of PL between the involved segments by assuming constraints such as (101) and (102) for [consonantal], [approximant], and [sonorant]:

(101) $\underline{\text{SHR}}\overset{\text{cont}}{\underset{\text{PL}}{\uparrow}}$ Assign ∗ to every pair of •s which share PL, but not [cont] in P

(102) $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{cont}}{\uparrow}}$ Assign ∗ to every pair of •s which share [cont], but not PL in P

As will become clear below, all constraints of the $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{M}}{\uparrow}}$ type (102) are undominated throughout Western Nilotic, whereas $\underline{\text{SHR}}\overset{\text{M}}{\underset{\text{PL}}{\uparrow}}$ constraints may be violated to various degrees. As I will show in section 7.5.2, these are undominated in Anywa, whereas they do not play any visible role in Mayak.

In Päri, manner sharing is crucially driven by undominated $\underline{\text{(N.T)}_{\text{PL}}}$, which countenances PL-sharing outside of (N.T) sequences only among homomodal (PL-sharing) segments. In many cases, manner sharing results from a conspiracy of $\underline{\text{(N.T)}_{\text{PL}}}$, the features specified in affixal •s, undominated DEP [rhot] and DEP [lat]. Thus affixation of a [+son] affix to a stop results in a nasal, not in a liquid due to DEP [l,r], which by virtue of $\underline{\text{(N.T)}_{\text{PL}}}$ – blocking PL-sharing in a stop.nasal configuration leads to a nasal-nasal cluster.

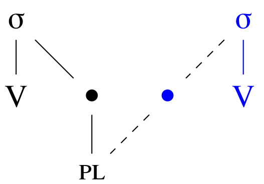
The following faithfulness constraints govern the surfacing of manner features in Päri (I abbreviate MAX [+nas] as MAX_{+n}, MAX [cons] as $\text{MAX}_{\text{-c}}$, and so on):

(103) **Faithfulness Constraints on Manner Features in Päri and their Ranking**

a. MAX$_{+n}$	Assign ∗ to every [+nasal] node in M which is not in P	≫
b. MAX$_{-c}$	Assign ∗ to every [–cons] node in M which is not in P	≫
c. °MAX$\overset{s}{\uparrow}_{\bullet}$	Assign ∗ to every onset •-node in P which dominates a [±son] node in M but does not dominate it in P	≫
d. MAX$\overset{s}{\uparrow}_{\bullet}$	Assign ∗ to every •-node in P which dominates a [±son] node in M but does not dominate it in P	

In the following tableaux, I will only consider candidates of the general form derived in ((96)-a) and repeated in (104), where the segmental root nodes are abbreviated by feature structures, phonetic PL-sharing by "( )$_{PL}$", and phonetic sharing of all manner features by the additional subscript "M" to these brackets – due to undominated $\underline{(N.T)}_{PL}$ (cf. the definition in (48)) the only candidates which can be successful and are not of this type have the form nasal+stop (105-a).

(104)



High ranking of MAX$_c$ is crucial to derive that affixation of the grade3°-stop to approximant-([–cons]-) final stems leads to approximant clusters as shown in (106). The defective affix C is not specified for [cons] whereas the stem C is[22] Hence MAX$_c$ enforces survival of the [–cons] of the stem-final segment directly excluding candidates (105-a,b). In (105-d), a stop shares PL with a non-stop, which hence fails by virtue of undominated $\underline{(N.T)}_{PL}$. The only escape hatch for the affix-• is to change into a non-nasal (non-stop) sonorant, and the only possibility to do so without violating the undominated DEP constraints for [rhot] and [lat] (cf. the discussion above) is to share all manner features of the approximant leading to full assimilation (105). Note that the topmost three constraints in this and the following tableaux are all from the highest constraint (i) stratum of (94), whereas MAX$_c$ and the constraints ranked below it belong to stratum (iii).

(105) **Approximant + Stop** (3°)

Input: [+s–c][–s] (w.T)

			*$_r$PL$_n$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	°MAX$\overset{s}{\uparrow}_{\bullet}$	MAX$\overset{s}{\uparrow}_{\bullet}$
	a. ([+s –c +n][–s])$_{PL,M}$	(m.b)				*!		
	b. ([+s–c][–s])$_{PL,M}$	(p.p)				*!		*
☞	c. ([+s–c][–s])$_{PL,M}$	(w.w)					*	*
	d. ([+s–c][–s])$_{PL}$	(w.b)		*!				

$\underline{(N.T)}_{PL}$ is also crucial for ruling out affixation of the stop • to an unmodified lateral which would again mean PL-sharing of a stop and a non-stop sound (106-d). Again one of the Cs

[22]This is actually derived by the Root-Level phonology, where affixes may remain defective to some degree whereas root segments must be fully specified for manner features.

must adjust in manner to the other one. Since both segments are specified for [son], and the [son] value of the affix C is in prominent onset position protected by $^{o}\textsc{Max}^{s}_{\uparrow\bullet}$ sonorizing the affix stop (106-c) is not a viable option. The only possibility to convert the stem C to a stop C without violating $\textsc{Max}^{s}_{\uparrow\bullet}$ (106-b) is to make it a nasal consonant (106-a) (recall that DEP [+nas] is ranked low in Päri):

(106) **[l] + Stop** (3°)

Input: [+s+l][–s] (l.T)

		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	$\textsc{Max}_{+n}$	$\textsc{Max}_{-c}$	$^{o}\textsc{Max}^{s}_{\uparrow\bullet}$	$\textsc{Max}^{s}_{\uparrow\bullet}$
☞ a. ([+s +l +n][–s])$_{PL}$	(n.d)						
b. ([+s+l][–s])$_{PL,M}$	(t.t)						*!
c. ([+s+l][–s])$_{PL,M}$	(l.l)					*!	*
d. ([+s+l][–s])$_{PL}$	(l.d)		*!				

For stem-final [r], the necessary adjustments are more dramatic due to undominated $*_{r}PL_{n}$ which blocks the transformation of the rhotic into a nasal. The only way to maintain the [–son] of the affix-•, and to satisfy $\underline{(N.T)}_{PL}$ is to turn [r] into an oral stop:

(107) **[r] + Stop** (3°)

Input: [+s+r][–s] (l.T)

		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	$\textsc{Max}_{+n}$	$\textsc{Max}_{-c}$	$^{o}\textsc{Max}^{s}_{\uparrow\bullet}$	$\textsc{Max}^{s}_{\uparrow\bullet}$
a. ([+s +r +n][–s])$_{PL}$	(ɲ.ɟ)	*!					
☞ b. ([+s+l][–s])$_{PL,M}$	(ɟ.ɟ)						*
c. ([+s+r][–s])$_{PL,M}$	(r.r)					*!	*
d. ([+s+r][–s])$_{PL}$	(r.ɟ)		*!				

Finally, for stem-final nasals and plosives, no adjustment in manner is necessary since they satisfy $\underline{(N.T)}_{PL}$ from the very beginning (recall that $\underline{(N.T)}_{PL}$ freely allows homomodal C-clusters), as shown in (108) and (109):

(108) **Stop + Stop** (3°)

Input: [–s][–s] p.T)

		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	$\textsc{Max}_{+n}$	$\textsc{Max}_{-c}$	$^{o}\textsc{Max}^{s}_{\uparrow\bullet}$	$\textsc{Max}^{s}_{\uparrow\bullet}$
☞ a. ([–s][–s])$_{PL}$	(p.p)						

(109) **Nasal + Stop** (3°)

Input: [+s+n][–s] (m.T)

		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	°MAX$^{s}_{\uparrow}$	MAX$^{s}_{\uparrow}$
	a. ([+s+n][–s])$_{PL,M}$	(m.m)					*!	*
	b. ([+s+n][–s])$_{PL,M}$	(p.p)						*!
☞	c. ([+s+n][–s])$_{PL}$	(m.b)						

7.4.5 Sonorant Affixation (Grades 4.0°/4.1°)

The inchoative (4°) leads to CC clusters with complete sharing of manner features, in particular these clusters are all sonorant. Where the stem-final C is already [+son] its manner is inherited without changes to the whole clusters. The only substantial change is that stem plosives turn into nasal stops (110). (111) repeats the lexical entry for the INC exponent:

(110) **Consonant Mutation in Grade 4.0°**

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in grade 4.0°	mm	mm	rr	ll	jj	ww

(111) INC ↔ +son
|
•

(112) shows how this change is derived. Affixation of the affix sonorant without adjusting the stem plosive (112-c) would violate undominated $\underline{(N.T)}_{PL}$ which requires that sonorants must be initial in a cluster where they share PL with an obstruent. Changing the sonorant into a stop is excluded by °MAX$^{s}_{\uparrow}$ (112-b), thus the only available option is to sonorize the stem stop. Recall that this may only result in a nasal due to high-ranked DEP [rhot], [lat]:

(112) **Stop + Sonorant** (4°)

Input: [–s][+s] p.R)

			$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	°MAX$^{s}_{\uparrow}$	MAX$^{s}_{\uparrow}$
☞	a. ([–s][+s])$_{PL,M}$	(m.m)						*
	b. ([–s][+s])$_{PL,M}$	(p.p)					*!	*
	c. ([–s][+s])$_{PL}$	(p.m)		*!				

All other potential stem-final consonants are underlyingly already [+son] which leads trivially to complete manner sharing between stem and affix C without any suppression of features, as shown in (113) to (116):

(113) **Nasal + Sonorant** (4.0°)

Input: [+s+n][+s] (m.R)

	$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$\overset{s}{\underset{\bullet}{\uparrow}}$	MAX$\overset{s}{\underset{\bullet}{\uparrow}}$
☞ a. ([+s][+s])$_{PL}$ (m.m)						

(114) **[l] + Sonorant** (4.0°)

Input: [+s+l][+s] (l.R)

	$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$\overset{s}{\underset{\bullet}{\uparrow}}$	MAX$\overset{s}{\underset{\bullet}{\uparrow}}$
☞ a. ([+s+l][+s])$_{PL,M}$ (l.l)						

(115) **[r] + Sonorant** (4.0°)

Input: [+s+r][+s] (r.R)

	$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$\overset{s}{\underset{\bullet}{\uparrow}}$	MAX$\overset{s}{\underset{\bullet}{\uparrow}}$
☞ a. ([+s+r][+s])$_{PL,M}$ (r.r)						

(116) **Approximant + Sonorant** (4.0°)

Input: [+s+c][+s] (w.R)

	$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$\overset{s}{\underset{\bullet}{\uparrow}}$	MAX$\overset{s}{\underset{\bullet}{\uparrow}}$
a. ([+s–c][+s])$_{PL,M}$ (m.m)				*!		
b. ([+s–c][+s])$_{PL}$ (w.m)		*!				
☞ c. ([+s–c][+s])$_{PL,M}$ (w.w)						

Grade 4.1° differs only minimally from 4.0 by overwriting approximants with nasal stops.[23] Recall that the relevant affixes (BEN and CP in the context of AP) apply exclusively to stems which have already undergone antipassive liquid stopping, hence there is no evidence as to whether liquids would undergo nasalization in this case. [24]

(117) **Consonant Mutation in Grade 4.1°**

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in grade 4.1°	mm	mm	?	?	ɲɲ	mm

(118) BEN / AP__↔
$$\begin{array}{c}+\text{nas}\\ |\\ \bullet\end{array}$$

[23]Andersen's (1988) table 3 on p. 85 lists [j:] as the 4.1° form of [j], but the data he gives for j-final stems show unequivocally nasals as the output of 4.1° mutation for [j] ([ɲɲ]). The output for [w] is actually [ww] in some cases (in the table as well as in the explicit data provided by Andersen) which suggests that there is some optionality. Variability for both approximants could be derived by optional reranking of MAX$_{+n}$ and MAX$_{-c}$, whereas different behavior would require to take into account other constraints. Given the scarcity of the data, I will not attempt any such refinement of the analysis.

[24]The ranking developed here actually predicts that they would turn into nasals since MAX$_{+n}$ is crucially undominated. Note that applying grade 4.1° nasalization directly to input roots incorrectly predicts the output [ɲɲ] since [r] in Päri qualifies as [–anterior] as shown by its alternation with [ɟɟ] in grades 3.0° and 5.0°. The [–anterior] part in 4.1° [nn] is inherited from the coronal stop of the AP affix.

(119) shows how high-ranked Max_{+n} triggers overwriting of approximants by nasals

(119) **Approximant + Nasal** (4.1°)

Input: [+s–c+t][+n–t] (w.R)

	$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	Max_{+n}	Max_{-c}	$^{o}\text{Max}\overset{s}{\underset{\bullet}{\uparrow}}$	$\text{Max}\overset{s}{\underset{\bullet}{\uparrow}}$
☞ a. ([+s–c+t][+n–t])$_{PL,M}$ (m.m)				*		*
b. ([+s–c+t][+n–t])$_{PL}$ (w.m)		*!				
c. ([+s–c+t][+n–t])$_{PL,M}$ (w.w)			*!			

For stems ending in other sound classes mutation works in parallel to grade 4.0°.

7.4.6 5°: Sonorant+Stop Affixation

Grade 5° emulates the effect of applying grade 4.0° and consequently grade 3.0° mutation to a stem. Both nasals and stems mutate to homorganic nasal-stop clusters (120) Consequently I will represent this grade as the combination of the defective root nodes found in grades 4.0° and 3.0 (121):[25]

(120) **Consonant Mutation in Grade 5.0°**

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in grade 5°	mb	mb	ɟɟ	nd	?	?

(121) FQ ↔

```
+son  –son
  |     |
  •     •
```

This results again in coda+onset clusters, but here the two Cs correspond to two underlying affix Cs whereas the stem C is deleted due to high-ranked • → PL and the restricted phonotactics of Päri. At the I-representation we get PL-sharing among three different Cs (cf. the tableau in (98)). (122) demonstrates this for a stem-final stop. Faithfulness to the [–son] of the stem plosive becomes ineffective since $\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$ only requires survival of [±son] for segments which are in P. Hence we get full adherence to the [+son][–son] sequence specified in the affix Cs resulting in an unmarked nasal+stop sequence:

(122) **(Stop) + Sonorant+Stop** (5°)

Input: [–s][+s][–s] p.R.T)

	$*_r\text{PL}_n$	$\underline{(\text{N.T})}_{\text{PL}}$	MAX_{+n}	MAX_{-c}	$^{o}\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$	$\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$
a. ([–s] [+s][–s])$_{\text{PL,M}}$ (m.m)					*!	*
b. ([–s] [+s][–s])$_{\text{PL,M}}$ (p.p)						*!
☞ c. ([–s] [+s][–s])$_{\text{PL}}$ (m.p)						

This result transfers straightforwardly to stem-final nasals and [l]. The only candidates which satisfy $^{o}\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$ for these inputs realize the rightmost • of the affix as a stop, which leads to a nasal spellout for the leftmost affix-•, which is the only possibility which for an underlying [+son] C satisfies $\underline{(\text{N.T})}_{\text{PL}}$ and $\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$ at the same time. Hence we get nasal+stop clusters in all these cases. For stem-final [r], $*_r\text{PL}_n$ still blocks appearance of a nasal in the PL-sharing cluster overriding $\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$ (123-c) since the constraint is defined over the I-structure and with respect to the PL-feature common to all three segments (recall also that [r.t] would fatally violate $\underline{(\text{N.T})}_{\text{PL}}$). Whereas one [son] value of the affix-•s must give way to $*_r\text{PL}_n$, it is the [+s] of the coda, not the [–son] of the onset (123-b) which is deleted due to $^{o}\text{MAX}\overset{s}{\underset{\bullet}{\updownarrow}}$:

[25] Andersen doesn't provide data for stem-final glides. See below for discussion of the prediction the analysis provided here makes for these cases.

(123) **([r]) + Sonorant+Stop** (5°)

Input: [+s+r][+s][–s] r.R.T)

		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$^{s}_{\uparrow}$	MAX$^{s}_{\uparrow}$
☞	a. ([+s+r] [+s][–s])$_{PL,M}$ (ɟ.ɟ)						*
	b. ([+s+r] [+s][–s])$_{PL,M}$ (r.r)					*!	*
	c. ([+s+r] [+s][–s])$_{PL}$ (ɲ.ɟ)	*!					

Whereas Andersen doesn't provide data for stem-final glides, the prediction the constraint ranking makes is that the output is the same as for grade 3° mutation. MAX$_{-c}$ enforces survival of [–cons] resulting in double glides:

(124) **(Approximant) + Sonorant+Stop** (5°)

Input: [+s–c][+s][–s] r.R.T)

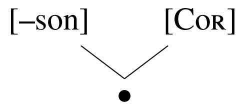
		$*_{r}PL_{n}$	$\underline{(N.T)}_{PL}$	MAX$_{+n}$	MAX$_{-c}$	^{o}MAX$^{s}_{\uparrow}$	MAX$^{s}_{\uparrow}$
	a. ([+s–c] [+s][–s])$_{PL,M}$ (m.m)				*!	*	*
☞	b. ([+s–c] [+s][–s])$_{PL,M}$ (w.w)						*
	c. ([+s–c] [+s][–s])$_{PL}$ (m.b)				*!		

7.4.7 Grade 2.1°: Antipassive

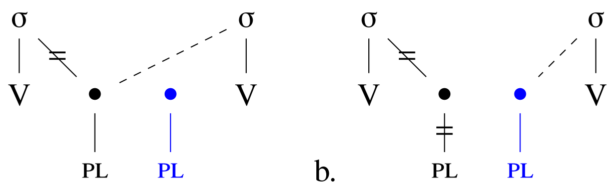
The analysis of the AP is almost completely identical to the one for the Mayak AP, but I present it here in full detail because Päri has a richer inventory of stem-final Cs and because I want to show that it is fully compatible with the overall analysis of Päri. Underlyingly the AP is again a stop/obstruent associated to [COR] place (126). Empirically the only difference to Mayak is that not only [l] is stopped, but also [r] (125):

(125) **Consonant Mutation in Grade 2.1°**

Stem-final C in Underived Stems	p	m	r	l	j	w
Stem-final C in grade 2.1° (AP)	p	m	t	t	j	w

(126) AP ↔ 

The underlying association of the affix-• to [COR] again effectively excludes PL-sharing (and consequently also sharing of manner features) by virtue of undominated $\underset{PL}{*}C_{PL}$ (see section 7.4.4 for detailed discussion). Thus the only potential candidates already determined by the constraints of stratum (i) and (ii) (cf. (94)) in tableau (97) have one of the shapes in (127) where either the stem-final or the affix–r is deleted:

(127) a. b. 

Thus in the tableaux of this subsection, I will systematically disregard candidates which realize both consonants, and most stratum (i) and (ii) constraints. This neglect extends to ^{o}MAX$\overset{\sigma}{\underset{\bullet}{\uparrow}}$ and MAX$\overset{\sigma}{\underset{\bullet}{\uparrow}}$ which are "freed" in mono-consonantal forms from the pressure of constraints on PL-sharing (which is systematically excluded in AP forms), and hence also manner-sharing. Thus there is no pressure by any constraints to change the manner features in the configurations in (127). However, MAX [c] and MAX [+nas] still exert interesting effects. All other constraints used here are of stratum (iv) in (94). (128) shows how the affix [t] "overwrites" stem [r] – in contrast to Mayak, MAX $\bullet_{[rhot]}$ is ranked below MAX $\bullet_{[-son]}$. In fact it is ranked so low in Päri that it does not exert any detectable effect and is hence also omitted in the following tableaux:

(128) **Deletion of Stem [r] before Affix [t] (2.1° Antipassive)**

Input: (r.t)

	MAX+n	MAX-c	MAX ●-son	MAX ●LAB,DOR	MAX ●-ant,+dist
a. (r.)			*!		
☞ b. (.t)					-ant

A further difference to Mayak is that Päri has glides at the input to the Stem Level. Here MAX-c becomes crucial to ensure survival of the approximants:

(129) **Deletion of Affix [t] after Stem [w] (2.1° Antipassive)**

Input: (w.t)

	MAX+n	MAX-c	MAX ●-son	MAX ●LAB,DOR	MAX ●-ant,+dist
☞ a. (w.)			*		
b. (.t)		*!		LAB	

(130) **Deletion of Affix [t] after Stem [j] (2.1° Antipassive)**

Input: (j.t)

	MAX+n	MAX-c	MAX ●-son	MAX ●LAB,DOR	MAX ●-ant,+dist
☞ a. (j.)			*		
b. (.t)		*!			–ant

For all other sound classes in stem-final positions the derivations run in parallel to the Mayak AP:

(131) **Deletion of Affix [t] after Stem Nasal (2.1° Antipassive)**

Input: (n.t)

	MAX+n	MAX-c	MAX ●-son	MAX ●LAB,DOR	MAX ●-ant,+dist
☞ a. (n.)			*		
b. (.t)	*!				

(132) **Deletion of Affix [t] after Stem [k] (2.1° Antipassive)**

Input: (k.t)

	MAX+n	MAX-c	MAX ●-son	MAX ●LAB,DOR	MAX ●-ant,+dist
☞ a. (k.)			*		
b. (.t)			*	DOR!	

(133) **Deletion of Affix [t] after Stem [t̻] (2.1° Antipassive)**

Input: (t̻.t)

	MAX$_{+n}$	MAX$_{-c}$	MAX •$_{-son}$	MAX •$_{LAB,DOR}$	MAX •$_{-ant,+dist}$
☞ a. (t̻.)			*		
b. (.t)			*		+dist!

(134) **Deletion of Affix [t] after Stem [c] (2.1° Antipassive)**

Input: (c.t)

	MAX$_{+n}$	MAX$_{-c}$	MAX •$_{-son}$	MAX •$_{LAB,DOR}$	MAX •$_{-ant,+dist}$
☞ a. (c.)			*		
b. (.t)			*		-ant!

7.4.8 Blocking among Mutation Patterns

Many combinations of different morphemes triggering consonant mutation seem to be ruled out for purely morphosyntactic or semantic reasons. Thus the only mutation-triggering derivational category which relatively freely combines with other derivational categories is the AP. Such combinations involving the AP have already been discussed in subsection 7.4.1. However, the person-number affixes seem to attach more or less freely to derived forms, exhibiting an interesting phenomenon, mutation blocking: Inflectional affixes which trigger mutation if affixed to non-derived verb roots fail to do so if they attach to a derived verb stem. This is illustrated in (135) for the LOC derivation, which is grade 2.0°, hence a Ø-marker which triggers insertion of the final derivational element, thereby intervocalic voicing of obstruents, and otherwise no overt changes in stem-final consonants. 1SG, 3SG, and 1PI are also grade 2.0°. whereas 1PE, 2PL, and 3PL are grade 3.0° triggered by the affixation of a PL-less stop (and also triggering morphologically insertion of the FDE). As we expect, the underived forms show the unmodified nasal before the 2.0° suffixes, and the post-stopped forms before the 3.0 suffixes. Also the 1SG, 3SG, 1PI forms of the LOC show the unmodified nasal as expected since both , the involved derivational an d inflectional categories trigger grade 2.0°, hence no modification of sonorants. The crucial and surprising part of the paradigm are the 1PE, 2PL, 3PL (grade 3.0°) forms of the LOC. What we intuitively expect is that the locative derivation applies first and vacuously (*a-lɛ:*ŋ ⇒ *a-lɛ:*ŋ) and provides the input for inflectional suffixation and 2.0° mutation resulting in post-stopping (*a-lɛ:*ŋ ⇒ *a-lɛ:*ŋ***g***-ʊ). However, this is not what we find: In some way, the application of grade 2.0° derivation seems to block the effect of grade 3.0° inflection – no post-stopping applies:

(135) **Derivational Grade 2.0° Mutation Blocks Inflectional Grade 3.0° Mutation**

		—	2.0° LOC
1.0°	**2SG**	a-lɛːŋ-ɪ	a-lɛːŋ-ɪ
	1SG	a-lɛːŋ-a	a-lɛːŋ-a
2.0°	**3SG**	a-lɛːŋ-ɛ	a-lɛːŋ-ɛ
	1PI	a-lɛːŋ-ɔ	a-lɛːŋ-ɔ
	1PE	a-lɛːŋ**g**-a	a-lɛːŋ-ʊ-wa
3.0°	**2PL**	a-lɛːŋ**g**-ʊ	a-lɛːŋ-ʊ
	3PL	a-lɛːŋg-ɛ	a-lɛːŋ-ɪ-gɪ

This effect is not restricted to the specific case in (135), but as shown by Andersen (1988), completely general: Derivation blocks any effect of mutation by inflectional categories.

Here I show that this blocking derives from the analysis developed so far and a generalized constraint against crossing association lines in PL-sharing, leading to intervention of segments between the potential PL-sharers. Crucially, there is no interleaving of affixation and phonology in this case: All grade 2.0° and grade 3.0° affixes are Stem Level, and the correct 2PL LOC output has the phonological representation in (136) at this stratum

(136) **2PL LOC Form**

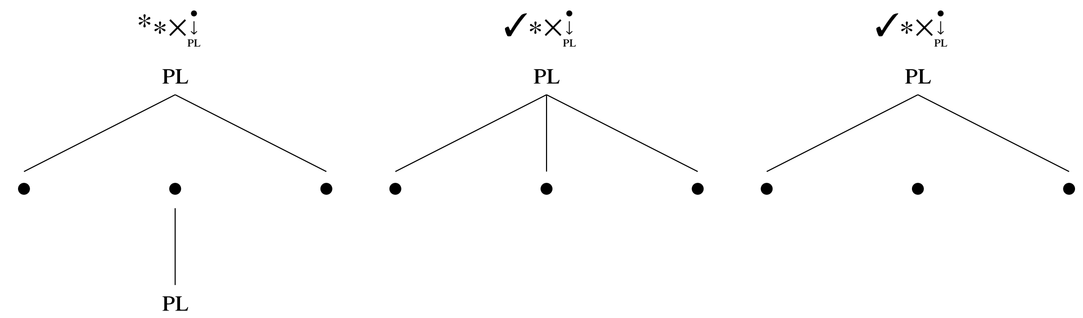
a-	lɛːŋ	-Ø	-V	-C ʊ
PREF	Root	LOC	FDE	2PL

Intuitively what bars the PL-less C of the 2PL suffix to share PL with the stem-final consonant is the intervening vowel which is also associated to a PL node. I formulate the relevant constraint against no-crossing in (137).

(137) $*\times^{\bullet}_{\downarrow\,\text{PL}}$ Assign $*$ to every triple of root nodes (R_1, R_2, R_3) in I such that:
(i) $R_1 \prec R_2 \prec R_3$
(ii) R_1 and R_3 dominate the PL node P_1, R_2 dominates the PL node P_2
(iii) $P_1 \neq P_2$

Note that the constraint formulation doesn't explicitly mention crossing which is highly dependent on the correct graphical representation of tiers, whereas (137) is more independent of the spatial imagination of the observer, but captures the same intuition . Crucially PL-sharing among stem and affix C in (136) would correspond to the constellation in (138-a) which violates $*\times^{\bullet}_{\downarrow\,\text{PL}}$ and is hence ruled out.

(138)

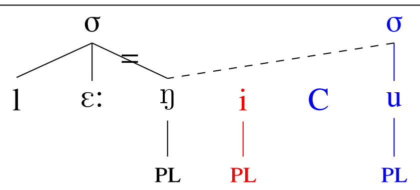
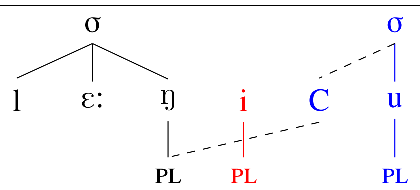
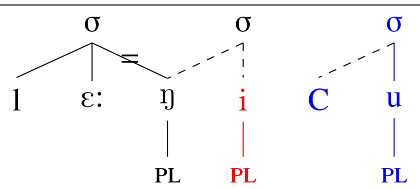
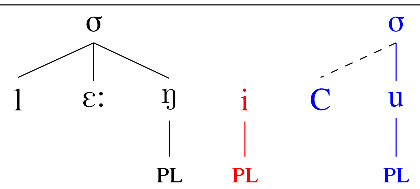
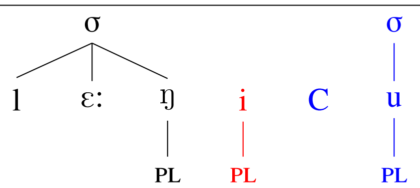


The tableau in (140) shows how this works in detail for the 2PL LOC form (red marks the FDE, and blue the inflectional suffix). Resyllabification is driven by the CODACONDITION: The PL-feature of [ŋ] cannot remain in word-internal coda position (139-d,e), and as a consequence [ŋ] is syllabified as the onset of the affix σ. Resyllabifying [ŋ] as the onset of a σ headed by FDE -*i* (139-c) leads to a hiatus configuration excluded by $*P_\nu P_\nu$ repeated in (139) which penalizes adjacent PL-features linked to different σ-nuclei. Indirect licensing of PL via sharing with the PL-less affix C would also satisfy CODACONDITION (and as an additional bonus $\bullet \rightarrow$ PL), but is blocked by $*\times\overset{\bullet}{\underset{\text{PL}}{\downarrow}}$ (139-b):

(139) $*\underline{PL}_\nu\underline{PL}_\nu$ Assign ∗ to every pair of P-adjacent PL nodes which are linked to different σ-nuclei

(140) **Derivational Grade 2.0° Mutation Blocks Inflectional Grade 3.0° Mutation**

Input: lɛːŋ+i+Cu

	$*\times\overset{\bullet}{\underset{\text{PL}}{\downarrow}}$	$*\underline{PL}_\nu\underline{PL}_\nu$	CODCON	$*_{\text{PL}}C_{\text{PL}}$	$\overset{\bullet}{\underset{\text{PL}}{\downarrow}}$
☞ a.  (lɛː.ŋu)					*
b.  (lɛːŋ.gu)	*!				
c.  (lɛː.ŋi.Cu)		*!			*
d.  (lɛːŋ.Cu)			*!		*
e.  (lɛːŋiCu)			*!		*

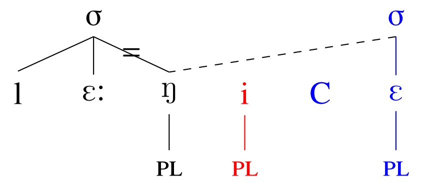
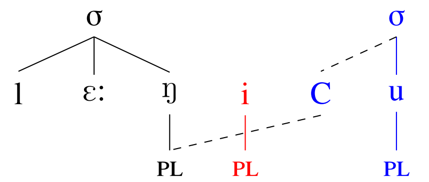
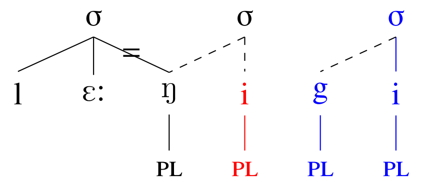
What is still missing from the picture is an account of the allomorphy found in 1PE and 3PL forms, where we get the grade 3.0° suffixes -*Ca* and -*Cɛ* for underived forms, and -*wa*/1PE vs. -*gɪ* for the derived forms where the FDE vowel -*i* which is otherwise deleted in forms with inflectional suffixes exceptionally emerges (and assimilates to the [w] of *-wa* in the 1PE).[26] Before the background of the analysis developed so far, this can be modeled as a case of straightforward phonological conditioned suppletion among the disjunctively specified exponents in (141):

(141) $3PL \leftrightarrow \left\{ \begin{array}{c} \text{-gI} \\ \text{-C}\varepsilon \end{array} \right\} \qquad 1PE \leftrightarrow \left\{ \begin{array}{c} \text{-a} \\ \text{-wa} \end{array} \right\}$

(142) shows the selection of the correct marker for the 3PL LOC (cf. (135)). Since the verb has undergone derivational morphology it bears the FDE *-i*. Choosing *-Cɛ* as the input form of the 3PL suffix leads to the dilemma already familiar from tableau (140): either NoCrossing is violated (142-b) or the affix C remains without PL-specification violating • → PL (142-a). Choosing *-gɪ* instead allows to satisfy all high-ranked constraints:

(142) **Allomorph Selection (Derived Form: 3PL LOC)**

Input: lɛːŋ+ i + $\left\{ \begin{array}{c} \text{-gI} \\ \text{-C}\varepsilon \end{array} \right\}$

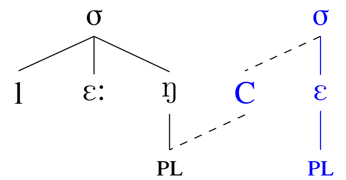
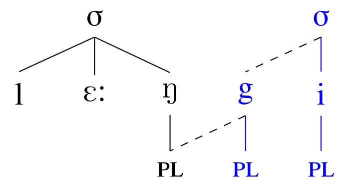
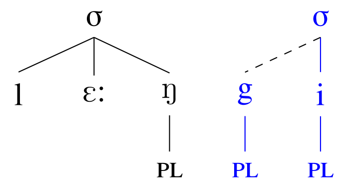
	*×↓PL	*PLᵥPLᵥ	Cod / Con	*PL C PL	• ↓ PL
a.  (lɛː.ŋɛ)					*!
b.  (lɛː.ŋ.gɛ)	*!				
☞ c.  (lɛː.ŋi.gi)					

[26] Andersen (p.80) calls *-wa* and *-gɪ* “ergative” enclitics.

In an underived form, there is no additional (FDE) vowel, and using the *-gɪ* allomorph leads into trouble because straightforward affixation + syllabification leaves the PL-feature of the stem in a pure coda position violating the CodaCondition (143-c). PL-sharing with the affixal [g] is excluded by *[CC]. On the other hand, in this context, the PL-less C of the -Cɛ-allomorph can be incorporated by standard PL-sharing without violating any of the high-ranked constraints (143-a):

(143) **Allomorph Selection (Underived Form)**

Input: lɛ:ŋ+ { -gI / -Cɛ }

	$*\times\overset{\bullet}{\downarrow}_{\text{PL}}$	$*\underline{\text{PL}_\gamma\text{PL}_\gamma}$	$\underline{\text{CodCon}}$	$*_{\text{PL}}\text{C}_{\text{PL}}$	$\overset{\bullet}{\downarrow}$ PL
☞ a.  (lɛ:.ŋ.gɛ)					
b.  (lɛ:ŋ.gi)				*!	
c.  (lɛ:ŋ.gi)			*!		

Let us consider a second example for blocking among mutation processes to see that the analysis is fully general (the number of interestingly different sub-cases is in fact limited by the restriction that Stem-Level inflectional suffixes only exhibit grades 2.0° and 3.0°). (144) illustrates a case where blocking is triggered by a grade 3.0° derivation. (144-i) gives the raw data, and (144-ii) the morphological and phonological structure of the forms at the Stem Level, where the second t̪ in the C-clusters corresponds to the underspecified affix C responsible for grade 3.0° mutation (2SG doesn't contain an affix in (144-ii) because the 1SG suffix is Word Level):

(144) **Derivational Grade 3.0° Mutation Blocks Inflectional Grade 2.0° Mutation**

(i)		—	**3.0° BEN**
1.0°	**2SG**	a-ɲʊ:t̪ -ɪ	a-ɲut̪-ɪ
	1SG	a-ɲʊ:d̪ -a	a-ɲut̪t̪ -a
2.0°	**3SG**	a-ɲʊ:d̪ -ɛ	a-ɲut̪t̪ -ɛ
	1PI	a-ɲʊ:d̪ -ɔ	a-ɲut̪t̪ -ɔ
	1PE	a-ɲʊ:t̪t̪-a	a-ɲut̪t̪ -ʊ-wa
3.0°	**2PL**	a-ɲʊ:t̪t̪-ʊ	a-ɲut̪t̪ -ʊ
	3PL	a-ɲʊ:t̪t̪-ɛ	a-ɲut̪t̪ -ɪ-gɪ

(ii)		—	**3.0° BEN**
1.0°	**2SG**	a-ɲʊ:t̪	a-ɲut̪
	1SG	a-ɲʊ:d̪-a	a-ɲut̪-t̪-i-a
2.0°	**3SG**	a-ɲʊ:d̪-ɛ	a-ɲut̪-t̪-i-ɛ
	1PI	a-ɲʊ:d̪-ɔ	a-ɲut̪-t̪-i-ɔ
	1PE	a-ɲʊ:t̪-t̪a	a-ɲut̪-t̪-ʊ-wa
3.0°	**2PL**	a-ɲʊ:t̪-t̪ʊ	a-ɲut̪-t̪-i-Cʊ
	3PL	a-ɲʊ:t̪-t̪ɛ	a-ɲut̪-t̪-ɪ-gɪ

That no grade 2.0° mutation applies to BEN forms follows directly from the phonological analysis developed so far: Grade 2.0° mutation is simply intervocalic voicing, i.e. a singleton obstruents between a left- and a right-adjacent V voices Since the BEN C leads to the C-cluster t̪t̪, there is no intervocalic singleton obstruent which could trigger Intervocalic voicing, and we get default voicelessness (cf. section 7.4.2) . In the 2PL, the BEN morpheme as well as the agreement suffix are grade 3.0° and bring a PL-less stop with them. Whereas the first one shares the PL-feature of the stem-final [t̪], the second one is again blocked to do so by the intervening V. 1PE and 3PL choose again the allomorphs with fully specified onset Cs avoiding the intervention problem.

Consider finally blocking in the context of 2SG *-i*. Here blocking follows from rather trivial reasons. As I have argued in subsection 7.4.2, 2SG is a Word-Level affix suffixed to the stem which results as output from Word-Level computation. Thus the apparent final obstruent devoicing which *-i* imposes on obstruents is just Word-Level affixation to stems which have undergone word-final devoicing at the Stem Level. Since all derivation is Stem-Level, this account straightforwardly transfers to derived stems. For example suffixing 2SG *-i* to a grade 2.0° form such as *a-ŋɔd-i*, 'to cut LOC' (p.90) would result in *a-ŋɔd-i* not *a-ŋɔt-i* since 2SG simply affixes to the Stem Level locative form.[27]

[27]The 2SG form *a-ŋɔd-i* is in line with Andersen's explicit description of the facts, but empirically hypothetical: Andersen doesn't provide a straightforward example where 2.0 derivation applies to an obstruent-final stem, he only gives related examples with palatals which involve additional morphophonological complications.

7.5 Anywa

Anywa has a similarly rich inventory of mutation-inducing •s as Päri. In fact, the detailed grammar by Reh (1993) provides extensive information on mutation in the nominal paradigm whereas our information on Päri (and Mayak) in this respect is restricted to the verbal system. (145) shows all relevant mutation patterns (the page numbers refer to Reh 1993). *-CI* and *-Wu* are nominal plural forms, and *-jɛ* a singulative affix (Reh uses the capital letters "C", "W", and "J" to indicate the mutation-inducing behavior of these affixes, a convention I adopt here since it allows to distinguish mutation-inducing number affixes from otherwise homophonous affixes). MN ('modified noun') is the consonant mutation pattern found in modified noun forms, the forms head nouns in a noun phrase adopt when they are modified by possessors or demonstratives; similar morphological categories are called anti-genitive, and status constructus in the literature). MNs is the MN-pattern found for singular nouns, MNp the one for plural forms. Similarly there are two different patterns found in INC(choative) mutation, one used after roots with long vowels (INC_1), and one used after roots with short root vowels (INC_2):

(145) **Patterns of Consonant Mutation in Anywa**

/j/	j	j:	j:	j:	j:	j:	ɲ:	ɲ:	j:
/w/	w	w:	w:	w:	w:	w:	m:	m:	w:
/p/	p	p:	p:	p:	p:	m:	m:	m:	m:
/m/	m	m:	m:	m	p:	m:	m:	m:	m:
/r/	r/t	r:	ɟ:	r	ɟ:	ɟ:	ɲ:	r:	ɟ:/ɲ:
/l/	t	l:	l:	l	t:	l:	l:	l:	l:
	AP	-CI/-Wu	-jɛ	FC/-ji	MNp	FQ	INC_1	INC_2	MNs
p.	222	105	103	236	123	244	247	248	118

As in Päri, the FC marker *-a* and 2SG *-ji* show a markedly different mutation behavior. Thus both MNp and FC/2SG induce stopping, but stopping applies consistently to all stem Cs only in the MNp, whereas sonorant Cs in the FC/*-ji* construction remain unaffected. In fact, FC/2SG are the only mutation-inducing categories in Anywa – apart from the AP – which don't lead to doubling of all stem-final Cs. Therefore I will assume that FC and 2SG *-ji*, and all other verbal agreement suffixes which do not induce mutation, are Word-Level affixes. Independent evidence for this classification comes from phonotactics: Agreement suffixes are the only suffixes in the languages which may result in coda+onset sequences which are not homorganic as shown by the examples in (146). Thus at the Stem-Level, the CODACONDITION holds again without exceptions.[28]

[28] Non-homorganic coda+onset sequences do also not occur at prefix-root boundaries since there are no consonant-final prefixes (affixes). It is possible (and predicted by the formulation of CODACONDITION in (14)) that they occur at root.root boundaries in compounds since these form independent PWords, as shown in chapter 5 for tone.

(146) **Heterorganic Coda+Onset Clusters in Anywa Agreement Suffixes (Reh 1993:194)**

1SG	/ˈɔ̀tɔ́	ā-gɛ́ːr-ā./	'I built the house'
	house	PA-build-1SG	
2SG	/ˈɔ̀tɔ́	ā-gɛ́ːr-í./	
3SG	/ˈɔ̀tɔ́	ā-gɛ́ːr-ɛ̄./	
1PI	/ˈɔ̀tɔ́	ā-gɛ̀ːr-ɔ́./	
1PE	/ˈɔ̀tɔ́	ā-gɛ́ːr-wā./	
2PL	/ˈɔ̀tɔ́	ā-gɛ́ːr-ʊ̄./	
3PL	/ˈɔ̀tɔ́	ā-gɛ́ːr-gī./	
IDF	/ˈɔ̀tɔ́	ā-gɛ̌ːr./	

I will discuss Word-Level mutation in subsection 7.5.4 and Stem-Level morphemes in subsections 7.5.2 and 7.5.3 after some crucial remarks on the phonology of Anywa obstruents (subsection 7.5.1) .

7.5.1 Phonological Preliminaries: Anywa Obstruents

Whereas obstruent voicing in root-initial position is fully distinctive, voicing of obstruents in root-final position is perfectly predictable (Reh 1993:28ff): Geminate obstruents are consistently voiceless if they do not undergo other modifications (such as shortening or lenition to be discussed below). Singleton stops are voiced in intervocalic position, and voiceless in word-final position.[29] Dorsal and palatal sounds undergo a number of lenition processes intervocalically. Most crucially, singleton [w],[j], [k], and [ɟ] are deleted in this context.[30] Geminate [ɟɟ] is glided, and [kk] shortened:

(147) **Intervocalic Lenition of Non-Anterior Consonants**

(i)	[w],[j], [k], [ɟ]	⇒	Ø
(ii)	[ɟɟ]	⇒	[jj]
(iii)	[kk]	⇒	[k]

Pattern (ii) is of especial importance for the analysis: If a mutation process results in the phonetic sequence [j:], this is systematically ambiguous between phonological [ɟɟ] and [jj]. In fact, Reh's description of mutation patterns seems to fluctuate freely between these two possible analyses. In the following, I will assume that lengthening mutation of [j] systematically results in [jj] (/j/ ⇒ [jj] ⇒ [j:]), while all cases of mutation where underlying [r] leads to phonetic [j:] go through an intermediate step of stopping at the Stem Level (/r/ ⇒ [ɟɟ] ⇒. [j:]). This is justified by bigger consistency of analysis: In the contexts where singleton /j/ is lengthened, also /w/ is lengthened, but never stopped. Assuming that /j/ gets [ɟɟ] in these contexts would require the problematic assumption that the two glide sounds behave phonologically in very different ways.[31] On the other hand, /r/ typically results in phonetic [j:] in contexts which otherwise trigger stopping, such as MNp stopping which transforms nasals, and laterals into stops.

[29] A third case, syllable-final position before a consonant-initial suffix, occurs only at the Word-Level with the two C-initial agreement suffixes *-gi*, 3PL and *-wa*, 1PE. To be sure, these are the only two suffixes in the language that surface with a C which does not share all features in a geminate-like manner with a preceding stem-final C. What Reh describes in this case sounds like incomplete devoicing (Reh 1993:30).

[30] This is concomitant with compensatory lengthening of the preceding stem vowel if the latter is short.

[31] Moreover this would lead to a Duke-of-York gambit McCarthy (2003c) which is probably problematic for learnability: [j] would first undergo stopping to return to glide status later on.

7.5.2 Emergence of Segments in Stem-Level Mutation

As is obvious from (148), a systematic difference between Päri and Anywa is that the latter requires exceptionless sharing of manner features among clusters of PL-sharing segments (note that I have split MNs into two patterns, $\text{MNs}_{ɟ}$ and $\text{MNs}_{ɲ}$, corresponding to the variable realization of input [r] in this context, cf. (145)).

(148) **Patterns of Stem-Level Mutation in Anywa**

	AP	**-Cɪ**	**-ɟɛ**	**MNp**	**FQ/MNs$_{ɟ}$**	**INC$_1$**	**INC$_2$**	**MNs$_{ɲ}$**
/j/	j	jj	jj	jj	jj	ɲɲ		jj
/w/	w	ww	ww	ww	ww	mm		ww
/p/	p	pp	pp	pp	mm	mm		mm
/m/	m	mm	mm	pp	mm	mm		mm
/r/	r/t	rr	ɟɟ	ɟɟ	ɟɟ	ɲɲ	rr	ɲɲ
/l/	t	ll	ll	tt	ll	ll		ll
p.	222	105	103	123	244/118	247	248	118

I assume that this is due to undominated $\underline{\text{SHR}}\overset{\text{M}}{\underset{\text{PL}}{\uparrow}}$ constraints for all manner features, such as (149) (repeated from (101)) for [±cont], requiring that segments which share PL also share specific manner features.

(149) $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{cont}}{\uparrow}}$ Assign ∗ to every pair of •s which share PL, but not [±cont] in P

Since the manner ⇒ constraints such as (150) are undominated throughout Western Nilotic, segments share manner if and only if they also share PL ((150) repeated from (102)) .

(150) $\underline{\text{SHR}}\overset{\text{cont}}{\underset{\text{PL}}{\uparrow}}$ Assign ∗ to every pair of •s which share [±cont], but not PL in P

Both groups of constraints will be collectively abbreviated in the following as $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{M}}{\updownarrow}}$. As for Päri, I assume that the $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{M}}{\uparrow}}$ constraints are undominated, just as DEP [+rhot], [+lat], [+cons]. In fact, apart from $\underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{M}}{\updownarrow}}$, the ranking is virtually identical to the one of Päri (note that MAX • is ranked relatively low because it is violated in AP forms):

(151) $\{ \frac{\underline{\text{COD}}}{\underline{\text{CON}}}, \overset{\bullet}{\underset{\text{PL}}{\downarrow}}, \underline{\text{SHR}}\overset{\text{PL}}{\underset{\text{M}}{\updownarrow}}, *[\underline{\text{CC}}], {}_{\text{PL}}^{*}\text{C}_{\text{PL}} \} \gg \text{MAX} \bullet$

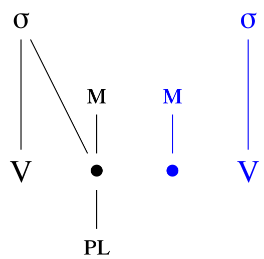
(152) shows the underlying representations of mutation-inducing Stem-Level Affixes:

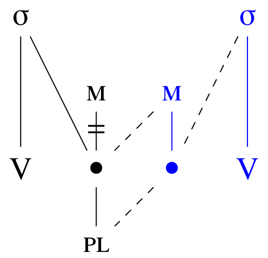
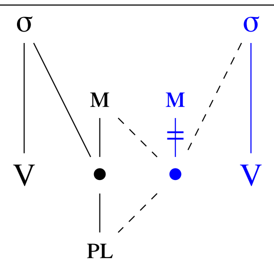
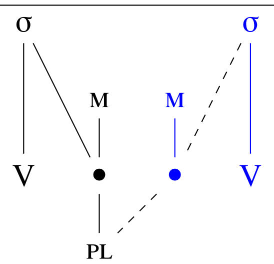
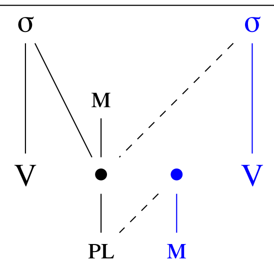
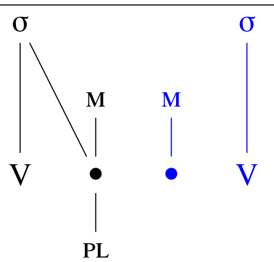
(152) **Patterns of Stem-Level Mutation in Anywa**

	AP	**-CI**	**-ɟɛ**	**MNp**	**FQ/MNs$_{ɟ}$**	**INC$_1$**	**INC$_2$**	**MNs$_{ɲ}$**
	[–son] | •$_{COR}$ | [–cont]	•	• | [–cont]	[–son] | •	[+nas] | • | [–cont]	[+son] | •$_{+c}$ | [–cont]	[+son] | •$_{+c}$	[+son] | • | [–cont]
/j/	j	jj	jj	jj	jj	ɲɲ		jj
/w/	w	ww	ww	ww	ww	mm		ww
/p/	p	pp	pp	pp	mm	mm		mm
/m/	m	mm	mm	pp	mm	mm		mm
/r/	r/t	rr	ɟɟ	ɟɟ	ɟɟ	ɲɲ	rr	ɲɲ
/l/	t	ll	ll	tt	ll	ll		ll
p.	(222)	(105)	(103)	(123)	(244/118)	(247)	(248)	(118)

For PL-sharing, there are two relevant subcases: Affixation of a single PL-less • (in most mutation patterns), and affixation of a • associated to a PL-node (in the AP). The first case is illustrated in (153) M is a shorthand for arbitrary manner features (thus it does not indicate a feature-geometric manner node á la Clements 1985, Sagey 1986, Clements and Hume 1995). Due to MAX • and • → PL, both Cs are integrated into prosodic structure dominating the same PL node (DEP PL is again undominated). Since Anywa doesn't countenance complex syllable margins (again implemented by undominated *[CC]) we get a coda+onset cluster:

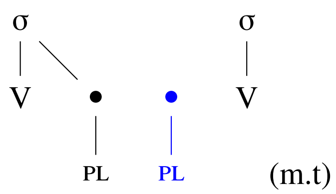
(153) **Doubling under •-Affixation**

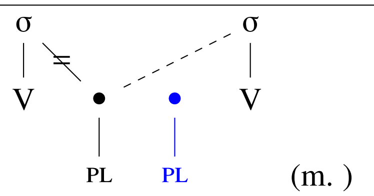
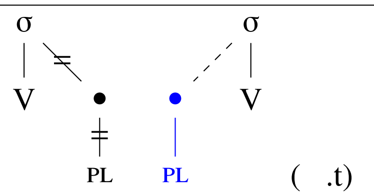
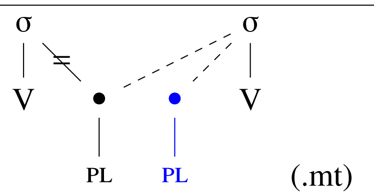
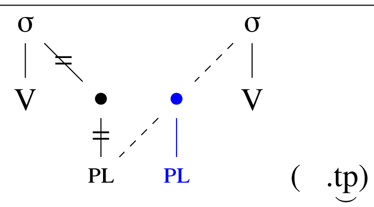
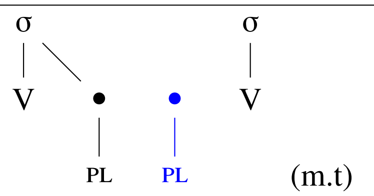
Input:  (m.T)

	CoD CoN	SHR↕ (PL/M)	*[CC]	$*C_{PL}$ (PL)	• ↓ PL	⊙PL⊙ (*)	Max •
☞ a.  (p.p)							
☞ b.  (m.m)							
c.  (m.p)		*!					
d.  (.m)						*!	*
f.  (m.)					*!		*

In the AP, PL-sharing is again ruled out in favor of segment deletion by virtue of the ranking $\overset{*}{_{PL}}C_{PL} \gg$ MAX •. • → PL is again irrelevant (vacuously satisfied) since both Cs are already underlyingly dominating a PL node. Since both segments cannot share PL they are also barred from sharing any manner features by virtue of $\underline{\text{SHR}}\overset{PL}{\underset{M}{\updownarrow}}$.

(154) **No Doubling (and Manner sharing) under •|PL Affixation (Antipassive)**

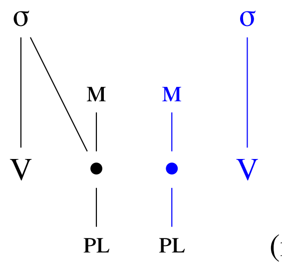
Input: 

	CodCon	$\text{SHR}\overset{PL}{\underset{M}{\updownarrow}}$	*[CC]	$\overset{*}{_{PL}}C_{PL}$	• ↓ PL	$\overset{\odot}{_{*}}$PL$^{\odot}$	MAX •
☞ a. 							*
☞ b. 							*
c. 			*!				
d. 				*!			*
e. 	*!						*

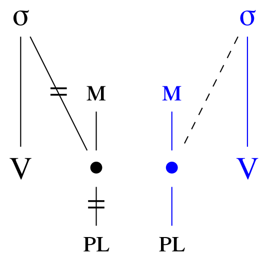
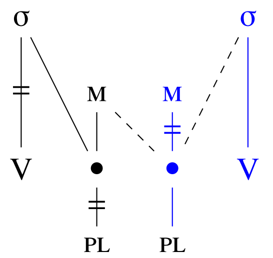
The choice which of the two Cs actually survives is determined in a way which is empirically virtually identical to the one found in Päri, and I will assume that this is the effect of the same lower-ranked faithfulness constraints not depicted here.The only interesting difference is that in a addition to [l], the AP also leads to [t] for underlying /r/. This might be captured by adding a specific faithfulness constraints for rhotics which is ranked variable above/below the MAX •$_{\text{-son}}$ of the Päri ranking (cf. the tableau in (128)). However, the actual behavior of underlying /r/ in AP forms seems to depend on the specific lexical item involved (Reh 1993:224-225). Hence it might well be that the alternation is actually a case of morphological suppletion. Therefore I won't discuss this problem further here.

Failure of PL-sharing immediately leads to failure of manner sharing as shown by the competition between (154-b) represented more in detail in (155-a) and a slight variant where the surviving affix C inherits the manner features of the deleted stem C:

(155) **No Manner Sharing under •|PL Affixation (Antipassive)**



Input: (m.T)

	CODCON	SHR PL↕M	*[CC]	*C$_{PL}$ (PL)	•↓PL	⊙PL⊙ (*)	MAX •
☞ a.  (.t)							*
b.  (.n)		*!					*

7.5.3 Emergence of Manner Features in Stem-Level •-Mutation

Let us now turn to the distribution of manner features for the cases where mutation is triggered by a PL-less •-node. The mutation patterns and affix representations are repeated in (156) and (157):

(156) **Patterns of Stem-Level Mutation in Anywa**

	[–son] | $\bullet_{COR}$ | [–cont]	•	• | [–cont]	[–son] | •	[+nas] | • | [–cont]	[+son] | $\bullet_{+c}$ | [–cont]	[+son] | $\bullet_{+c}$	[+son] | • | [–cont]
/j/	j	jj	jj	jj	jj	ɲɲ		jj
/w/	w	ww	ww	ww	ww	mm		ww
/p/	p	pp	pp	pp	mm	mm		mm
/m/	m	mm	mm	pp	mm	mm		mm
/r/	r/t	rr	ɟɟ	ɟɟ	ɟɟ	ɲɲ	rr	ɲɲ
/l/	t	ll	ll	tt	ll	ll		ll
	AP	**-Cɪ**	**-ɟɛ**	**MNp**	**FQ/MNs$_{ɟ}$**	**INC$_1$**	**INC$_2$**	**MNs$_{ɲ}$**
p.	(222)	(105)	(103)	(123)	(244/118)	(247)	(248)	(118)

Given the underlying representation of exponents in (156), the survival of manner features in Anywa C clusters follows the principles in (157):

(157) **Principles of Manner Realization in Anywa**

1. **Glides and [cons]:** If the affix is specified as [+cons], the cluster gets [+cons], otherwise the glide is retained (remains [–cons])

2. **Dominance of affix [son] and [cont]:** [±son] and [±cont] values of affixes always surface in the cluster as long as this is compatible with (1.)

3. **Intermediate Status of [l]:** The lateral gets a stop for affix [–son] (in accordance with (2.)), but gets never nasalized

4. **The Nasophophia of [r]:** [r] rather stops than nasalizes with affix [–cont], [–son] and [+nas]. It only nasalizes under the combined force of affix [+son] and [–cont] (obeying (2.))

I implement this distribution by the ranking of constraints shown in (158) which closely corresponds to the observations in (157). All constraints are segment-feature MAX constraints except for $*_{r}\bullet_{n}$ which implements [r]'s reluctance to get a nasal (159).[32] Note that all constraints in (158) are ranked below the constraints discussed in subsection 7.5.2, and don't have any effect on whether one or two input segments are realized):

(158) $\{{}^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}, \text{MAX}\overset{\bullet}{\downarrow}_{c}\} \gg {}^{o}\text{MAX}\overset{\bullet}{\downarrow}_{s,t} \gg \text{MAX}\overset{\bullet}{\downarrow}_{l} \gg *_{r}\bullet_{n} \gg {}^{o}\text{MAX}\overset{\bullet}{\downarrow}_{n} \gg \text{MAX}\overset{\bullet}{\downarrow}_{s,t,n}$

(159) $*_{r}\bullet_{n}$ Assign $*$ to every • which is associated to [+rhot] and [+nas] in I

[32]This is slightly different from the similar constraint active in Anywa which penalizes PL linked to [+r] and [+n].

Let us now go through all relevant classes of stem-final Cs and consider by which affix-•s they are overwritten manner-wise, and conversely on which affix Cs they impose their manner features.

Stem-final Glides: If the affix C is not specified for [±cons] such as in MNp stopping, $^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}$ is vacuously satisfied by all outputs since the onset C has no underlying [cons] feature to be faithful to, and $\text{MAX}\overset{\bullet}{\downarrow}_{c}$ will favor realization of the stem C's [–cons]. Since the only [–cons] sounds which Anywa allows in coda position are glides (hence [–continuant] and [+sonorant]) we get double glides:

(160) **[w] ⇒ [ww]** (MNp Stopping)

Input: [–c+s+t][–s] (w.T)

	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{s,t}$	$\text{MAX}\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{n}$	$\text{MAX}\overset{\bullet}{\downarrow}_{s,t,n}$
☞ a. [–c+s+t][–s] (ww)			*				*
b. [–c+s+t][–s] (pp)		*!					***

On the other hand, if the affix is explicitly specified as [+cons] (which is true only for INC_1 and INC_2), this feature value overwrites the manner features of an underlying stem glide: (161-a) and (161-b) tie on $\text{MAX}\overset{\bullet}{\downarrow}_{c}$, and $^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}$ favors survival of the affix C's [+c]. Undominated DEP [lat] and DEP [rhot] ensure that possible output sonorant consonants are always nasal:

(161) **[w] ⇒ [ww]** (INC_2 Nasalization)

Input: [–c+s+t][+c+s] (w.R)

	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{s,t}$	$\text{MAX}\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{n}$	$\text{MAX}\overset{\bullet}{\downarrow}_{s,t,n}$
a. [–c+s+t][+c+s] (ww)	*!	*					
☞ b. [–c+s+t][+c+s] (mm)		*					*

Stem-final [l]: All affix-•s except MNp and FQ/$\text{MNs}_{ɟ}$ contain exclusively features for which [l] is already specified underlyingly ([+son], [+cons], and [–cont]). Hence the manner features of [l] are fully preserved in the CC cluster, resulting in double [l]s:

(162) **[l] ⇒ [ll]** ($\text{MNs}_{ɲ}$ Nasalization)

Input: [+s–t+l][+s–t] (l.T)

	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$\text{MAX}\overset{\bullet}{\downarrow}_{c}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{s,t}$	$\text{MAX}\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	$^{o}\text{MAX}\overset{\bullet}{\downarrow}_{n}$	$\text{MAX}\overset{\bullet}{\downarrow}_{s,t,n}$
a. [+s–t+l][+s–t] (nn)				*!			
☞ b. [+s–t+l][+s–t] (ll)							

The first case of real conflict is the [–son] specification of MNp which leads to stopping to maintain the [son] value of the affix/onset:

(163) **[l]** ⇒ **[tt]** (MNp Stopping)

Input: [+s+l–t][–s] (l.T)

	°MAX$\overset{\bullet}{\downarrow}_{c}$	MAX$\overset{\bullet}{\downarrow}_{c}$	°MAX$\overset{\bullet}{\downarrow}_{s,t}$	MAX$\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	°MAX$\overset{\bullet}{\downarrow}_{n}$	MAX$\overset{\bullet}{\downarrow}_{s,t,n}$
a. [+s+l–t][**–s**] (ll)			*!				*
☞ b. [**+s+l** –t][–s] (tt)				*			*

The other case of conflict is FQ/MNs$_{ɟ}$ nasalization. Here [l] prevails due to the ranking MAX$\overset{\bullet}{\downarrow}_{l}$ ≫ °MAX$\overset{\bullet}{\downarrow}_{n}$:

(164) **[l]** ⇒ **[ll]** (FQ Nasalization)

Input: [+s+l–t][+n-t] (l.T)

	°MAX$\overset{\bullet}{\downarrow}_{c}$	MAX$\overset{\bullet}{\downarrow}_{c}$	°MAX$\overset{\bullet}{\downarrow}_{s,t}$	MAX$\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	°MAX$\overset{\bullet}{\downarrow}_{n}$	MAX$\overset{\bullet}{\downarrow}_{s,t,n}$
a. [**+s+l** –t][**+n**–t] (tt)				*!			**
b. [+s**+l**–t][+n–t] (nn)				*!			
☞ c. [+s+l–t][**+n**–t] (ll)						*	*

Stem-final [r]: is transformed into a stop whenever the affix C is specified as [–cont] (but not [+son]) as with -ɟɛ, and FQ/MNs$_{ɟ}$ - or [–son] as with MNp. The nasal option (165-b) is excluded by high-ranked $*_{r}\bullet_{n}$:

(165) **[r]** ⇒ [ɟɟ] (-ɟɛ-Stopping)

Input: [+c+s+t][–t] (r.J)

	°MAX$\overset{\bullet}{\downarrow}_{c}$	MAX$\overset{\bullet}{\downarrow}_{c}$	°MAX$\overset{\bullet}{\downarrow}_{s,t}$	MAX$\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	°MAX$\overset{\bullet}{\downarrow}_{n}$	MAX$\overset{\bullet}{\downarrow}_{s,t,n}$
☞ a. [+c**+s+t**][–t] (ɟɟ)							**
b. [+c+s**+t**][–t] (nn)					*!		*
c. [+c+s+t][**–t**] (rr)			*!				*

The INC$_2$ •, which is only specified [+son+cons], is trivially compatible with [r] and results in [rr]. If the affix-• is specified [+son–cont] as in INC$_1$ and MNs$_{ɲ}$, we get nasalization of stem-final [r] since this is the only way to maintain a [+s-t] sound without inserting [+lat] which is excluded by undominated DEP [lat].

(166) **[r]** ⇒ **[ɲɲ]** (INC$_1$ Nasalization)

Input: [+c+s+t][+c+s–t] (r.J)

	°MAX$\overset{\bullet}{\downarrow}_{c}$	MAX$\overset{\bullet}{\downarrow}_{c}$	°MAX$\overset{\bullet}{\downarrow}_{s,t}$	MAX$\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	°MAX$\overset{\bullet}{\downarrow}_{n}$	MAX$\overset{\bullet}{\downarrow}_{s,t,n}$
a. [+c**+s+t**][+c**+s**–t] (ɟɟ)			*!				**
☞ b. [+c+s**+t**][+c+s–t] (ɲɲ)					*		*
c. [+c+s+t][+c+s**–t**] (rr)			*!				*

Stem-final Stops: are turned into nasals by all affix-•s which contain a [–son] specification due to high-ranked $^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{s,t}$:

(167) **[t]** ⇒ **[nn]** (INC_2 Nasalization)

Input: [+c–s–t][+c+s] (t.R)

	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{c}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{c}$	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{s,t}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{n}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{s,t,n}$
☞ a. [+c –s –t][+c+s] (nn)							*
b. [+c–s–t][+c +s] (tt)			*!				*

Stops could be glided by affix-•s specified as [–cons], but obviously there are no such affixes in Anywa. Affixal [–cont] specifications are without effect on stem stops since they are already [–cont] (and Anywa has no [+cont] affix-•s). Recall also that affix stops can only be turned into nasals, not into [r] or [l] due to undominated Dep [rhot,lat].

Stem-final Nasals: are the mirror image of stops in this position: They are stopped by MNp – the only affix-• specified as [–son]:

(168) **[n]** ⇒ **[tt]** (MNp Stopping)

Input: [+s–t][–s–t] (n.T)

	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{c}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{c}$	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{s,t}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{l}$	$*_{r}\bullet_{n}$	$^{o}\textsc{Max}\overset{\bullet}{\downarrow}_{n}$	$\textsc{Max}\overset{\bullet}{\downarrow}_{s,t,n}$
☞ a. [+s –t][–s–t] (tt)							*
b. [+s–t][–s –t] (nn)			*!				*

All other featural specifications in affix-•s are trivially compatible with nasals ([+son], [+cons], [–cont]).

7.5.4 Word-Level Mutation

Word-Level mutation in Anywa is restricted to two patterns: The 2PL suffix -*Wu* triggers complete doubling (and will be analyzed in the same way as Stem-Level -*C*ɪ, whereas the FC marker -*a* and the 2SG suffix -*Ji* trigger selective gemination of stops and approximants only. I will argue that this is underlyingly the pendant of MNp at the Stem Level, hence only specified for [–son], where its different behavior is derived from a slightly different constraint ranking at the Word Level. Similarly 1PE -*wa* and 3PL -*gi* correspond in structure to the entry for AP at the Word Level since they are specified for PL (and integrated into Root-Level σ-structure). As already mentioned above, these affixes are straightforwardly realized without any effects on the stem C due to the low ranking of the CODACONDITION at the Word Level:

(169) **Patterns of Word-Level Mutation in Anywa**

	a. **2PL -Wu**	b. **FC -a / 2SG -Ji**	c. **1PE -wa / 3PL -gi**
	•	• | [–son]	[–son] | •DOR | [–cont]
/j/	jj	jj	j.g
/w/	ww	ww	w.g
/p/	pp	pp	p.g
/m/	mm	m	m.g
/r/	rr	r	r.g
/l/	ll	l	l.g
p.	(105)	(236)	

There are two constraints which are crucial in deriving selective doubling with FC and 2SG affixes, listed in (170). $*_{-s}C_{+s}$ excludes manner sharing of a [+cons] sound with [+son] and [–son] at the same time, and thus blocks doubling for sonorant stem consonants with a [–son] affix C (though not for approximants which are [–cons] or for the affix-• in (169-b) which is not specified for [±cons]). MAX$\overset{\bullet}{\underset{\text{PL}}{\uparrow}}$ ensures that the stem •-node is retained, not the affix-• if realization of both •-nodes is blocked. Again this becomes only relevant with stem-final sonorants in the (169-b) pattern.

(170) **Additional Undominated Constraints at the Word Level**

a. $*_{-s}C_{+s}$	Assign ∗ to every • which is associated to [+son], [+cons], and [–son] in I
b. MAX$\overset{\bullet}{\underset{\text{PL}}{\uparrow}}$	Assign ∗ to every PL-node in P which is dominated by the •-node *R* in M, but not in P

(171) shows the Word-Level ranking for Anywa. (170-a) and (170-b) are crucially undominated with most of the constraints already discussed for the Stem level. MAX • and • → PL are violated by partial doubling (169-b), and therefore ranked relatively low, whereas <u>CODCOND</u> is violated by the pattern in (169-c). MAX • must dominate <u>CODCOND</u> since segments are realized even though this leads to a PL-node which is only in coda position (cf. again (169-c)):

(171) **Word Level Constraint Ranking:**

$$\{\text{MAX}\overset{\bullet}{\uparrow}_{\text{PL}},\ {}_{*}^{\odot}\text{PL}^{\odot},\ *[\underline{\text{CC}}]\ *_{-\text{S}}\text{C}_{+\text{S}},\ \underline{\text{SHR}}\overset{\text{PL}}{\updownarrow}_{\text{M}},\ {}_{\text{PL}}^{*}\text{C}_{\text{PL}}\} \gg \text{MAX}\ \bullet \gg \{\ \frac{\underline{\text{COD}}}{\underline{\text{CON}}}\ ,\ \overset{\bullet}{\downarrow}_{\text{PL}}\ \}$$

Let us start with the simple cases. The bare •-node of 2PL *-Wu* leads to perfect doubling of the stem C since deletion (172-a) of the affix-• would violate MAX•, and sharing only PL, but not manner, is problematic for $\underline{\text{SHR}}\overset{\text{PL}}{\updownarrow}_{\text{M}}$ (172-b):

(172) **Realization of Completely Underspecified Affix-•** (2PL -Wu)

Input: $[\text{+s+t}]_{\text{COR}}[\quad]$ (r.•)

	*[CC]	${}_{\text{PL}}^{*}\text{C}_{\text{PL}}$	$\text{MAX}\overset{\bullet}{\uparrow}_{\text{PL}}$	$*_{-\text{S}}\text{C}_{+\text{S}}$	$\underline{\text{SHR}}\overset{\text{PL}}{\updownarrow}_{\text{M}}$	MAX •	COD/CON	$\overset{\bullet}{\downarrow}_{\text{PL}}$
a. $[\text{+s-+t}]_{\text{COR}}[\quad]$ (r.)						*!		*
b. $([\text{+s+t}]_{\text{COR}}[\quad])_{\text{PL}}$ (r.t)					*!		*	
☞ c. $([\text{+s+t}]_{\text{COR}}[\quad])_{\text{PL,M}}$ (r.r)								

On the other hand, PL-sharing as in (173-b) is impossible for 3PL *-gɪ* due to ${}_{\text{PL}}^{*}\text{C}_{\text{PL}}$ since it is already underlyingly specified for PL. As a consequence manner sharing (173-a) is ruled out as well by $\underline{\text{SHR}}\overset{\text{PL}}{\updownarrow}_{\text{M}}$. Deletion of the stem C (173-c) is blocked by MAX • (but not by $\text{MAX}\overset{\bullet}{\uparrow}_{\text{PL}}$ since the PL-node of the stem-C is itself deleted). Thus both Cs are fully realized under violation of low-ranked <u>CODACONDITION</u>:

(173) **Realization of PL-Specified Affix C** (3PL -gɪ)

Input: $[\text{+s+t}]_{\text{COR}}[\text{–s–t}]_{\text{DOR}}$ (r.g)

	*[CC]	${}_{\text{PL}}^{*}\text{C}_{\text{PL}}$	$\text{MAX}\overset{\bullet}{\uparrow}_{\text{PL}}$	$*_{-\text{S}}\text{C}_{+\text{S}}$	$\underline{\text{SHR}}\overset{\text{PL}}{\updownarrow}_{\text{M}}$	MAX •	COD/CON	$\overset{\bullet}{\downarrow}_{\text{PL}}$
a. $([\text{+s+t}]_{\text{COR}}[\text{–s–t}]_{\text{DOR}})_{\text{M}}$ (t.g)					*!			
b. $([\text{+s+t}]_{\text{COR}}[\text{–s–t}]_{\text{DOR}})_{\text{PL}}$ (?.g)		*!						
c. $[\text{+s-+t}]_{\text{COR}}[\text{–s–t}]_{\text{DOR}}$ (g)						*!		
☞ d. $[\text{+s+t}]_{\text{COR}}[\text{–s–t}]_{\text{DOR}}$ (r.g)							*	

Let us now turn to selective gemination triggered by • – [–son] in FC *-a* and 2SG *-Ji*. With stem-final stops, doubling follows trivially (174-c) because PL and manner sharing satisfies $\text{MAX}\overset{\bullet}{\uparrow}_{PL}$, MAX • and • → PL which would be violated by deleting one of the input Cs (174-a,b). Crucially, (174-c) does not incur a violation of $*_{-s}C_{+s}$ since no instance of [+son] is associated to any of the involved segments:

(174) **Doubling with Stops**

Input: [+c–s][–s] (p.T)

	*[CC]	$*_{PL}C_{PL}$	$\text{MAX}\overset{\bullet}{\uparrow}_{PL}$	$*_{-s}C_{+s}$	$\text{SHR}\updownarrow^{PL}_{M}$	MAX •	COD/CON	• ↓ PL
a. [+c–s][–s] (p)						*!		*
b. ([+c–s][–s])$_{PL,M}$ (p)			*!			*		
☞ c. ([+c–s][–s])$_{PL,M}$ (pp)								

With approximants, doubling results in a slightly more complex situation. Deleting one of the input Cs (175-c,d) again fatally violates $\text{MAX}\overset{\bullet}{\uparrow}_{PL}$ and/or MAX •. Deleting the manner features of the stem-final glide and associating its •-node to the [–son] of the affix-• (175-b) leads to a violation of $*_{-s}C_{+s}$ since the stem-final segment is now associated phonetically to [–son] and [+cons], and morphologically to [+son]. On the other hand, extending the manner features of the stem-approximant to the affix-• (175-a) is unproblematic for $*_{-s}C_{+s}$: The stem-final segment is not associated to [+son] or [+cons] at any level of representation. The affix-• is associated to [–son] in M and to [+son] in P, but it is not associated to [+cons] at any level of representation. In P – phonetically – it is associated to the [–cons] of the stem glide and in M ("underlyingly") it is simply not specified for [±cons]:

(175) **Doubling with Approximants**

Input: [–c+s][–s] (w.T)

	*[CC]	$*_{PL}C_{PL}$	$\text{MAX}\overset{\bullet}{\uparrow}_{PL}$	$*_{-s}C_{+s}$	$\text{SHR}\updownarrow^{PL}_{M}$	MAX •	COD/CON	• ↓ PL
☞ a. ([–c+s][–s])$_{PL,M}$ (ww)								
b. ([–c+s][–s +c])$_{PL,M}$ (pp)				*!				
c. ([+c+s][–s])$_{PL,M}$ (p)			*!			*		
d. [–c+s][–s] (w)						*!		*

However, doubling is crucially blocked with sonorant Cs (176), where it necessarily violates $*_{-s}C_{+s}$. Consider the two candidates (176-b,c) with perfect PL and manner sharing. In (176-b), both segments are associated to the [–son] node of the affix-•, hence the stem C is specified [+cons] and [+son] in M, and [–son] in P summing up to a violation of $*_{-s}C_{+s}$ (in I). In (176-c), both segments share the manner features of the stem C in P. Hence the affix-• is associated in P to the [+cons] and [–son] of the stem segment, and to its own [–son] in P. Thus once again we get a violation of $*_{-s}C_{+s}$. The only remaining option is to delete one of the segments, and due to undominated MAX$\overset{\bullet}{\underset{PL}{\uparrow}}$, the affix-• has to go if the affix-• marauds the PL-node of the stem-C.

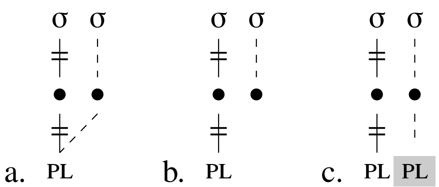
(176) **Non-Doubling with Sonorant Cs**

Input: [+c+s][–s] (n.T)

		*[CC]	$*_{PL}C_{PL}$	MAX$\overset{\bullet}{\underset{PL}{\uparrow}}$	$*_{-s}C_{+s}$	SHR$\overset{PL}{\underset{M}{\updownarrow}}$	MAX •	COD/CON	•↓PL
	a. ([+c+s][–s])$_{PL}$ (nt)					*!			
	b. ([+c +s][–s])$_{PL,M}$ (tt)				*!				
	c. ([+c+s][–s])$_{PL,M}$ (nn)				*!				
	d. ([+c+s] [–s])$_{PL}$ (t)			*!			*		
☞	e. [+c+s] [–s] (n)						*		*

(177-a) illustrates the MAX$\overset{\bullet}{\underset{PL}{\uparrow}}$-violation of (176-d) in more detail. The marauded PL-node of the stem-• is in P since it is dominated by the affix-•, but not dominated in P by its original mother node. Deletion of the stem-• could potentially also result in one of the configurations (177-b) or (177-c) which don't violate MAX$\overset{\bullet}{\underset{PL}{\uparrow}}$ because the PL-node of the stem-C is itself not in P. Thus these configurations must also be excluded by undominated • ⇒ PL and DEP PL.

(177)



Appendix A

Abbreviations

Grammatical Categories

		(Alternative Names)
B(EN)	Benefactive	
BAP	Benefactive Antipassive	
AP	Antipassive	Patient Deletion (Reh 1993), Qualitative (Tucker 1994)
CP	Centripetal	Ventive (Reh 1993)
CF	Centrifugal	Itive (Reh 1993)
GEN	Genitive	
CMP	Comparative	
FIN	Finite	
FQ	Frequentative	Multiplicative (Andersen 1988)
FOC	Focus	
INC	Inchoative	
LOC	Locative	
MN	Modified Noun	Antigenitive (Andersen 2004)
NOM	Nominative	
NTS	Non-Topic Subject	
PL	Plural	
PE	Plural Exclusive	
PI	Plural Inclusive	
PREF	Prefix	
SG	Plural	

Phonological Labels

C	Consonant
F	Falling tone
H	High tone
L	Low tone
PW, PWord	Prosodic (Phonological) Word
R	Rising tone
V	Vowel

Phonological Features

[⊣]	advanced tongue root
[⊢]	retracted tongue root
PL	place
M	manner
[±h]	[±high]
[±c]	[±consonantal]
[±l]	[±low] or [±lateral]
[±n]	[±nasal]
[±r]	[±rhotic]
[±s]	[±sonorant]
[±t]	[±continuant]

Symbols

•	Segmental root node
⊙	Ancestor node
◎	Designated ancestor node
μ	Mora
σ	Syllable

Other Abbreviations

DAN	Designated Ancestor Node
`esc`	Extended Stratal Optimality
FDE	Final Derivational Element (in Päri, cf. section 7.4.1)
LP	Linearization Specification
OT	Optimality Theory
PWord	Phonological/Prosodic Word
SOT	Stratal Optimality Theory
VI	Vocabulary Item
VQA	Vowel Quality Alternation (Mayak)

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