Deriving the nonconcatenative preference in Dinka*

Coppe van Urk and Adam Chong
Queen Mary University of London

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▷ Western Nilotic languages have been cited as a challenge for concatenative approaches to morphology, because of a **preference for non-concatenative processes** (e.g. Aronoff and Fudeman 2011:54; Inkelas 2014:72; Arkadiev and Klamer 2018:450).

▷ In Dinka, many inflected forms are marked only by changes to the root vowel and lengthening, as illustrated for the verb *mîit* 'pull':

Table 1. Forms of *mîit* 'pull' marked only by non-concatenative morphology.

	Simple	CF	CP	APPL	AP.APPL	AP
UNM	mìit	mîiit	mi̱ìit	mî̱it	mî̱iit	mi̱ìit
NF	mîiit	mjêɛɛt	mjè̱eet	mjê̱et	mjê̱eet	mí̱iit
NTS	míiit	míiit	mí̱iit	mí̱it	mí̱iit	mí̱iit
1SG	mjɛ̀ɛɛt	mjêɛɛt	mjè̱eet	mjê̱et	mjê̱eet	mjè̱eet
2SG	mîit		mí̱iit			mí̱it
3SG	mìiit	mîiit	mi̱ìit	mî̱it	mî̱iit	mi̱ìit
PASS	mîit					

This talk: We develop a concatenative view of Dinka morphology, in which these changes are taken to reflect -V affixes that integrate into the root (cf. Trommer 2011, 2015).

- ▷ We demonstrate that licit -V suffixes in Dinka show vowel reduction and propose that -V suffixes incorporate into the root **to escape a ban on vowel contrast in final position**.
- ▷ This proposal explains the **strong correlation between grade changes and lengthening across paradigms** in verbal and nominal morphology and provides an explanation of an apparent exception in -CV affixes.

⇒ The apparent preference for non-concatenative morphology reflects surface conditions on the wellformedness of suffixes. As a result, Dinka morphology in fact provides evidence for an approach in which non-concatenative expression may be determined by the phonology.

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1 Non-concatenative morphology in Dinka

1.1 Monosyllabicity in Dinka roots

▷ Dinka roots are generally **monosyllabic with an obligatory onset and coda**, as illustrated with some nouns and verbs in Luanyjang Dinka (1a–h):

(1)

	Noun	Meaning		Verb	Meaning
a.	jòom	'wind'	e.	máaan	'hate.NF'
b.	kít	'color'	f.	kóoot	'care.for.NF'
c.	pjɛ̀en	'viper'	g.	kwà̱a̱t̪	'wrap.NF'
d.	gwɛ̀ɛl	'collar bone'	h.	tɛ̈et	'pick.NF'

(Remijsen and Ladd 2008:180,186, Remijsen and Manyang 2009:115,119)

⇒ Andersen (1993:2) and Remijsen and Manyang (2009:114) provide the following template for the surface form of Dinka nouns and verbs in the Agar and Luanyjang dialects, respectively:

(2) **Surface template for Dinka nouns and verbs:**
C (w) (j) V (V) (V) C

Note: The *underlying* form of roots is more restricted and maximally permits a long vowel and one glide (Andersen 1993, 2014; Ladd and Blum 2021).

Length, voice, and tone in Dinka roots

▷ Dinka vowels display a **ternary contrast in length** (Remijsen and Gilley 2008), between short, long, and overlong vowels. Some near-minimal triplets from Luanyjang are in (3):[1]

(3)

Short		Long		Overlong	
láŋ	'k.o. berries	làaŋ	'k.o. berry'	lăaaŋ	'slave'
kít	'color'	kɪ̱̀it	'colors'	kɪ̱̀iit̪	'cloth bag'
cól	'mouse'	cŏol	'charcoal'	còool	'charcoal.PL'

▷ Most Dinka dialects distinguish **three or four tones**, high /◌́/, low /◌̀/, falling /◌̂/, and sometimes also rising /◌̌/. Agar Dinka has three tones, while Luanyjang Dinka has all four.

▷ Finally, vowels show a binary contrast between **modal/creaky voice (unmarked) and breathy voice /◌̤/**, in all vowels except *u*.[2]

1.2 Vowel fronting and lowering

The most common expression of non-concatenative morphology in Dinka involves two processes of **vowel fronting and vowel lowering**.

[1] Luanyjang examples are taken from the Remijsen (2013) corpus of noun pairs, where a source is not specifically indicated.

[2] We will follow Andersen and mark voice and tone only on the first vowel.

Andersen (1993) describes fronting and lowering in terms of **three distinct vowel "grades"**:

Table 2. Dinka vowel grades.

	Creaky					Breathy					
Root vowel (Grade 1)	i	e	a	ɔ	o	i̤	e̤	a̤	ɔ̤	o̤	ṳ
Fronting (Grade 2)	i	e	ɛ	ɔ	o	i̤	e̤	ɛ̤	ɔ̤	o̤	ṳ
Lowering (Grade 3)	jɛ	ɛ	a	a	wɔ	je̤	ɛ̤	a̤	a̤	ɔ̤	wo̤

- ▷ **Grade 1** describes the underlying vowel in the root.[3]
- ▷ **Vowel fronting (Grade 2):** A number of different inflectional and derivational categories involve **vowel fronting**, primarily of the central vowel *a*:[4]

(4)

Underlying form	**3SG**	**Non-topical subject**	**Meaning**
lêer	lèeer	léeer	'roll'
ŋáaŋ	ŋèɛɛŋ	ŋɛ́ɛɛŋ	'open'
cɔ̂ɔl	cɔ̀ɔɔl	cɔ́ɔɔl	'call'

(Agar Dinka; Andersen 1993:20)

- ▷ **Vowel lowering (Grade 3):** Other morphological categories systematically involve **vowel lowering and breaking** (of peripheral vowels), except when the root vowel is already low:

(5)

Underlying form	**1SG**	**2PL**	**Meaning**
pî̤k	pjɛ̀ek	pjɛ́k-ka̤	'push'
bɔ̤̂k	bɔ̀ɔk	bɔ́k-ka̤	'throw at'
lât	làat	lát-ka̤	'insult'

(Agar Dinka; Andersen 1993:11–12)

⇒ **Key point:** A vowel grade does not represent a single morpheme, but describes recurring processes that are used by a variety of morphological categories to signal inflection.

2 Constraints on Dinka suffixes

Why would a language prefer non-concatenative morphology?

- ▷ The form of affixes is significantly restricted. Suffixes are limited to a -(C)V template (cf. Reid 2020:52 on Nuer), and vocalic suffixes always take the shape of **the reduced vowel *e̤***.
- ▷ We propose that Dinka places a **constraint on vowel contrast word-finally**, so that a -V suffix is preferentially integrated into the root. Non-concatenative morphology then is a result of **surface phonological constraints**.

[3] This vowel is most frequent and surfaces in unmarked forms (see Andersen 1993, 2017).

[4] With centrifugal verbs and some antipassives, Grade 2 optionally fronts *ɔ* to *ɛ* (Andersen 2017:sec. 3.3).

2.1 Restrictions on suffixes in Dinka

What do suffixes look like in Dinka?[5]

1. **Verbal suffixes.** Verbs take a number of suffixes, which either have the form -V or -CV. All vocalic suffixes are *-e̤*, whereas the CV suffixes are *-ka̤*/*kṳ*/*ke̤*.

Table 3. Agar Dinka verbal paradigms by suffix.

	Simple	CF	CP	APPL	AP.APPL	AP
UNM						
NF						
NTS						
1SG						
2SG		-é̤		-é̤	-é̤	-é̤
3SG						
1PL	-kṳ/kú	-kṳ	-kṳ	-kṳ	-kṳ	-kṳ
2PL	-ka̤/ká	-ka̤	-ka̤	-ka̤	-ka̤	-ka̤
3PL	-ke̤/ké	-ke̤	-ke̤	-ke̤	-ke̤	-ke̤
PASS		-e̤	-e̤	-e̤	-e̤	–
PASS:CT	-e̤	-e̤	-e̤	-e̤	-e̤	-e̤

(NF = non-finite, NTS = non-topical subject, CT = circumstantial topic, CF = centrifugal, CP = centripetal, APPL = applicative, AP.APPL = antipassive applicative)

2. **Nominal construct state suffixes.** There are two -C suffixes that mark modified nouns. The suffix *-n* usually triggers nasal replacement, but may surface overtly with some nouns:

(6) a. ɖɔ̤̀ɔk
'boy'

b. ɖɔ́ɔ-**ŋ** dà
boy-CS1.SG another
'another boy' (Agar Dinka; Andersen 2020:275,277)

⇒ Dinka places **significant restrictions on suffixes:**

- ▷ **Optional onset:** Unlike roots, suffixes may surface without an onset.
- ▷ **No length:** Unlike roots, suffixes do not display long or overlong vowels.
- ▷ **No coda:** Unlike roots, suffixes do not surface with a coda.
- ▷ **Little stacking:** Suffixes display little stacking (though the plural clitics can be decomposed into a -C and -V suffix).

A -CV template:
Suffixes are restricted to **the form -CV maximally** (see also Appendix).

[5] We focus on suffixes, since non-concatenative morphology is oriented to the final syllable (as evident in polysyllabic nouns, for example).

2.2 Vowel grades as -V suffixes

Key observation:
Dinka permits few -V suffixes. Those that do surface **have the form -ẹ̱**.

- ▷ The suffix -ẹ̱ marks the passive, passive circumstantial topic, and 2nd person singular. No other vowel suffixes occur (though CV suffixes may have different vowels, see sec. 3.3).
- ▷ There is evidence that ẹ̱ is the underspecified vowel in Dinka:
  - Remijsen and Gilley (2008:p. 335) note that short *e* (breathy or creaky) is "appropriately transcribed [ə] in many of its realizations".
  - Andersen (2007:fn. 20) points out that much of the reduced functional vocabulary ends in ẹ̱, suggesting **vowel reduction**. Examples include the preposition ẹ̀/nẹ̀, the negative auxiliary cẹ̀, and some complementizers (e.g. kẹ̀ 'then', ɟẹ́ 'while').
  - In the paradigms of the perfect auxiliary cɟẹ́ and future auxiliary bɟẹ́, short forms surface with ẹ̱, alternating with full vowels in long forms.

Proposal:
The prevalence of -ẹ̱ reflects a pressure to reduce vowel contrast in word-final position. Dinka vowel grades reflect -V affixes that undergo metathesis **to escape vowel reduction**.

- ▷ **Fronting (Grade 2):** We posit a front vowel suffix -*i* for Grade 2 (or possibly -*ɛ*), since this grade triggers fronting. In addition, this grade likely has its origins in a front vowel. See the cognates of 3rd person singular:

(7)

Form	**Gloss**	**Language**
ʔàm-**ɛ̀**	eat-3SG	Surkum (Andersen 2014:239)
ríiŋ-**ɛ́**	run-3SG	Nuer (Reid 2020:102)
ā-gɛ́ɛr-**ɛ̄**	PST-build-3SG	Anywa (Reh 1996:194)

- ▷ **Lowering (Grade 3):** We identify Grade 3 with the low vowel -*a*, since this grade triggers vowel lowering across the board. The cognate of Grade 3 inflection is also often a low vowel, such as in the 1st person singular:

(8)

Form	**Gloss**	**Language**
ʔàm-**à**	eat-1SG	Surkum (Andersen 2014:239)
lɛ̄ap-**á̱**	open-1SG	Nuer (Reid 2020:103)
ā-gɛ́ɛr-**ā**	PST-build-1SG	Anywa (Reh 1996:194)

Another piece of evidence for this proposal is that auxiliaries with a reduced vowel (the perfect cɟẹ́ and future bɟẹ́) surface with these vowels in Grade 2 and Grade 3 contexts, respectively:

Table 4. Paradigm of perfect auxiliary.[6]

	Grade in lexical verbs	Perfect auxiliary
UNM		cɟẹ́
NTS	2	**cɟ̱í**
1SG	3	**cà**
2SG	(3)	**cá**
3SG	2	cɟẹ̀
1PL		cụ̀uk
2PL	3	**câak**
3PL		cɟ̀ik
PASS	(2)	**cɟ̱í**
PASS:CT	2	**cɟ̱in-ɛ̀**

(NF = non-finite, NTS = non-topical subject, CT = circumstantial topic)

3 Vowel grades as metathesis

3.1 Prominence reduction drives metathesis

What constraints drive vowel reduction?

- ▷ Crosswhite (2001, 2004), based on a crosslinguistic survey on vowel reduction, proposes that vowel reduction is driven in some languages by what she calls "prominence reduction", a pressure to neutralize contrast in less prominent positions.
- ▷ We suggest that the word-final position is a less prominent position in Dinka. We adopt a constraint that **bans a mora word-finally**:

(9) *μ#: Assign a violation mark for a word-final mora.

- ▷ We propose that reduction to the default vowel ẹ̱ occurs because ***ẹ̱* can be a non-moraic vowel in Dinka** (see also Crosswhite 2001 on schwa). As a result, ẹ̱ will not violate (9).

What happens when a root takes a suffix with a moraic vowel (e.g. *-i* or *-a*)?

- ▷ For vocalic affixes with moraic vowels, (9) drives incorporation into the root if faithfulness constraints preventing vowel reduction or deletion outrank constraints blocking metathesis (MAXμ >> LINEARITY).

[6] Grades in parentheses indicate grades found in derived paradigms. The 2SG and PASS exceptionally do not show their grade in the simple transitive paradigm.

▷ We illustrate with a tableau in (10) for Grade 2, the 3rd person singular of *mîit* 'pull'. As motivated above, the Grade 2 suffix is -*i*.

(10) **Tableau for Grade 2 3SG suffix.**

	Input: [mîit+ì$_{3SG}$]	MAXμ	*μ#	LINEARITY
☞	a. mìiit			*
	b. mìit	*!		
	c. mîit-ì		*!	
	d. mîit-ɛ̀	*!		

▷ (We model the fronting and lowering effects as the outcome of assimilation under vowel coalescence, see also Zaleska 2020. Details omitted for time.)

3.2 Grade changes imply lengthening in verbal paradigms

Changes in vowel grade **strongly correlate with lengthening**. We present the distribution of vowel grade and length in Agar Dinka for five verbal paradigms (Andersen 1992, 1993, 2017):

Table 5. Agar Dinka paradigms by grade.

	Simple	CF	CP	APPL	APPL.AP
UNM		2	2	2	2
NF		3	3	3	3
NTS	2	2	2	2	2
1SG	3	3	3	3	3
2SG		3	2	3	3
3SG	2	2	2	2	2
1PL		2	2	2	2
2PL	**3**	3	3	3	3
3PL		2	2	2	2
PASS		2	2	2	2
PASS:CT	2	2	2	2	2

▷ This table is laid out according to Andersen's division between "derivational" morphology (columns) and "inflectional" morphology (rows).

▷ This division is useful for displaying paradigms, but likely about attachment height rather than a difference in type of morphology.

Table 6. Agar Dinka paradigms by length.

	Simple	CF	CP	APPL	APPL.AP
UNM		-μ	-μ	-μ$_{II}$	-μ
NF	**-μ**	-μ	-μ	-μ$_{II}$	-μ
NTS	-μ	-μ	-μ	-μ$_{II}$	-μ
1SG	-μ	-μ	-μ	-μ$_{II}$	-μ
2SG		-μ	-μ	-μ$_{II}$	-μ
3SG	-μ	-μ	-μ	-μ$_{II}$	-μ
1PL		-μ	-μ	-μ$_{II}$	-μ
2PL		-μ	-μ	-μ$_{II}$	-μ
3PL		-μ	-μ	-μ$_{II}$	-μ
PASS		-μ	-μ	-μ$_{II}$	-μ
PASS:CT	-μ	-μ	-μ	-μ$_{II}$	-μ

(NF = non-finite, NTS = non-topical subject, CT = circumstantial topic, CF = centrifugal, CP = centripetal, APPL = applicative, APPL.AP = applicative antipassive, -μ = lengthening of the root by one mora, -μ$_{II}$ = lengthening of the root up to a bimoraic limit)

⇒ In accordance with our view, Grade 2 and Grade 3 morphological categories reliably lengthen roots by **one degree of length** across verbal and nominal paradigms (Andersen 1993, 2017; Ladd and Blum 2021; Van Urk and Sun 2021).

3.3 The lack of vowel reduction in -CV suffixes

Consider verbal paradigms for the simple transitive:

Table 7. Verbal paradigms of simple transitive by verb class.[7]

	Grade	CVC/F	CVC/L	CVVC/F	CVVC/H
UNM		CV̀C	CV̀C	CV̀VC	CV̀VC
NF		CV̂VC	CV̀VC	CV̂VVC	CV́VVC
NTS	2	CV́VC	CV́VC	CV́VVC	CV́VVC
1SG	3	CV̀VC	CV̀VC	CV̀VVC	CV̀VVC
2SG		CV̀C	CV̀C	CV̂VC	CV́VC
3SG	2	CV̀VC	CV̀VC	CV̀VVC	CV̀VVC
1PL		CV́C-kṳ̀	CV́C-kṳ̀	CV̀VC-kṵ́	CV̀VC-kṵ́
2PL	3	CV́C-kạ̀	CV́C-kạ̀	CV̀VC-kạ́	CV̀VC-kạ́
3PL		CV́C-kɛ̀	CV́C-kɛ̀	CV̀VC-kɛ́	CV̀VC-kɛ́
PASS		CV́C	CV́C	CV̂VC	CV́VC
PASS:CT	2	CV̂VC-ɛ̀	CV̂VC-ɛ̀	CV̂VVC-ɛ̀	CV̂VVC-ɛ̀

(NF = non-finite, NTS = non-topical subject, CT = circumstantial topic)

[7]There are four root types, which we follow Andersen (1993) in labeling according to the length and tone displayed in the non-finite form.

Observation:
There is no obvious restriction on vowels in the plural -CV suffixes (e.g. 2PL *-kạ* and 1PL *-kụ*).

- ▷ Section 2 posits the ranking MAXμ >> *μ#. The effect of the constraint favoring reduction only emerges because of the low ranking of LINEARITY.
- ▷ This set-up predicts that, if **metathesis is impossible**, then we should not see any reduction. We suggest that, in -CV suffixes, the initial consonant **protects** the vowel from integration.
- ▷ We posit a ban on **non-local metathesis**, enforced by Carpenter's (2002) I-ADJACENCY, in addition to high-ranking constraints blocking complex codas and consonant deletion.[8] Since reduction is blocked by MAXμ >> *μ#, the vowel surfaces faithfully:

	Input: [cɔ̀ɔl+kṵ$_{1PL}$]	MAXC	*COMPLEX CODA	I-ADJ	MAXμ	*μ#	LINEARITY
☞	a. cɔ̀ɔl-kṵ					*	
	b. cɔ̀ɔɔl	*!					*
	c. cɔ̀ɔɔlk		*!	**			**
	d. cɔ̀ɔl-kẹ̣				*!		
	d. cɔ̀ɔɔl-kẹ̣			*!*			**

⇒ In accordance with this account, there is **no lengthening before -CV suffixes**. As evident in Table 7, short roots remain short and long roots remain long.

Independent evidence for a preference for local metathesis

- ▷ One piece of support for the idea that Dinka bans non-local metathesis comes from auxiliaries that **lack a coda consonant**, such as the perfect *cẹ́* and future *bẹ́*.
- ▷ Precisely with these auxiliaries, the vowels in plural -CV suffixes **do undergo metathesis**, because metathesis is now local (only the onset C intervenes):

(11)

	Plural suffix	Perfect auxiliary
1PL	-kṳ̀	cṳ̀uk
2PL	-kạ̀	câak
3PL	-kẹ̀	cị̀ik

[8] We may also want to block metathesis within the -CV suffix, to rule out the candidate *càal-ạ́k*. But note that codas are generally banned in affixes in any case, so the impossibility of this repair may simply reflect a NOCODA constraint (see Appendix for more detail).

Concluding remarks

- ▷ We have argued that the prevalence of non-concatenative inflection in Dinka ultimately derives from **surface phonological constraints on permissible suffixes**.
- ▷ Dinka morphology in fact **provides evidence that affixation is underlyingly concatenative**, since such a view posits a direct relationship between the wellformedness of suffixation and non-concatenative processes.

Across Western Nilotic
We're currently working on extending this view across Western Nilotic systems, focusing on Shilluk and Nuer. A number of observations that we think are promising:

- ▷ In Shilluk, all affixes are limited to [-ATR] vowels. Instead of process of lowering and fronting, several morphological categories in Shilluk shift the root vowel to [+ATR].
- ▷ In Dinka/Nuer, no contrast in creaky/breathy voice is found in suffix vowels. In Dinka, all suffix vowels are breathy. In Nuer, voice quality is strictly determined by [ATR] value in suffixes. Both languages shift the root vowel to breathy in a number of paradigms.
- ▷ In Shilluk, almost all suffixes contain short vowels. All lengthening lengthens the root to overlong (i.e. by two degrees of length if possible).

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Appendix: Implementing a -(C)V template for affixes

How do we model the -CV restriction on suffixes?

▷ **On the -(C)V shape.**

- The onset requirement of roots is evidence for high-ranking Onset. In suffixes, the **onset C is already provided by the obligatory coda consonant of the root**.[9]
- We attribute the absence of codas to NoCoda. Roots must be exempted from this effect, perhaps by McCarthy and Prince's (1990) FinalC (see also Gafos 1998).
- The absence of long or overlong vowels is attributable to a constraint on long vowels at the end of the word, *μμ#. A similar restriction is active in Nuer (Reid 2020).

▷ **Little stacking.**

A number of authors have related **word maximality effects to metrical structure** (de Lacy 2003; Ketner 2006; Uchihara and Mendoza Ruiz 2021). The combination of maximal root and affix template are reminiscent of a **disyllabic foot**.

To enforce this maximum, we propose **two constraints on foot shape**: i) a (categorical) constraint forcing right-aligned feet (Uchihara and Mendoza Ruiz 2021), and ii) a constraint anchoring the root to a foot boundary.

(12) Align-R(Ft,Wd): A foot should be right-aligned with the word edge.
Align-L(Root,Ft): The root should be left-aligned with a foot.

Taken together, these constraints ensure that a prosodic word ideally consists of one foot, anchored by the root.[10]

⇒ **Suffixes come in all shapes that fit the CV maximum** determined by independent constraints (-C, -V, and -CV). Non-concatenative morphology results from **surface phonological conditions** and how Dinka prefers to resolve violations of them.

[9] In support of this, notice that some auxiliaries lacking a coda, such as the perfect auxiliary *cé* or the sequentive *góo* insert a consonant before a -V suffix (e.g. *cîi**n**-ɛ̀* 'prf-pass.ct' and *gôo**r**-ɛ̀* 'seq-pass.ct', Andersen 2007). But there are other functional items without onsets, such as the nominal prefix *a-* or the general purpose preposition *ɛ̀*. So it is also possible that Onset applies to roots only.

[10] Of course, we also need constraints that enforce the root template.

Appendix B: Multiple affixation and mora coalescence

Why do verbs appear to be restricted to at most one Grade 2 or Grade 3 affix?

- ▷ We can see in Table 6 that most of what Andersen (1993) and Trommer (2011) call the "derivational" morphology (centrifugal, centripetal, applicative, and applicative antipassive) is usually marked by Grade 2.[11]
- ▷ When we combine a Grade 2 derivational category with one of the "inflectional" categories marked by a vowel grade (e.g. NTS, 1SG, 3SG), we only get one degree of lengthening.

Proposal: We adopt a constraint that penalizes lengthening a short root to overlong, building on the intuition that this type of overlengthening is too great a change.

(13) MATCH-LENGTH: Assign a violation mark if the length of a syllable input differs by more than one degree in the output.

This constraint will allow lengthening of a short root to long and a long root to overlong, but prevents multiple lengthening.

> **Problem:** If this constraint is highly-ranked, we should see a preference for overt affixation return (because MAXμ >> *μ# blocks reduction).

Why are overt Grade 2/3 affixes avoided in multiple affixation?

- ▷ We want to draw an analogy with work on multiple reduplication avoidance (Stonham 2007; Zimmermann 2021).
- ▷ In some reduplicating languages, such as Nuu-chah-nulth, **only one reduplicating morpheme surfaces** in contexts with multiple triggers of reduplication (the underlined suffixes):

(14) **m'aa**-m'aaɬ-ʔas-ap
RED-cold-at.wrist-really
'S/he has really cold wrists.' (Nuu-chah-nulth; Rose 1981:341)

- ▷ Zimmermann argues that the abstract prosodic material associated with reduplicating morpheme can undergo **prosodic coalescence**, in violation of the constraint UNIFORMITY, which regulates the one-to-one correspondence of input and output elements.

(15) UNIFORMITYμ: Assign a violation mark for every input mora that does not map to a unique output mora.

[11] There are two systematic cases where Grade 2 is not observed when there is no Grade 2/3 in the simple paradigm, which is that the NF and 2SG forms are often marked by Grade 3.

⇒ We suggest that a similar repair is at work in multiple affixation. Multiple grade affixes will generate multiple moras that incorporate into the root, but these undergo **mora coalescence**. The ranking *μ# >> UNIFORMITYμ ensures a preference for coalescence over overt affixation:

Input **Output**

The bimoraic template in the applicative

- ▷ As discussed by Andersen (1992), Flack (2007), and Trommer (2015), the applicative **imposes a bimoraic template** and blocks lengthening of long roots to overlong:

(16) **Bimoraic template in applicative:**

Unmarked form	Unmarked applicative	Meaning
wèc	wɛ̰ec	'kick'
nàj	nɛ̰ɛj	'plait'
cɔ̀ɔl	cɔ̰ɔl	'call'
ŋàaŋ	ŋɛ̰ɛŋ	'open'

(Agar Dinka; Andersen 2017:14)

- ▷ We follow Flack (2007) in assuming that the applicative is associated with an **indexed markedness constraint** penalizing overlong vowels.
- ▷ This markedness constraint will play the same role as MATCH-LENGTH in limiting mora incorporation, leading to mora coalescence instead of overt affixation.