

Positional licensing and the preference for nonconcatenative morphology in Dinka*

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Abstract

Dinka morphophonology has been cited as a challenge for strict item-and-arrangement approaches to morphology, because of the apparent preference for nonconcatenative morphology: most morphological categories are marked solely by phonological changes in a monosyllabic root (Andersen 1992 et seq.). This paper introduces the novel observation that the phonological properties involved in these changes are restricted in overt suffixes. We develop an analysis in which vocalic suffixes undergo CV metathesis into the root, driven by a positional licensing constraint that prefers vowel contrast to be expressed in the root, resulting in changes in vowel quality with predictable lengthening. An item-and-arrangement analysis derives this relationship and accounts for two key properties of Dinka morphology: nonconcatenative morphology is consistent and additive (cf. Sande 2022), while apparent cases of extended exponence are predictable outcomes of vowel harmony or epenthesis conditioned by a complex tonal melody.

Keywords: Dinka, Nilotic, nonconcatenative morphology, item-and-arrangement, item-and-process, metathesis, positional licensing, root prominence, extended exponence, coalescence, haplology

1 Introduction

Morphological theories can be distinguished according to the extent to which morphological marking arises through “item-and-arrangement”, in the sense of Hockett (1954), via the addition of an affix to a constant base (henceforth *item-based*), or “item-and-process”, via the triggering of a phonological change in the base (henceforth *process-based*). Within syntacticized approaches of morphology, an influential hypothesis is that all morphology is item-based (Trommer 2011; Bermúdez-Otero 2012; Bye and Svenonius 2012). But many other frameworks argue for the need for process-based morphological marking in addition to item-based marking (Orgun 1996; Inkelas and Zoll 2005; Pater 2009; Inkelas 2014), because of the diversity of nonconcatenative morphology across languages.

One challenge to strict item-based models comes from languages like Dinka (Western Nilotic; South Sudan). Dinka and related Western Nilotic languages like Nuer or Shilluk are well-known for their

*Our thanks to Matthew Baerman, Jonathan Bobaljik, Mirella Blum, Andrew Lamont, Irina Monich, and Zhouyi Sun for comments and discussion, as well as audiences of presentations at Harvard, Leipzig, QMUL, UCL, AMP 2022 at UCLA, and NELS 53 in Göttingen. We would also like to thank the Co-editor at *Phonology*, Yoonjung Kang, an Associate Editor, and three anonymous reviewers for insightful comments and feedback on earlier versions of this manuscript. All remaining faults are our own.

apparent *preference* for nonconcatenative morphology. In verbal paradigms, for instance, many inflected forms are marked only by changes to the root, as illustrated for the verb *mîit* ‘pull’ in Table 1.¹

Table 1. Partial paradigms of *mîit* ‘pull’ in Agar Dinka (Andersen 2017).

	Transitive	CF	CP	APPL	AP.APPL	AP
UNM	mîit	mîiit	mîiit	mîit	mîiit	mîit
NF	mîiit	mîêêet	mîêet	mîêet	mîêet	mîiit
NTS	mîiit	mîiit	mîiit	mîit	mîiit	mîiit
1SG	mîêêet	mîêêet	mîêet	mîêet	mîêet	mîêet
2SG	mîit	mîêêet-ê	mîiit	mîêet-ê	mîêet-ê	mîit
3SG	mîiit	mîiit	mîiit	mîit	mîiit	mîiit
PASS	mîit	mîiit-ê	mîiit-ê	mîit-ê	mîiit-ê	—

boxed = forms with affixes²

As Table 1 demonstrates, morphological categories in Dinka are typically indicated by a combination of changes in four phonological dimensions: i) vowel quality, ii) length, iii) voice quality and iv) tone. The pervasiveness of nonconcatenative morphology in Dinka has been cited as a problem for item-based approaches (e.g. Aronoff and Fudeman 2011:54 and Arkadiev and Klammer 2018:450), because it undermines the idea that concatenation is the primary mode of morphological marking.

This paper argues that Dinka morphology in fact provides evidence that nonconcatenative morphology reflects underlying affixation, building on Trommer (2011, 2015), as well as Sande’s (2022) diagnostics for distinguishing item- vs. process-based patterns. We first present the novel observation that the phonological form of overt suffixes is *severely restricted* in Dinka. Dinka suffixes permit no contrast in length, voice quality, and tone, and vowel contrast is also limited. Instead, contrasts in these four dimensions are almost exclusively realised within the monosyllabic root (see Table 1). Exactly these properties are also manipulated in nonconcatenative marking. We suggest that nonconcatenative morphology in Dinka is motivated by a desire to express phonological features in the *most morphologically prominent constituent*, so that vowel features are preferentially linked to the root. We build on work

¹Throughout, we follow Torben Andersen’s presentation of paradigms, with what he calls inflectional morphology in rows, and derivational morphology in columns. Abbreviations used: AP = antipassive, APPL = applicative, CF = centrifugal, CP = centripetal, CT = circumstantial topic, MULT = multiplicative, NF = non-finite, NTS = non-topical subject, UNM = unmarked, PASS = passive.

²Note that we will argue in section 4.3 that these are in fact epenthetic vowels and not vowel suffixes, even if subject to the same phonological constraints as suffixes. Our analysis is that these vowels are epenthesized to allow for the realization of the tone of a suffix. Given this we choose to present these forms with a morphological boundary throughout, following Andersen (2017).

on positional licensing and vowel contrast (Crosswhite 2001, 2004; Walker 2005, 2011; Kaplan 2008, 2015), and propose the licensing constraint $\text{LICENSE}([\text{VFeat}], \text{Root})$:

(1) $\text{LICENSE}([\text{VFeat}], \text{Root})$:

Assign a violation mark for any vowel feature not linked to a root segment.

This constraint means that any vowel features (height, backness, roundness, ATR, and voice quality) in affixes is disfavoured and the preferred outcome of affixation is for vowel features in an affix to be expressed in the root, leading to regular CV metathesis of vocalic affixes. The need to link phonological features to the most morphologically prominent constituent explains how a nonconcatenative preference can arise in an item-based view of morphology.

Not only can an item-based view accommodate Dinka morphology using phonologically general constraints (Sande 2022), such an analysis derives two other important properties of Dinka nonconcatenative morphology. First, phonological changes in the base are *additive*, and involve extra material that can be identified with an underlying affix. Nonconcatenative marking consistently results in a step of lengthening, and changes in vowel quality result in two segments when the root vowel can be retained as an onset glide. Second, cases of *extended exponence* (Matthews 1972:82), where nonconcatenative effects obtain before an overt affix, do not involve two instances of morphological marking, but reflect either word-internal lowering harmony, before the 2PL *-ka*, or vowel epenthesis to host a complex tonal melody that cannot be realised in a monosyllabic form (Rolle and Merrill 2022), in the 2SG and passive.

The link between affixation and nonconcatenative morphology offers evidence for an item-based view of Dinka (Lieber 1992; Trommer 2011; Bermúdez-Otero 2012). An item-and-process analysis misses the broader generalisation that the nonconcatenative preference arises precisely because of the direct relationship between the wellformedness of affixation and phonological changes in the base. More generally, our analysis provides a novel rationale for nonconcatenative marking, via positional licensing constraints that favour realisation in a more morphologically prominent base.

The paper is structured as follows. Section 2 introduces the four phonological changes at work in the Dinka vowel grade system (Andersen 1992, 1993, 2017). Section 3 presents the novel observation that nonconcatenative morphology manipulates phonological properties that are *severely restricted* in affixes. These generalisations motivate a positional licensing constraint on vowel contrast in Dinka, building on Crosswhite (2001, 2004), Walker (2005), and Kaplan (2008, 2015): we propose that vowel features must be licensed by the root, causing vocalic affixes to undergo CV metathesis and restricting vowel contrast in suffixes. Section 4 demonstrates that this item-based analysis explains two further

important properties of Dinka morphology. First, phonological changes in the root are reliably additive in length, vowel quality, and voice. Second, apparent cases of phonological changes in the base before an affix are predictable and reflect either word-internal harmony or tone-driven epenthesis. Section 5 demonstrates that vowel lowering and vowel fronting can be understood as coalescence of the root and affix vowel, with chain shift effects emerging because of constraint conjunction (Kirchner 1996; Mascaró 2011). Section 6 shows that our account of lowering and fronting extends to multiple affixation, as long as each instance of affixation is evaluated on a separate cycle. We also examine the failure of cumulative lengthening, which we attribute to a suffix haplology effect. This independent markedness constraint induces mora coalescence, rather than a return to overt suffixation.

2 Nonconcatenative morphology in Dinka

This section provides an overview of the expression of nonconcatenative morphology in Dinka. As we show in section 2.1, Dinka roots are subject to a monosyllabic template, with an obligatory onset and coda consonant. Section 2.2 introduces the most frequent expression of nonconcatenative morphology in Dinka, two processes of vowel lowering and vowel fronting, described by Andersen (1992, 1993) by means of three “vowel grades”. Section 2.3 demonstrates that changes in vowel grade are accompanied by lengthening, changes in tone, and sometimes, voice quality. Section 2.4 looks at how to adjudicate between item- and process-based approaches, and introduces diagnostics proposed in Sande (2022).

2.1 Constraints on Dinka roots

Dinka is a Western Nilotic language spoken in South Sudan, with several million speakers and at least four major dialect groupings (see Blum 2023:ch. 1 for discussion). In this paper, we draw primarily on data from the Agar variety of Dinka, described in detail by Andersen (1987, 1992, 1993, 2007a, 2014, 2017), though very similar facts appear to apply to other dialects, such as Luac (Remijsen and Ladd 2008; Ladd et al. 2009; Remijsen and Manyang 2009) or Bor South (Blum 2023).

As is common in Western Nilotic languages, Dinka roots are subject to a monosyllabic template.³ In addition, content word roots come with an obligatory onset and coda consonant. Examples of nouns and verbs in Agar are presented in (2a–f).

³Similar templates occur in Anywa (Reh 1996:47), Nuer (Reid 2019:sec. 3.6), Shilluk (Remijsen and Ayoker 2022:ch. 1:6), and Thok Reel (Reid 2010:30).

(2)	Noun	Meaning	Verb	Meaning
a.	tòɔŋ	‘pot’	d.	kwâal ‘steal.NF’
b.	dít	‘bird’	e.	géeet ‘roast.NF’
c.	lwàaŋ	‘fly’	f.	djòŋ ‘stir.NF’

(Andersen 1993:11–12, Andersen 2014:223,230)

As a result, the surface form of roots obey the following template Andersen (1992:2):

(3) **Surface template for Dinka nouns and verbs:**

C (w) (j) V (V) (V) C

As (3) shows, vowels come in three degrees of length, though roots only permit short or long vowels underlyingly (Andersen 1993, 2014; Ladd and Blum 2021), so that overlong vowels are always derived. Onsets can be made more complex through the addition of one or two glides. These glides are the only way in which Dinka forms phonetic diphthongs. Because these glides do not affect length, we follow Andersen (1993) in taking these glides to be part of the onset, rather than part of the vowel nucleus like a ‘true’ diphthong. We follow Andersen in using the term ‘diphthong’ to describe these sequences below.

Within monosyllabic roots, length, voice, and tone mark a wealth of morphological distinctions. First, Dinka vowels display a ternary contrast in length (Remijsen and Gilley 2008), between short, long, and overlong vowels. Some minimal triplets from Agar are in (4):

(4)	Short		Long		Overlong
	wèc	‘kick.2SG’	wèec	‘kick.3SG’	wèeec ‘sweep.3SG’
	bòk	‘throw.PASS’	bòok	‘throw.CF.3SG’	bòook ‘throw.MULT.AP’

(Agar; Andersen 1993:3)

Most Dinka dialects distinguish three (e.g., Agar) or four tones (e.g., Luac, Bor South), high /ó/, low /ò/, falling /ô/, and sometimes also rising /ǒ/. Finally, vowels show a binary contrast between modal/creaky voice (unmarked) and breathy voice /ᵒ̤/, in all vowels except *u*. Examples in (5) illustrate.

(5)	Creaky		Breathy	
	wár	‘shoes’	wàr	‘cowdung.PL’
	lêeŋ	‘drum’	lêec	‘tooth’
	pɛɛɛj	‘moon, month’	bɛɛɛj	‘homes’
	pìŋ	‘ground’	rìŋ	‘meats’
	tòol	‘smoke’	tòon	‘pot’
	kòɔɔr	‘elbow’	kòɔɔr	‘lions’
			rúk	‘knot’

(Andersen 2002:20, Andersen 2007a:104, Andersen 2014:223,232–233,238,242)

We mark voice and tone only on the first vowel, following the Dinka literature, though voice and tone are properties of the whole vowel nucleus.

Exceptions to the monosyllabic template occur with nouns. A few CV nouns lack a final coda (6a). The prefix *a-*, historically a nominalizer, attaches to some roots to create disyllabic forms (6b–c). Also, some loanwords diverge from the root template (6d).

(6) *Exceptional nominal roots:*

- a. ɟó ‘dog’
- b. aŋɪj ‘hyena’
- c. agwóɔɔ ‘kind of bean’
- d. lɪbó ‘beehive’

(Andersen 2014:245, Andersen 2020:275–276)

We focus in this paper on verbal morphology, in which the monosyllabic template is invariably obeyed, so these exceptional forms will not play a role in our consideration of nonconcatenative morphology. All morphological changes in these forms affect the final syllable, which is subject to the same surface template as monosyllabic roots. As a result, the proposal we develop should also extend to these forms.

2.2 Fronting and lowering in Dinka vowel grades

Nonconcatenative morphology in Dinka involves phonological changes along four dimensions. The most important phonological change affects the vowel quality of the root, by means of processes of vowel lowering/breaking and vowel fronting. Andersen (1992, 1993, 2017) describes these changes in terms of three distinct vowel “grades”. Changes in length, tone, and voice quality are almost always

accompanied by a vowel quality change also, and so we first introduce the vowel grade system.

Andersen classifies each morphological category into Grade 1, Grade 2, or Grade 3. These vowel grades are presented in Table 2. Each row lists all vowels found in a grade, and each column indicates how vowels correspond across grades.

Table 2. Dinka vowel grades.

	Creaky					Breathy					
Grade 1	i	e	a	ɔ	o	ĩ	ẽ	ǎ	ɔ̃	õ	u
Grade 2	i	e	ɛ	ɔ	o	ĩ	ẽ	ɛ̃	ɔ̃	õ	u
Grade 3	jɛ	ɛ	a	a	wɔ	jɛ̃	ɛ̃	ǎ̃	ǎ̃	ɔ̃	wɔ̃

Grade 1 is the basic vowel grade, and reflects the root vowel, since Grade 2 and Grade 3 both neutralize some underlying contrasts (see Andersen 1993, 2017).⁴ Another clear indication that Grade 2 and Grade 3 are derived is that, although vowel grade is determined by the outermost affix (Section 5), there is no morphological category that regularly shifts the vowel back to Grade 1.

Grade 2 is characterized by vowel fronting. A number of different inflectional and derivational categories shift the underlying vowel to Grade 2, fronting *a* to *ɛ*, but leaving all other vowels unaffected, as in the 3SG or non-topical subject form (7).⁵

(7)	Unmarked	3SG	Non-topical subject	Meaning
	lèer	lèeer	léeer	‘roll’
	ḡàaḡ	ḡèèḡ	ḡééḡ	‘open’
	còɔl	còòɔl	cóóɔl	‘call’

(Agar Dinka; Andersen 1992:20)

Grade 3 involves vowel lowering and breaking⁶ of peripheral vowels. The form of lowering depends on the root vowel. Lowering often creates an [ATR] contrast, between [+ATR] vowels in Grade 1 and an [-ATR] vowel in Grade 3 (e.g. *i* → *jɛ*, *e* → *ɛ*, *o* → *wɔ*, *ɔ* → *ɔ̃*).⁷ But underlying *ɔ* and *a* map to *a*, the only [+low] vowel. Underlyingly high vowels also undergo breaking, with the high vowel expressed as

⁴Grade 3 neutralizes the contrast between *ɔ̃* and *a/ǎ*. In the centrifugal, Grade 2 optionally neutralizes the contrast between *ɔ* and *a* (see Andersen 2017:23). As a result, underlying vowel quality is not fully predictable from Grade 2 or Grade 3.

⁵In derivational morphology, Grade 2 also optionally fronts *ɔ* to *ɛ* (Andersen 2017:sec. 3.3), showing that the effect of Grade 2 is vowel fronting rather than vowel raising.

⁶We use the term ‘breaking’ (as opposed to ‘gliding’) to refer to the process of a monophthong (e.g. /i/) alternating with a diphthong (e.g. here [jɛ]). We take ‘gliding’ to mean the alternation of a monophthong high vowel to a single glide which is distinct from the process in Dinka which results in a glide+vowel sequence. To maintain this distinction, we continue to use the term ‘breaking’ throughout.

⁷This effect is obscured in breathy vowels after glides, where *ɛ/ɔ* neutralize to *e/o* (Andersen 1993:sec. 8.2).

an onset glide. Examples of Grade 3 lowering and breaking are found in the 1SG and 2PL (8).

(8)	Unmarked	1SG	2PL	Meaning
	pìk	pjèek	pjék-kà	‘push’
	bòk	bòok	bók-kà	‘throw at’
	làt	làat	lát-kà	‘insult’

(Agar Dinka; Andersen 1993:11–12)

It is important to emphasize that Grade 2 and Grade 3 are labels for recurring fronting and lowering processes. Neither plausibly represents a single morpheme. These grades are associated with a number of different morphological categories, across the nominal and verbal paradigms, with different effects on tone and voice quality. As a result, we treat all of these as different morphemes underlyingly, which happen to have a similar phonological form.

2.3 Changes in length, voice quality, and tone

While a vowel grade change is the most common expression of morphological categories in Dinka, it is often accompanied by three other nonconcatenative effects: the root may lengthen, display replacive tone and shift to breathy voice. We discuss these in turn.

A grade change is typically accompanied by one step of lengthening (see section 4.1). Short roots become long and long roots become overlong. The 1SG, as in (9), is a Grade 3 category: the root vowel lowers and undergoes lengthening.

(9)	Unmarked	1SG	Meaning
	wèc	wèec	‘kick’
	lèer	lèeer	‘roll’
	tèem	tèeem	‘cut’

(Agar Dinka; Andersen 1992:28–29)

There are some morphological categories which display lengthening without a change in vowel quality, though, such as the nonfinite form of transitive verbs (10).

(10)	Unmarked	NF	Meaning
	wèc	wêec	‘kick’
	tèŋ	téenŋ	‘dust’
	jàaŋ	jâaaŋ	‘skin’
	(Agar Dinka; Andersen 1992:23,28)		

Many morphological categories also have tonal effects (Andersen 1992; Trommer 2022). The non-topical subject (NTS) form is associated with a replacive high tone (11).

(11)	Unmarked	NTS	Meaning
	wèc	wéec	‘kick’
	tèŋ	téenŋ	‘dust’
	tèem	téem	‘cut’
	ŋàaŋ	ŋééŋ	‘open’
	(Agar Dinka; Andersen 1992:20,28–29)		

As with lengthening, tonal effects are often associated with a grade change. In (11), the non-topical subject form is Grade 2, and triggers fronting of *a*. But tone can be the sole exponent of a morphological category. As described by Andersen (2002), case morphology in Dinka is tonal. The formation of the oblique case from the absolutive often involves mapping a low to a falling tone, or a falling or high tone to a low (12) (see Andersen 2002).

(12)	Absolutive	Oblique	Meaning
	màac	mâac	‘fire’
	dít	dît	‘bird’
	jâak	jàak	‘pelican’

The final nonconcatenative change that can occur in roots is to alter voice quality. Root vowels may be either creaky/modal or breathy. Most morphological categories preserve underlying voice quality. But a number of categories, like the centripetal and applicative in verbs (13), shift the underlying voice quality to breathy (Andersen 1993, 2017).

(13)	Unmarked	Unmarked CP	Unmarked APP	Meaning
	bàr	bẹ̀er	bẹ́er	‘take along’
	mliit	ṃiit	ṃiit	‘pull’
	gùt	g̣ùt	g̣ùt	‘stab’

(Agar Dinka; Andersen 2017:10,12-13)

A shift in voice quality co-occurs with a change in vowel quality. The centripetal and applicative are both Grade 2 and so show fronting of *a*. No morphological categories effect a shift to creaky voice.

2.4 A preference for nonconcatenative morphology

These nonconcatenative processes are widespread in Dinka, so that verbs, for instance, have at least a dozen distinct monosyllabic forms. In contrast, as we discuss in section 3.1, Dinka employs only a limited set of affixes. This situation is typical of Western Nilotic languages. Anywa, Nuer, Shilluk, and Thok Reel verbs are also monosyllabic and encode a large number of morphological categories nonconcatenatively (Reh 1996; Reid 2010, 2019; Remijsen and Ayoker 2022).

Systems in which nonconcatenative morphology is pervasive are an important testing ground for the question of whether morphological marking is item-based, process-based, or both. The preference for nonconcatenative marking in Dinka is cited by Aronoff and Fudeman (2011:54) and Arkadiev and Klammer (2018:450) as a problem for the idea that nonconcatenative morphology arises from underlyingly item-based representations. The limited use of affixation in Dinka seems to undermine the idea that concatenation is the primary mode of morphological marking. Trommer (2011, 2015) presents an exclusively item-based view of significant parts of Dinka verbal morphology, showing that changes in length and tone can be handled by means of underspecified moraic suffixes.⁸ But a key question for any item-based approach is *why* languages like Dinka appear to *prefer* nonconcatenativity.

Within exclusively process-based approaches, like Anderson (1992) or Aronoff (1993), or theories that allow for both item-based and process-based exponence (Orgun 1996; Inkelas and Zoll 2005; Pater 2009; Inkelas 2014; Sande et al. 2020), morphological marking may result in a potentially category-specific phonological process. Within such approaches, overt affixation is either an independent dimension of content (see particularly Inkelas 2014; Sande et al. 2020), or simply another form that phonological manipulation can take. In any case, languages that primarily utilize nonconcatenative changes to a

⁸Trommer does not directly discuss the Dinka grade system and the strong correlation between changes in vowel quality and length (though there is an analysis of lowering in Thok Reel in Trommer (2011:6.3) that has much in common with Dinka Grade 3), or the cases of extended exponence we examine.

base are just as expected as languages that only use affixes.

In our discussion of whether Dinka morphology is best analysed as item-based or process-based, we draw on Sande (2022), who adopts a framework that allows for both types of exponence. In a discussion of theories of grammatical tone, she identifies three diagnostics to help adjudicate whether a pattern is better analysed as item-based or process-based (14). Item-based morphology should (i) have a *consistent realisation* that can be attributed to the addition of a single item, (ii) be *phonologically derivable*, and (iii) be derived by the *general phonology* of a language. To expand these diagnostics beyond tone, we add the expectation that item-based changes should *not display extended exponence* (Matthews 1972:82), in that marking should not co-occur with another overt affix.⁹

(14)

	Consistent realisation	Phonologically derivable	Derivable from general phonology	Extended exponence
Item-based	yes	yes	yes	no
Process-based		yes		

(empty = no prediction)

At first glance, the criteria in (14) may suggest a process-based analysis of Dinka. The grade changes we described in section 2.2 are intricate and seem to involve restrictions that are phonologically derivable, such as the absence of low vowels in Grade 2, but less obviously general. In addition, Dinka nonconcatenative morphology appears to participate in patterns of extended exponence, since there are morphological categories in which nonconcatenative changes co-occur with affixation. The 2PL suffix *-kə* triggers vowel lowering in the root (15).

(15)

Unmarked	2PL (3)	Meaning
wèc	wác-kə	‘kick’
lèer	lèer-kə	‘roll’
tèem	tèem-kə	‘cut’

(Agar Dinka; Andersen 1992:28–29)¹⁰

The passive suffix *-ə* and 2SG suffix *-ə* also appear with changes to the root (16). The passive is accompanied by vowel fronting, lengthening, and a replacive falling tone. The 2SG triggers vowel lowering

⁹A process-based analysis does not necessarily make negative predictions about these diagnostics, since a phonological process can result in an additive logic (see fn. 12 for more discussion).

¹⁰Note that there is no contrast between [e] and [a] in short vowels (Andersen 1993), and the 2PL forms of ‘kick’ and ‘dust’ are transcribed with [a] in Andersen (1992) which we follow here.

and also induces lengthening and a replacive low tone.¹¹

(16)	Unmarked	Passive CT	Applicative	2SG applicative	Meaning
	gùt	gûut-ẹ	gûut	gwòot-ẹ	‘stab’
	mìit	mîiit-ẹ	mîit	mjèet-ẹ	‘pull’
	bàr	bêër-ẹ	bğër	bàar-ẹ	‘take along’

(Agar Dinka; Andersen 2017:10–13)

As argued by Inkelas (2008, 2014), such patterns suggest that affixation is independent of nonconcatenative processes of marking in the root.

This paper argues that nonconcatenative effects in Dinka meet Sande’s (2022) criteria and are derivable from *phonologically general* constraints that explain the preference for nonconcatenative marking. First, there is a principled link between the wellformedness of affixation and nonconcatenative processes in Dinka, offering evidence that these types of morphological marking are not independent. We argue that the typical expression of nonconcatenative morphology in Dinka, a shift in vowel grade accompanied by lengthening, arises because restrictions on vowel contrast in suffixes drive CV metathesis into the root, where grade changes reflect the phonologically general outcome of coalescence (Sande’s criteria ii and iii). Dinka nonconcatenative morphology is *additive* and *consistent* across paradigms (Sande’s criterion i). The cases of extended exponence are shown to reflect configurations in which a single morpheme creates the environment for an independent phonological effect, rather than multiple marking, as predicted by an item-based approach (our criterion iv).

As a result, the logic of Dinka morphology is additive, and in fact reflects the primacy of concatenation: nonconcatenative marking arises only because phonological constraints prevent surface affixation. Dinka then provides evidence for an item-based analysis of the type of nonconcatenative system found in Western Nilotic languages, even within an architecture such as Sande’s (2022) that allows for item-based and process-based exponence.¹²

¹¹ As noted in section 4.3, both categories delete in the simple transitive and do not surface in isolation. So we illustrate with the passive circumstantial topic form, which is generally syncretic with the passive, and the applicative 2SG.

¹² A reviewer notes that a process-based analysis cannot be ruled out, since such a view apparently makes no predictions with regards to the diagnostics in (14). We think an item-based view is to be preferred if possible, because it captures generalisations about Dinka missed in a process-based view, as we emphasize throughout the paper. We note also that the specific predictions of an item-and-process account vary based on implementation. It does not seem straightforward to us, for example, to explain the consistently additive nature of Dinka morphology as affix-specific phonology.

3 An item-based analysis of Dinka vowel grades

This section presents a novel generalisation about Dinka that we suggest is crucial to understanding the preference for nonconcatenative marking: exactly those properties that are expressed through nonconcatenative morphology, namely, vowel quality, length, tone, and voice quality, are subject to *neutralization* in suffixes. We develop an item-based analysis of Dinka vowel grades that captures this correlation. We focus particularly on the fact that vocalic suffixes have the form *-e*, which we show is an underspecified vowel in Dinka. On this basis, we argue that Dinka suffixes are subject to constraints that favour the expression of vowel contrast in the most morphologically prominent constituent, the root. Building on work on vowel reduction (Crosswhite 2001, 2004) and harmony (Walker 2005, 2011; Kaplan 2008, 2015), we propose a positional licensing constraint that requires vowel features to be linked to the most morphologically prominent constituent, the monosyllabic root, which is satisfied by CV metathesis.

3.1 Constraints on suffixes in Dinka

A key observation that we bring to the study of Dinka nonconcatenative morphology is that the phonological changes that occur in the root mirror restrictions on overt suffixes. In this section, we demonstrate that Dinka suffixes are restricted in vowel quality, length, tone, and voice quality, exactly the four types of nonconcatenative effects identified in section 2.

Torben Andersen’s work provides a comprehensive overview of verbal and nominal morphology in the Agar variety (Andersen 1992, 1993, 2007a, 2014, 2017, 2020), and demonstrates that overt suffixes are significantly restricted in form, as in other Western Nilotic languages (e.g. Reh 1996:48 on Anywa, Reid 2019:sec. 3.6 on Nuer, and Remijsen et al. (2015) on Shilluk). We focus on suffixes rather than prefixes, because nonconcatenative morphology is oriented to the final syllable (as evident, for example, in the polysyllabic nouns discussed in section 2.1).¹³

We argue that Dinka has two paradigms of true suffixes. The first set is found in the verbal paradigms. We show the distribution of verbal suffixes in Table 3 (Andersen 1992, 1993, 2017).

Table 3. Agar Dinka verbal paradigms by suffix.

¹³It is also not clear that there are genuine prefixes, aside from the prefix *a-* mentioned there.

	Transitive	CF	CP	APPL	APPL.AP	AP
UNM						
NF						
NTS						
1SG						
2SG		-é		-é	-é	-é
3SG						
1PL	-kù/kù	-kù	-kù	-kù	-kù	-kù
2PL	-kà/kà	-kà	-kà	-kà	-kà	-kà
3PL	-kè/kè	-kè	-kè	-kè	-kè	-kè
PASS		-è	-è	-è	-è	—
PASS.CT	-è	-è	-è	-è	-è	-è

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

Verbal suffixes are significantly more limited in form than roots. All suffixes obey a -CV maximum, with little stacking.¹⁴ Unlike roots, suffixes do not require an onset consonant, and lack codas. In addition, suffixes permit little contrast in the four phonological dimensions involved in nonconcatenative processes. All suffix vowels are breathy, with no contrast between creaky and breathy voice. Suffix vowels do not show length distinctions and are all short. Although suffixes carry different tones, the tone on the suffix is in fact *predictable* from the tone of the root. If the root has a low tone, the suffix carries a high tone. If the root has a falling or high tone, the suffix is low-toned.

Contrast in vowel quality is also limited in suffixes. Vocalic suffixes representing the 2nd person singular, passive, and passive circumstantial topic all have the form -*ɛ*. No other vowel suffixes occur, although the plural -CV suffixes may have different vowels, a point to which we return in section 4.2. We suggest that the occurrence of the vowel *ɛ* in these forms is not accidental. There are a number of pieces of evidence suggesting that *ɛ* is the underspecified vowel in Dinka. Firstly, Remijsen and Gilley (2008:p. 335) note that short *e* (breathy or creaky) is “appropriately transcribed [ə] in many of its realisations”.¹⁵ Further, as Andersen (2007a:fn. 20) observes, much of the reduced functional vocabulary (e.g.,

¹⁴The plural CV suffixes *-ka/kɛ/kɛ* could plausibly be decomposed into a plural suffix *-k* and a person marker, in which case stacking is possible up to the -CV maximum.

¹⁵Note that breathiness is not contrastive in suffixes, so that the breathiness of short *ɛ* in reduced forms is likely not indicative of a specification for breathy voice.

preposition *ɛ̃/nɛ̃*, the negative auxiliary *cɛ̃*) ends in *ɛ̃*, suggesting that at least some of these forms have undergone vowel reduction. Finally, in the paradigms of the perfect auxiliary *cɛ̃* and future auxiliary *bɛ̃*, short forms surface with *ɛ̃*, alternating with full vowels in long forms. This alternation is also suggestive of reduction in the short form. We conclude that the prevalence of *-ɛ̃* is indicative of a restriction on vowel contrast in suffixes.

A second set of suffixes occurs in the nominal domain, but these are even smaller. Andersen (2016, 2020) identifies two *-C* suffixes that occur in so-called *construct state* forms, which modify nouns. With most nouns, construct states are marked by nasalization of the coda consonant (for singulars) or changes in length and tone only (for plurals). However, with the few exceptional singular CV nouns, the construct state is marked by the suffix *-n/ŋ* (17).

(17)	Noun	Construct state 1	Meaning
	<i>ɲà</i>	<i>ɲà-n</i>	‘girl’
	<i>ɟó</i>	<i>ɟó-ŋ</i>	‘dog’
	(Andersen 2020:275)		

This suffix has a plural counterpart *-k*, though it only surfaces on the one plural CV noun *cá* ‘milk’ (e.g. *cêek=kà* ‘this milk’)¹⁶ and the diminutive morpheme *tɿi* (e.g. *tɿi-k* ‘DIM-PL.CS1’)(Andersen 2020:276,291).¹⁷

We conclude from suffixation in the verbal and nominal domain then that suffixes are limited to a CV maximum and are significantly restricted in vowel quality, length, tone, and voice quality, exactly the four qualities that are used in nonconcatenative processes. This connection suggests that the prevalence of nonconcatenative effects is linked to *phonologically general* constraints on the wellformedness of suffixes. In the next section, we start to develop an analysis of Dinka nonconcatenative morphology that builds on these insights, and derives all nonconcatenative effects from underlying affixation.

3.2 Positional licensing of vowel contrast in Dinka

In this section, we argue that the phonological restrictions on suffixes arise as a result of *positional licensing* (Steriade 1994; Zoll 1998; Walker 2011), the idea that phonological features may be required to be associated with phonologically or morphologically prominent positions. We propose that the Dinka nonconcatenative preference arises because of a desire to align all vowel features with the morphologically prominent root (Beckman 1999; Kaplan 2008, 2015; Walker 2011). This pressure results in productive

¹⁶Liquids are often grammatically plural in Dinka (Andersen 2014:253).

¹⁷Dinka has postnominal demonstratives and pronominal possessors that permit more contrasts. But Andersen (2020:293,298) demonstrates that these elements are phrasal enclitics and not suffixes.

CV metathesis, allowing vocalic suffixes to be realised inside the root.

Positional licensing is the idea that phonological features in positions where they may be harder to perceive may require *licensing* by being associated with a more salient position, such as a stressed syllable or the root. Crosswhite (2001, 2004) argues that positional licensing explains the common pattern of reduction of contrast in unstressed positions, for example. Positional licensing has also been argued to be the driving force behind many patterns of vowel harmony, where the target is often a prominent position (e.g. Walker 2005, 2011). In Eastern Andalusian varieties, deletion of final *s* triggers the appearance of a final [-ATR] vowel, triggering regressive [-ATR] harmony to the stressed syllable (18a–c).

(18) *Eastern Andalusian [-ATR] harmony:*

tos-e	[<u>t</u> o.se]	‘cough-3sg’	tos	[<u>t</u> ɔ]	‘cough’
nene	[<u>n</u> e.ne]	‘baby’	nene-s	[<u>n</u> ɛ.nɛ]	‘babies’
mono	[<u>m</u> o.no]	‘monkey’	mono-s	[<u>m</u> ɔ.nɔ]	‘monkeys’

(Jiménez and Lloret 2007:3)

Jiménez and Lloret (2007) understand [-ATR] harmony as positional licensing, boosting the perception of an [ATR] contrast by associating [-ATR] with a stressed position. Much as in Grade 3 in Dinka, the change from [+ATR] to [-ATR] serves as an important cue to a morphological alternation.

Work on positional licensing identifies at least three types of prominent positions: initial syllables, stressed syllables, and roots (see Walker 2011:ch. 2 and Kaplan 2008, 2015). Kaplan (2008) argues that, in Lango (Nilotic; Uganda), [ATR] harmony occurs so that [+ATR] features are licensed by the root. [+ATR] suffixes like *-ni* and *-wu* trigger regressive harmony to the root-final syllable (19).

(19) *Lango [+ATR] harmony to the root:*

‘bò.ŋó + <u>ní</u>	‘bò.ŋó- <u>ní</u>	‘your dress’
‘pà.là + <u>ní</u>	‘pà.là- <u>ní</u>	‘your knife’
‘bò.ŋó + <u>wú</u>	‘bò.ŋó- <u>wú</u>	‘your (pl.) dress’

(Noonan 1992:32–33,79)

These disyllabic forms show that harmony does not target the initial or stressed syllable. Instead, Kaplan argues that [ATR] features are licensed by the root, so that the root-final syllable is a sufficient target.

We propose that positional licensing provides a phonologically general rationale for the nonconcatenative preference in Dinka and explains contrast reduction in suffixes: all vowel contrast is preferentially licensed by the monosyllabic root. It is well-known that roots can act as privileged domains for phono-

logical properties (Zoll 1998, Beckman 1999, Walker 2011:2.5, Kaplan 2008, 2015). In Dinka, too, the monosyllabic root is a prominent position for other phonological effects: only roots permit overlong vowels and roots are subject to special requirements, such as the obligatory onset and coda.

We posit a positional licensing constraint (20) that requires *all* vowel features to be anchored to root segments, LICENSE([VFeat],Root) (see also Kaplan 2008:75, and Walker 2011:ch. 3 on the statement of positional licensing constraints).

(20) LICENSE([VFeat],Root):

Assign a violation mark for any vowel feature not linked to a root segment.

In other words, vowel contrasts are preferentially expressed in the root. Positional licensing has generally been argued to serve to boost phonetic properties that may be difficult to perceive. The intuition we pursue is that Dinka maximizes the salience of a single vowel quality. The lack of true diphthongs and the obligatorily monosyllabic root, in conjunction with (20), ensure that only one set of vowel features is licensed within any word. Even the obligatory onset and coda serve this purpose, since they provide obligatory CV and VC transitions, maximizing cues to vowel identity (cf. Steriade 2008).

As noted in section 2.1, even in exceptional polysyllabic nouns, the root-final syllable still serves as the target for nonconcatenative morphology. This orientation to the root-final syllable mirrors the Lango harmony pattern. We note that, although Dinka lacks an obvious stress system, nothing would change if we posited abstract final stress, and referred to the stressed syllable in (20). Any approach to Dinka morphophonology must recognize that the monosyllabic root is a prominent domain, since it is subject to special constraints on shape and most suprasegmental contrast is expressed only root-finally.

Walker (2011:7.3) points out that some Northern Italian dialects satisfy positional licensing by metathesis of unstressed *i* where other varieties display harmony. We argue that the same logic applies in Dinka. The featural licensing constraint in (20) will be violated by any vowel feature in suffix position. Alongside reduction and harmony, CV metathesis can also satisfy positional licensing, if it places the affix vowel in the root. We propose that, in Dinka, LICENSE([VFeat],Root) outranks a faithfulness constraint banning metathesis, LINEARITY. Where an overt suffix does surface, the default short vowel *ɛ* results, because it is unspecified for features, and so not subject to a licensing requirement. In addition, we suggest that short *ɛ* in word-final position differs from full vowels in that it is *non-moraic*, as Crosswhite (2001) also suggests for schwa in some languages. We enforce the linkage between vowel features and moras by an undominated constraint $\mu/[V]$ (21).

(21) $\mu/[V]$: Assign a violation mark for any mora not associated with vocalic features.

This constraint ensures that the default underspecified vowel ϵ is not associated with a mora, since it lacks vocalic features. This idea ensures that vowel reduction as a strategy is generally dispreferred to other possibilities, such as CV metathesis, since it results in the deletion of a mora.

3.3 Vowel grades as -V suffixes

The licensing constraint on vowel contrast motivated in the previous section provides an explanation for the prevalence of lengthening and the processes of lowering and fronting. A key ingredient in our item-based account is the idea that the vowel grades correspond to vocalic suffixes. It has been widely argued that stem-internal changes in vowel quality in Western Nilotic derive from vocalic suffixes historically (Andersen 1989; Reh 1996; Dimmendaal To appear). The Grade 2 3SG and applicative, for example, have front vowel cognates in other Nilotic languages (22).

(22)	Root	3SG	Applicative	Language
	bar ‘take along’	b̥ɛr	b̥ɛr	(Agar) Dinka
	r̥iɲ ‘run’	r̥iɲ-ɛ		Nuer (Reid 2019:102)
	càm ‘eat’	á-càam-ɛ	á-cám-ì	Shilluk (Remijsen et al. 2016:21,29)
	ṭàaɲ ‘push’	ṭàaɲ-í		Kurmuk (Andersen 2007b:36,86)
	púur ‘hoe’		púr-íʃ	

We propose to analyse Grade 2 as a front vowel suffix in Dinka too. We take this suffix to be *-i* rather than *-ɛ*, since *i* is the vowel that surfaces overtly in Dinka auxiliaries (see Table 4).¹⁸ We identify Grade 3 with the low central vowel *-a*. Cognates of Grade 3 inflection across Western Nilotic also reveal vocalic suffixes with a low or central vowel, such as in the 1SG and non-finite (23).¹⁹

¹⁸Grade 2 could also correspond to underlying *-ɛ*. The fact that vowel fronting has the same effects across categories suggests a uniform underlying representation, despite variability in cognate suffixes. One possibility is that suffix vowels underwent a historical process of reduction to corner vowels in Dinka (Crosswhite 2004), which would be consistent with the vowels in CV suffixes also. This idea would also explain uniform underlying *-a* for Grade 3 categories.

¹⁹Dinka 2SG is also Grade 3, but, across Nilotic, 2SG is typically marked by *-i*, suggesting that the 1SG and 2SG underwent syncretism in the history of Dinka. A similar syncretism occurs in intransitives in Jumjum (Andersen 2018).

(23)	Root	1SG	Non-finite ²⁰	Language
	miit ‘pull’	mjèēt	mjêēt	(Agar) Dinka
	lēap ‘open’	lēap-ǎ		Nuer (Reid 2019:103)
	cām ‘eat’	á-cāam-á	cāam-ǎ	Shilluk (Remijssen and Ayoker 2022:35,68)
	gээр ‘build’	ā-gээр-ā		
	kāad ‘weave’		kāad-ǎ	Anywa (Reh 1996:187,194)

Our analysis diverges from Trommer (2011, 2015), who posits underlying moraic affixes which concatenate to the final mora of roots. An advantage of positing defective affixes is that nonconcatenative realisation can be explained through the use of general constraints that require association of floating material on one tier to elements on other relevant tiers, such as *FLOAT. Under this proposal, nonconcatenative effects are, therefore, a by-product of a structural imperative within Autosegmental Phonology (Goldsmith 1976). We pursue a different approach in adopting underlying representations of affixes that are fully specified. We do this first because these abstract affixes are not obviously deficient: they contribute predictable lengthening, vowel quality, voice quality, and tone, and these properties go together. Positing defective affixes does not capture the observation that vowel grade changes lie at the core of Dinka morphology. Second, a theory in which nonconcatenative effects are a by-product of the need for autosegmental association misses an important generalisation, namely that constraints on the licensing of vowel quality drive nonconcatenative morphology. As a result, our proposal provides an explanation for why a language like Dinka appears to prefer nonconcatenative marking. We emphasize, however, that our approach and Trommer’s are in principle compatible, since positional licensing could drive integration of a defective affix.

Independent evidence for the vowels we posit for Grade 2 and Grade 3 comes from vowel alternations in auxiliaries. Auxiliaries with a reduced vowel (the perfect *cé* and future *bé*) surface with *-i* and *-a*, in correspondence with where we see Grade 2 and Grade 3 on regular verbs, as Table 4 shows.²¹

Table 4. Paradigm of perfect auxiliary.

²⁰The Anywa infinitival suffix *-ǎ* is a likely cognate, since it surfaces in clauses with auxiliaries and is absent on underived active verbs (Reh 1996:186–189), like the Grade 3 non-finite in Dinka. The Shilluk suffix also marks infinitives in clauses with auxiliaries (Remijssen and Ayoker 2022:sec. 7.6). The “stem vowel” suffix *-o/-ɔ* of Dholuo Tucker (1994) and Lango (Noonan 1992) may be related, since it is often absent before other inflection.

²¹As Table 4 shows, vowel alternations in these auxiliaries involve more complexity. The vowel that surfaces in the 1PL and 3PL are also a regular outcome of CV metathesis (see section 4.2). The passive circumstantial topic form surfaces with an additional suffix *-nǎ* (see Van Urk 2015:2.4). The 3SG is an exception to our generalisation and unexpectedly shows reduction.

	Grade on regular verbs	Perfect
UNM		cẹ
NTS	2	c̣i
1SG	3	cà
2SG	(3)	cá
3SG	2	cẹ
1PL		c̣uk
2PL	3	c̣aak
3PL		c̣ik
PASS	(2)	c̣i
PASS:CT	2	c̣i-nẹ

Note: Grades in parentheses indicate the grade in derived paradigms.

In these paradigms, we see the suffix vowels we posit surface overtly. This vowel alternation is otherwise unattested in Dinka, but it follows if Grade 2 and Grade 3 are identified with these vocalic suffixes.

Our proposal is that these vocalic suffixes undergo CV metathesis into the root to satisfy the licensing constraint on vowel features motivated in section 3.2. Similar patterns of language-general CV metathesis into prominent domains occur in other languages. Rotuman (Austronesian, Fiji), for example, displays a well-known metathesis pattern that is attributable to metrical structure (Hale and Kissonck 1998; McCarthy 2000). The final syllable of the root undergoes metathesis in the so-called “incomplete phase”. Metathesis results in rising diphthongs, umlaut, or deletion, depending on the vowels (24).

- (24) **Root Incomplete phase Meaning**
- | | | |
|------|------|--------------|
| hosa | hoas | ‘flower’ |
| hoti | höt | ‘to embark’ |
| rako | rak | ‘to imitate’ |
- (Rotuman; McCarthy 2000:148)

Rotuman metathesis shows striking similarity to Dinka vowel grades, which involves similar vowel changes, though the Rotuman pattern is driven by metrical structure rather than positional licensing.

We demonstrate our analysis for a Grade 3 category in (29), the 1SG of *còol* ‘call’. As motivated above, the Grade 3 1SG suffix is underlyingly *-a*. All vowel features must be linked to a root segment because of the high ranking of $LIC([VFeat], Root)$. Dinka resolves this problem with CV metathesis of the

vocalic suffix into the root, because of the low ranking of a constraint penalizing metathesis *LINEARITY*, which we define in terms of immediate precedence in (25), following Heinz (2005) (see Hume 2001, Takahashi 2019 and Mooney 2022 for different approaches).

- (25) *LINEARITY*: For any pair of input segments *a* and *b* and their output correspondents *a'* and *b'*, where *a* immediately precedes *b*, assign a violation mark if *a'* does not immediately precede *b'*.

We define *LINEARITY* in terms of CV slots, so that a candidate in which the suffix vowel migrates into the root incurs one violation, since the coda consonant of the root no longer precedes the suffix V.

Because Dinka permits one V slot per nucleus, CV metathesis leads to coalescence of the root and suffix vowel, violating a low-ranked *UNIFORMITYV* constraint (26). We illustrate with the autosegmental structure for the input and winning candidate in (29). The features that win out in coalescence are determined by the ranking of *MAX* constraints prohibiting feature deletion, following the schema in (27).

- (26) *UNIFORMITYV*: Assign one violation mark for every vowel in the output that has more than one correspondent in the input.
- (27) *MAX[αF]*: Assign one violation mark for every [αF] that is present on a segment in the input but not present on the correspondent of that segment in the output.
- (28) *DEP(link)*: Assign one violation mark for every association line in the output that is not present in the input. (cf. **ASSOCIATE*, Yip 2002)

The winning candidate with CV metathesis (29a) violates *LINEARITY* once, because the coda C of the root no longer precedes the suffix V in the output. It is, nonetheless, preferred over the faithful candidate (29b), which violates positional licensing. The low ranking of *LINEARITY* ensures that metathesis is the preferred repair to violations of *LIC*([VFeat],Root). *MAX*[+low] is high-ranked, so that coalescence results in *a* rather than a candidate that preserves the [-low] quality of *ɔ* (29c). A candidate (29d) that associates the suffix vowel by means of spreading to the root is blocked by a constraint *DEP(link)* (28), which penalizes the addition of association lines in the output.²² This constraint blocks the satisfaction of positional licensing via harmony. Deletion of the suffix vowel in candidate (29e) is blocked by high-ranked *MAXμ*, which also prevents vowel reduction as a solution (29f), since *ɛ* is non-moraic.

²²The same constraint rules out *cāaal-é*, in which the mora and features of the suffix move into the root, but the suffix V slot is retained to avoid violations of *LINEARITY* and *UNIFORMITYV*.

(29) Tableau for CV metathesis driven by positional licensing

Input: /còɔl+á _{1SG} /	$\begin{matrix} [-low] \\ \vdots \\ C_1 & V_2 & C_3 & V_4 \\ & \swarrow & \downarrow \\ & \mu & \mu & \mu \end{matrix}$ $\begin{matrix} [+low] \\ \vdots \\ V_4 \end{matrix}$	MAX μ	DEP (link)	LIC ([VF],Rt)	MAX [+low]	LIN	UNIFV
a. càaal	$\begin{matrix} [+low] \\ \vdots \\ C_1 & V_{2,4} & C_3 \\ & \swarrow & \downarrow \\ & \mu & \mu & \mu \end{matrix}$					*	*
b. còɔl-á	$\begin{matrix} [-low] & [+low] \\ \vdots & \vdots \\ C_1 & V_2 & C_3 & V_4 \\ & \swarrow & \downarrow \\ & \mu & \mu & \mu \end{matrix}$			*!			
c. còɔɔl	$\begin{matrix} [-low] \\ \vdots \\ C_1 & V_{2,4} & C_3 \\ & \swarrow & \downarrow \\ & \mu & \mu & \mu \end{matrix}$				*!	*	*
d. càal-á	$\begin{matrix} & [+low] \\ & \vdots \\ C_1 & V_2 & C_3 & V_4 \\ & \swarrow & \downarrow & \vdots \\ & \mu & \mu & \mu \end{matrix}$		*!				
e. còɔl	$\begin{matrix} [-low] \\ \vdots \\ C_1 & V_2 & C_3 \\ & \swarrow & \downarrow \\ & \mu & \mu \end{matrix}$	*!					
f. còɔl-é	$\begin{matrix} [-low] \\ \vdots \\ C_1 & V_2 & C_3 & V_4 \\ & \swarrow & \downarrow \\ & \mu & \mu \end{matrix}$	*!			*		

This is our basic account of Grade 2 and Grade 3 affixation. This proposal provides an explanation for constraints on suffixes as well as the nonconcatenative preference in Dinka, and why lengthening and changes in vowel quality typically go together, as a predictable outcome of CV metathesis and vowel coalescence (as developed in more detail in section 5). In this view, nonconcatenative morphology is a direct outcome of surface constraints on the licensing of vowel contrast (Sande’s criteria ii and iii).

For reasons of space, we omit a full discussion of tone, though we discuss the tonal effects of the passive and 2SG in section 4.3. Dinka tonal paradigms are complex and it is difficult to determine the underlying tone of roots, but we take the view generally that Dinka grammatical tone is *replacive*. We refer the reader to Trommer (2022) and Van Urk (2025) for more detailed discussion.²³

²³For simplicity, we use the unmarked low-toned form as the basic form in the prose. In the tableaux, we leave roots toneless

4 Additivity and the absence of extended exponence in Dinka

This section shows that our item-based analysis explains two key properties of nonconcatenative morphology in Dinka. First, nonconcatenative marking is *additive*, in that it adds prosodic material to the base, unless independently blocked. Second, we demonstrate that cases of extended exponence, in which nonconcatenative processes occur before an affix, are only apparent. Vowel lowering before the 2_{PL} *-ka* reflects word-level lowering harmony, and so does not result in lengthening. Overt suffixes in the passive and 2_{SG} are the result of epenthesis to host a complex tonal melody that cannot be realised in the base (Rolle and Merrill 2022). These effects then offer evidence for an item-based view: there is no extended exponence in Dinka morphology.

4.1 Nonconcatenative morphology in Dinka is additive

In an item-based analysis, morphological marking should be analysable as the consistent addition of a single item (Sande criterion i). This section presents the generalisation that nonconcatenative morphology in Dinka is indeed *additive* and *consistent*. These properties follow from an item-based analysis, which treats derived forms as the addition of a consistent affix with a constant base. In contrast, a process-based view of nonconcatenative morphology makes no predictions as to whether a morphophonological process is additive or subtractive, and so misses a key generalisation.

Recall from section 2 that there are four phonological properties that change in Dinka roots as a result of nonconcatenative morphology: length, voice quality, vowel quality, and tone. The distribution of these changes, however, is not arbitrary. The primary means of marking a morphological category is through a grade change and one degree of lengthening. Changes in tone and voice quality typically only occur in addition to such marking, as shown in section 2.3.

A change to Grade 2 or Grade 3 is additive and consistent, and reliably involves the lengthening of roots by one degree across verbal and nominal paradigms (Andersen 1993, 2017; Ladd and Blum 2021). We show the consistency of lengthening by presenting the distribution of vowel grade and length in Agar Dinka in Table 5, for five verbal paradigms (Andersen 1992, 1993, 2017).²⁴ Much the same distribution is found in Bor South (Blum 2023).

underlyingly and associate the grammatical tone found in a morphological category with the affix.

²⁴We omit the antipassive paradigms, where there is significant variation depending on verb class. This variation accords with the claim that grade changes imply lengthening, although long roots sometimes show additional shortening effects in the antipassive. See Andersen (2017).

Table 5. Agar Dinka paradigms by grade and length, across root types.

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

(-μ = lengthening of the root by one mora, -μ_{II} = lengthening of the root up to a bimoraic limit)

Table 5 marks all cells with a change to Grade 2 or Grade 3. The absence of a grade change means the verb is in Grade 1, the underlying form of the root. In each cell, we indicate lengthening alongside the grade. As evident from this overview, a grade change consistently triggers one step of lengthening.

There are two cells that only show a grade change or lengthening, not both (highlighted in gray). The non-finite NF is additive, but happens to be irregular in the basic transitive, because it displays lengthening without the Grade 3 change associated with it in derived paradigms. The 2PL appears to be an exception to additivity, since a Grade 3 change occurs without lengthening. But we provide a principled explanation of this effect in section 4.2, where we argue that the grade change reflects lowering harmony triggered by the low vowel in the 2PL suffix, rather than CV metathesis. Note also that applicative forms are subject to an independent restriction that blocks lengthening to overlong (see section 6.2).

Consistent additive realisation can also be demonstrated for changes in vowel quality and voice quality. First, Dinka vowel grades can be analysed as the outcome of coalescence of the features of the root vowel and the affix vowels we posit, as we discuss in more detail in section 5. But the additive character of these changes can be demonstrated more straightforwardly. As noted in section 2.1, high glides can appear after an onset consonant to form a complex onset. In Grade 3, we see that high root vowels are preserved as onset glides, alongside the coalescence process that results in lowering, as highlighted in Table 6. When the root vowel can be retained then, vowel quality changes result in an extra segment.

Table 6. Dinka grade 3, without glides.

	Creaky	Breathy
Grade 1	i e a ɔ o	ĩ ẽ ǣ ɔ̃ ɔ̄ ʉ
Grade 3	[jɛ] ɛ a a [wɔ]	[jẽ] ẽ ǣ ǣ ɔ̃ [wɔ̃]

Additional evidence that vowel quality changes are additive when they can be comes from closely related Western Nilotic languages Nuer and Thok Reel (Reid 2010, 2019). Unlike Dinka, both languages permit diphthongs with initial [-ATR] mid vowels. As expected, in the equivalent of Grade 3 lowering in both languages, such mid vowels are also preserved via breaking, as shown for Nuer Grade B in Table 7.

Table 7. Nuer lowering, without glides (Reid 2019:119).

	Creaky	Breathy
Grade A	ɪ ɛ a ɔ ʊ	ĩ ẽ ʌ ɔ̃ ɔ̄ ʉ
Grade B (lowering)	[iɛ] [ɛa] a [ɔa] [ʊɔ]	[iẽ] ẽ ǣ [ɔ̃a] o [ʉɔ̃]

Changes in voice quality are also regular and additive. In some morphological categories, creaky roots become breathy, and the opposite pattern is never found. An additive analysis explains this generalisation, if [spread glottis] is a privative feature for breathy voice quality and creakiness involve the absence of a voice specification.

The question of whether grammatical tone in Dinka displays additivity is more difficult to answer, because the distribution of tone across morphological categories is complex. In Trommer’s (2022) analysis, some morphological categories do involve the concatenation of the tone of the root and the affix tone, but there are no clear surface alternations of this type. We take the view that grammatical tone in Dinka is generally *replacive*, as also discussed in section 4.3.²⁵ In any case, the association of tones with morphological categories is predictable (see Trommer 2022 and Van Urk (2025) for proposals). As predicted by an item-based analysis then, the expression of nonconcatenative morphology in Dinka is consistent and additive in the domain of length, vowel quality, and voice quality.

4.2 Lowering and the absence of reduction in -CV suffixes

As noted in section 2.4, an item-based analysis of nonconcatenative morphology predicts that there should be no instances of extended exponence. But 2_{PL} *-ka* is accompanied by a Grade 3 change in the root, an apparent case of extended exponence. A related problem for our account is the fact that

²⁵There seems to be little evidence of tonal concatenation in general in Dinka (see Remijsen and Ladd 2008 and Blum 2023 on tone sandhi processes in Dinka varieties).

CV suffixes surface with full vowels, in violation of positional licensing. We argue that full vowels are permitted in CV suffixes as a last resort because metathesis in these cases would be *non-local* (Hume 2001; Carpenter 2002), so that CV metathesis is blocked and no lengthening is observed. We analyse the Grade 3 change before 2PL *-kə* as word-level harmony triggered by the suffixal low vowel.

These two problems are illustrated in Table 8 with plural forms of a short and a long root.

Table 8. Plural suffixes in basic transitive.

	Grade	wec ‘kick’	teem ‘cut’
1PL		wéc-kù	tèem-kù
2PL	3	wéc-kà	tèem-kà
3PL		wéc-kè	tèem-kè

(Agar Dinka; Andersen 1992:28–29)

First, we see that full vowels surface without reduction in the 1PL and 2PL, although the default *ə* occurs in the 3PL. However, in accordance with our account, there is no lengthening before these suffixes. Short roots remain short, and long roots remain long. The question then is why a full vowel is licensed in a CV suffix. The second issue is that nonconcatenative marking occurs in the root before the 2PL suffix, Grade 3 lowering of the underlying vowel *e* to *ə*. If a grade change reflects metathesis of a vocalic suffix, this is surprising: the 2PL would be marked by two morphemes. The step of lengthening that otherwise always accompanies Grade 3 is absent, though, and this difference provides the motivation for our claim that Grade 3 lowering before the 2PL is an instance of word-level lowering harmony.

Full vowels can surface in a CV suffix, with no apparent metathesis. With vocalic suffixes, positional licensing drives CV metathesis. With CV suffixes, metathesis must skip over two segments, because Dinka verbs must end in an obligatory coda consonant, and so would be *non-local*. It has been suggested that non-local metathesis may be restricted or impossible (Hume 2001; Carpenter 2002; Takahashi 2019; Mooney 2022; see also Buckley 2011:sec. 2 for discussion). As discussed by McCarthy (2000:fn. 20) and Carpenter (2002), for instance, Rotuman seems to restrict metathesis to local configurations.

Carpenter restricts metathesis through a family of constraints that favour the preservation of adjacency relations between segments. We posit the constraint ADJACENCY, based on Carpenter’s (2002) I-ADJACENCY_σ (30).²⁶

²⁶Carpenter’s (2002) constraint I-ADJACENCY_σ restricts the constraint to segments *in the same input syllable*, so that disruption of adjacency between the root vowel and the coda consonant in *pure* → *puer* does not induce a violation. We avoid this complication for Dinka because the root and suffix vowel coalesce. This solution likely extends to Rotuman, since Besnier’s (1987) description shows that features of the root are retained in the second vowel of a rising diphthong (see Table 1 on p. 211).

- (30) **ADJACENCY:** For any pair of input segments a and b and their output correspondents a' and b' , where a is adjacent to b , assign a violation mark if a' is not adjacent to b' .

Local CV metathesis does not violate **ADJACENCY** in Dinka, because the coda consonant and suffix vowel remain adjacent. We repeat the representation for a winning candidate with CV metathesis in (31).

- (31) **Input:** /cɔɔl-à_{1SG}/ $\Rightarrow$ **Output:** [càaal]

Recall that violations of **LINEARITY** and **ADJACENCY** are defined in terms of CV slots. Because the root and suffix vowel coalesce into one slot $V_{2,4}$, both vowels preserve adjacency to the coda consonant C_3 .

ADJACENCY permits local metathesis, but non-local metathesis incurs a violation, and so positional licensing cannot be satisfied this way. For the _{1PL} suffix *-kù*, we propose that a violation of positional licensing is tolerated, as shown in (32) for a verb *mòc* ‘shoot’. The faithful candidate (32a) violates **LIC**ENSE([VFeat],Root), but other options incur violations of higher-ranked constraints. Non-local metathesis with insertion of epenthetic ϵ (V_6) to maintain the onset C incurs a violation of **ADJACENCY** (32b), because the suffix vowel V_5 is no longer adjacent to the onset C_4 . Deletion of the onset C to create a local environment in candidate (32c) violates **MAXC**. Reduction to ϵ to avoid a violation of positional licensing is blocked because of high-ranked **MAX μ** , since the default vowel is non-moraic. Finally, candidate (32e) with vowel harmony violates the constraint against new association lines.

(32) **Tableau for 1PL suffix**

Input: /moc+kù _{1PL} /	C ₁	V ₂ μ	C ₃	C ₄	V ₅ μ	ADJ	MAXC	MAX μ	DEP (link)	LIC ([VF],Rt)	DEPV
a. mòc-kù	C ₁	V ₂ μ	C ₃	C ₄	V ₅ μ					*	
b. móoc-kè	C ₁	V _{2,5} μ	C ₃	C ₄	V ₆	*!					*
c. mòoc	C ₁	V _{2,5} μ	C ₃				*!				
d. mòc-kè	C ₁	V ₂ μ	C ₃	C ₄	V ₅			*!			
e. múc-kù	C ₁	V ₂ μ	C ₃	C ₄	V ₅ μ				*!		

Independent evidence for a preference for local metathesis comes from auxiliaries. The perfect auxiliary *cẹ* and future auxiliary *bẹ* lack a coda consonant. Precisely with these auxiliaries, the vowels in plural -CV suffixes *do* undergo metathesis (33), since metathesis is now local and satisfies ADJACENCY.

(33)

	Plural suffix	Perfect auxiliary
1PL	-kù	cùuk
2PL	-kà	càak
3PL	-kẹ	cìik

The lack of metathesis in regular verbs is therefore not due to the idiosyncratic behaviour of these -CV suffixes: when phonological conditions allow, they pattern like vocalic suffixes.

Another pattern that emerges when CV metathesis is unavailable is found with the 2PL. As previously noted, the 2PL triggers the Grade 3 process of vowel lowering in the root (34).

(34)

Unmarked form	2PL	Meaning
bòk	bók-kà	‘throw at’
kòt	kàat-kà	‘scratch’
màat	màat-kà	‘smoke’

(Agar Dinka; Andersen 1993:12)

We propose that lowering in the root represents a process of word-level harmony rather than CV metathesis, similar to the [-ATR] harmony pattern in Eastern Andalusian noted in section 3.2. Regressive vowel harmony explains why the Grade 3 change in the 2PL is different from Grade 3 changes elsewhere in not triggering lengthening.

Consider the changes that occur in Grade 3 again (35).

Table 9. Dinka Grade 3

	Creaky					Breathy					
Grade 1	i	e	a	ɔ	o	ĩ	ẽ	ã	ɔ̃	õ	u
Grade 3	jɛ	ɛ	a	a	wɔ	jɛ	ɛ	ã	ã	ɔ̃	wɔ̃

The specific features we adopt for Dinka vowels are presented in Table 10. Note that *u* does not occur in the creaky series, and *o* is the peripheral vowel here. We posit that creaky *o* is specified as [+high]

featurally as the only back [+ATR] vowel (see also Andersen 1993:32). We treat *a* as a low central vowel in accordance with acoustic evidence from Luac in Remijsen and Manyang (2009:117) and Remijsen and Gilley (2008:339).

Table 10. Dinka vowel features.

			[+front]	[-front]	
			[-back]		[+back]
[+high]	[-low]	[+ATR]	i		u
[-high]		[-ATR]	e		o
			ɛ		ɔ
	[+low]			a	

The shifts to Grade 3 in (34) involves changes in one of two features, [$\pm$ ATR] and [$\pm$ low].²⁷ Most vowels in Grade 1 are [+ATR] and yield a [-ATR] vowel in Grade 3, sometimes alongside breaking. The only [-ATR] vowel in Grade 1 is *ɔ*, and it lowers to *a* instead, while remaining [-ATR]. Both effects result in lowering, since [-ATR] vowels are generally lower in Dinka than their [+ATR] counterparts (Remijsen and Manyang 2009:117).

We propose to analyse lowering without lengthening before 2pl *-ka* as regressive [-ATR] harmony. Word-level [ATR] harmony is common across Nilotic languages. Most display [+ATR] dominance, as in the Lango pattern discussed in section 3.2 (see also Kurmuk, Andersen 2007b, or Mayak, Andersen 1999), though regressive [-ATR] assimilation triggered by a suffix is reported for Turkana (Dimmendaal 1983) and Ateso (Barasa 2018:4.3). But we note that Dinka conforms to a correlation established by Casali (2003) concerning inventory and [$\pm$ ATR] dominance. Casali shows that languages with [ATR] contrast only in non-high vowels show [-ATR] dominance. In accordance with this generalisation, Dinka is unusual among Nilotic languages in the absence of [-ATR] high vowels.²⁸

We propose that [-ATR] harmony is driven by a feature-specific positional licensing constraint that favours the vowel features introduced by [-ATR] vowels, defined in (35) (Jiménez and Lloret 2007; Walker 2011). As we have noted, Grade 3 typically involves mapping a Grade 1 [+ATR] vowel to its closest [-ATR] counterpart. This licensing constraint serves to boost an [ATR] contrast that plays an

²⁷Note that [ATR] contrast is independently banned in breathy vowels after glides in Agar (though we observe predicted *wɔ* in Luac, Ladd and Blum 2021).

²⁸The proto-Nilotic [ATR] contrast has been reinterpreted as a contrast between creaky/breathy vowels in Dinka. As a result, voice quality is distinctive in roots. Perhaps it is as a result of this change that the alternation between [+ATR] and [-ATR] now plays a morphological role. See Dimmendaal (2002) for historical discussion of Nilotic vowel harmony.

important role in cuing a morphological alternation, as in the Eastern Andalusian pattern discussed in section 3.2.

(35) LICENSE([VFeat]/[-ATR],Root):

Assign a violation mark for any vowel feature on a [-ATR] vowel not linked to a root segment.

The realisations of Dinka’s three [-ATR] vowels are reasonably close to each other (see Remijsen and Manyang 2009:117), and are subject to neutralization in various contexts (see Andersen 1993:sec. 5 and Andersen 2017). This licensing constraint thus helps distinguish Dinka’s [-ATR] vowels.

The tableau in (36) demonstrates how the constraint in (35) results in lowering in a verb with underlying $\mathfrak{c}$, $k\mathfrak{c}\mathfrak{c}\mathfrak{t}$ ‘scratch’. The high ranking of the licensing constraint favouring [-ATR] vowels ensures that violations of DEP(link) must occur. MAX[-ATR] is undominated, so that spreading cannot be avoided by deleting the feature. We focus on candidates with sharing of [-ATR].²⁹ A candidate (36b) with only [-ATR] harmony still violates positional licensing for other vowel features, so that the winning candidate (36a) also has regressive [+low] harmony.³⁰

(36) **Tableau for [+low] harmony $\mathfrak{c} \rightarrow a$ before Grade 3 2PL suffix**

Input: /k $\mathfrak{c}\mathfrak{c}\mathfrak{t}$ +ká _{2PL} /	[-ATR] [-low]		[-ATR] [+low]		MAX [-ATR]	LIC([vF]/ [-ATR],Rt)	DEP (link)	LIC ([vF],Rt)	MAX [+low]	MAX [-low]
	C ₁	V ₂	C ₃	V ₄						
a. k $\mathfrak{c}\mathfrak{c}\mathfrak{t}$ -ká							*			*
b. k $\mathfrak{c}\mathfrak{c}\mathfrak{t}$ -ká						*!		*		

The same logic should force full sharing of features for all root vowels. Instead, [+ATR] vowels only undergo partial lowering and shift to [-ATR]. We suggest that partial lowering occurs because of constraints preventing too large an acoustic change. There are a number of ways in which we can restrict lowering to prevent larger changes. Here we follow Kirchner (1996) and Mascaró (2011) who analyse

²⁹Not sharing [-ATR] simply induces more violations of positional licensing. We posit coalescence of the two [-ATR] features, in violation of low-ranked UNIFORMITY[-ATR]. Feature coalescence incurs no violation of DEP(link), since the coalesced feature retains the association lines in the input.

³⁰We propose that feature spreading from the root to the suffix is generally blocked, ruling out a candidate that spreads [-low]. One option is to posit a constraint penalizing progressive harmony. Another is to adopt high-ranked crisp edge constraints that restrict features other than [-ATR] and [+low] to a syllable (see also Walker 2011).

similar chain shifts through the use of constraint conjunction.³¹ Under our analysis, full lowering of [+ATR] vowels is blocked through a conjoined constraint that penalizes violations of both MAX[+ATR] & MAX[-low] (37).

- (37) MAX[+ATR] & MAX[-low]: Assign a violation mark if both MAX[+ATR] and MAX[-low] are violated.

This conjoined constraint outranks LICENSE([VFeat]/[-ATR],Root), so that only assimilation to [-ATR] occurs. The tableau in (38) illustrates this partial lowering for [+ATR] vowels, with the verb *gòor* ‘look for’. The faithful candidate (38b) violates positional licensing for all unshared features ([-ATR] and [+low]), with the root vowel not assimilated to the suffix vowel. The fully lowered candidate (38c) violates the conjoined faithfulness constraint and so the winner is candidate (38a) with partial lowering. A candidate (38d) that avoids harmony by changing the features of the suffix vowel violates MAX[-ATR].

(38) Tableau for partial lowering $\text{ø} \rightarrow \text{ɔ}$ with Grade 3 2PL suffix

Input: /gòor+ká _{2PL} /	[+ATR] [-low] C₁ V₂ [-ATR] [+low] C₃ V₄	MAX [-ATR]	MAX[+ATR] & MAX[-low]	LIC([VF]/ [-ATR],Rt)	MAX [+low]
a. gòor-ká	[-ATR] [-low] C₁ V₂ [+low] C₃ V₂			*	
b. gòor-ká	[+ATR] [-low] C₁ V₂ [-ATR] [+low] C₃ V₄			**!	
c. gàar-ká	C₁ V₂ [-ATR] [+low] C₃ V₄		*!		
d. gòor-kó	[+ATR] [-low] C₁ V₂ C₃ V₄	*!			*

The same logic will generate [-ATR] harmony in all the other [+ATR] vowels. High [+ATR] vowels like *i* and *u* map to [-ATR] mid vowels, since there are no high [-ATR] vowels, and so must also incur a violation of low-ranked MAX[+high]. But, in this view, full lowering is only possible when the root

³¹See Trommer (2011) for a different approach to partial lowering in Thok Reel, and Łubowicz (2003) and Mortensen (2006) on chain shifts more generally.

vowel is already [-ATR], as a type of parasitic harmony. In this analysis, then, the appearance of Grade 3 lowering before 2PL *-kɑ* is word-level harmony, and so does not involve multiple morphemes and is not extended exponence.

To sum up, rather than pose a problem for our account, the behavior of plural suffixes offers evidence for it. CV suffixes show the predicted CV metathesis pattern when the context permits. There is no extended exponence in the 2PL, but a process of word-level harmony.

4.3 Extended exponence in the passive and 2SG

Another case of apparent extended exponence is found in the passive and 2SG. These categories display a grade change *with lengthening*, in addition to an overt suffix, *-ɛ̃* in the passive and *-ɛ̃* in the 2SG. But our account predicts nonconcatenative lengthening in the root should not co-occur with an overt suffix. This characterization is accurate for the bulk of Dinka morphology, across most of the verbal paradigms, case inflection, number marking, and the construct state (Andersen 1992, 2002, 2014, 2020), but the passive and 2SG appear to be counterexamples. We demonstrate that these categories contribute fixed tonal melodies that cannot be realised in the monosyllabic stem. We propose an analysis in which this tonal melody triggers tone-driven epenthesis in order to be hosted, as in Wamey (Niger-Congo, Senegal; Rolle and Merrill 2022). In this view, no independent suffix occurs in these constructions.

Let us first demonstrate the problem. The passive and 2SG are marked by a grade change in the root as well as an overt suffix. Passive *-ɛ̃* is accompanied by Grade 2, while 2SG *-ɛ̃* triggers Grade 3. These effects are illustrated for the centrifugal paradigm in (39).

(39)	Unmarked form	Passive centrifugal (2)	2SG centrifugal (3)	Meaning
	ɬɛl	ɬɛ̃ɛl-ɛ̃	ɬɛ̃ɛl-ɛ̃	‘pull’
	nəj	nɛ̃ɛj-ɛ̃	nɛ̃aj-ɛ̃	‘plait’
	miit	miiit-ɛ̃	mjɛ̃ɛɛt-ɛ̃	‘pull’

(Agar Dinka; Andersen 2017:14)

Unlike in the 2PL, these grade changes are not obviously attributable to harmony.

Whether the passive and 2SG also trigger lengthening is not straightforward to establish, because the short verbs in (39) would also be lengthened by centrifugal morphology and there is a ban on cumulative lengthening (see section 6.2). In the basic transitive, both the passive and 2SG suffix undergo idiosyncratic deletion and no grade change is observed at all. However, the passive circumstantial topic (PASS.CT) is syncretic with the passive and shows lengthening in the transitive. For the 2SG, suggestive evidence

comes from one of the verb classes in the antipassive, which shows variability in whether the 2SG suffix is present (Andersen 2017). The presence of the suffix correlates with lengthening and a change in grade (40). Andersen (2017:fn. 19) notes similar variation in intransitives.

(40) *Variation in 2SG suffix:*

2SG	Meaning
mjèeet-é ~ mjit	‘pull.AP’
njèeen-é ~ niin	‘sleep’

(Agar Dinka; Andersen 2017:18, fn. 19)

We conclude that the passive and 2SG give rise to lengthening and a grade change, like most other morphological categories. As a result, our account treats these categories as vocalic suffixes that undergo CV metathesis and there should be no additional overt suffix.

Our account of this apparent extended exponence builds on the observation that these categories display unique tonal behavior. The passive suffix and 2SG suffix are associated with a consistent tonal melody (see also Trommer 2011, 2022), as evident in (39) and (40). The passive suffix -è always carries a low tone, with a falling tone on the root. The 2SG suffix -é always has a high tone, with a low-toned root. These suffixes differ from the plural suffixes, whose tone varies depending on root tone.

We argue that this tonal template is key to understanding the presence of a suffix. Dinka has a small inventory of tones, used across a large number of morphological categories, and a vocalic suffix allows for a more complex tonal melody that helps distinguish these forms. The 2SG creates a rising melody through the combination of a low tone on the verb and a high tone on the suffix. Rising tones are banned within a syllable in the Agar dialect. Rising tones are more susceptible to time pressure (Zhang 2001), and so these disyllabic forms effectively create the space to host this melody.

A similar logic applies to the HL-L melody in the passive. At first glance, it is not obvious why a disyllabic form is needed to facilitate a falling melody, since there are also monosyllabic forms marked by a falling tone (e.g. in the applicative and centrifugal). However, as noted by Andersen (1987) for Agar (see also Remijsen and Ladd 2008:sec. 2.2.2, Remijsen 2013:304–305, and Blum 2023:sec. 2.7.1 on other dialects), falling tones associated with a single syllable are truncated to H unless utterance-final. In practice then, the realisation of the falling tone is also subject to durational constraints. As in the 2SG, a disyllabic form provides additional segmental material, and therefore time, to realise this contour.

Rolle and Merrill (2022) argue for tone-driven epenthesis in similar conditions in Wamey. In Wamey, roots are typically monosyllabic and do not end in ə. CV and CVC stems surface with an L, H, or HL

tone. But a class of CVC roots is augmented with the epenthetic vowel ə to host a rising LH tone (41).

(41) *Root types in Wamey:*

L	-cə̀w̃	‘hiding’
H	-cə́w̃	‘urinating’
HL	-cə̀w̃	‘domestic animal’
LH	-nkə̀w̃á	‘dance (noun)’

(Rolle and Merrill 2022:7)

In Wamey, as in Agar Dinka, monosyllabic roots cannot host a rise, but the insertion of a vowel allows the complex melody to be realised.

To implement this idea, we propose that these suffixes differ from other grade-changing affixes in that they are associated with more complex tonal melodies (42). The 2SG vocalic affix contributes a rising tone. For the passive, we posit a fall on the vocalic affix, followed by a floating L tone. The need to host this floating L is what distinguishes the passive from other categories marked by a falling tone.

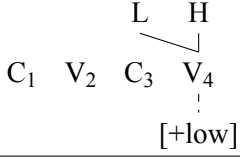
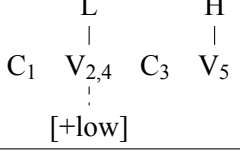
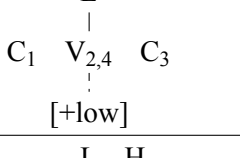
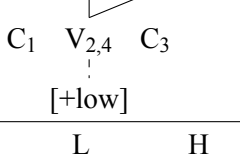
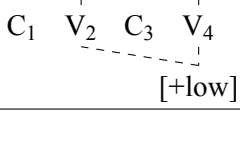
(42) *Representation of 2SG and passive:*

2SG	→	-ǎ
PASS	→	-î ^L

As in Wamey, realisation of these melodies is only possible with epenthesis. The suffix vowel and its tone are integrated into the root, effecting a grade change with lengthening. The default vowel -e̞ is inserted to allow the rise to be realised, in the 2SG, or to host the floating L tone of the passive. (43) illustrates with the 2SG form of intransitive *n̩in* ‘sleep’.³²

³² An interesting question is why the epenthetic vowel is breathy, since this quality is marked. We take e̞ to be the phonetic interpretation of a featureless V in Dinka, as suggested by the fact that it is the outcome of vowel reduction in other environments. Future acoustic examination would shed light on the phonetic differences between epenthetic and contrastive e̞.

(43) Tableau for Grade 3 2SG suffix of *n̄in* ‘sleep’

Input: /n̄in+ǎ _{2SG} /		MAX TONE	*RIS _{EG}	DEP (link)	LICENSE ([VF],Rt)	LIN	DEPV
a. nj̄ɛ̄ɛ̄n-ɛ̄				*		*	*
b. nj̄ɛ̄ɛ̄n		*!				*	
c. nj̄ɛ̄ɛ̄n			*!			*	
d. nj̄ɛ̄n-á				**!			

(43a) with epenthesis of a default vowel wins out in order to realise the rising melody of the 2SG, because MAXTONE, which penalizes deletion of tones, outranks DEP_V and DEP(link). Candidates with no suffix, such as (43b) and (43c) violate either MAXTONE or the ban on a rising melody within a syllable, *RIS_{EG}. Candidate (43d) creates a disyllabic form by employing spreading without metathesis, but the ranking of DEP(link) over LINEARITY (and DEP_V) ensures metathesis is preferred, even if epenthesis is required.

This analysis carries over to complex falling melody of the passive. Hosting the floating L tone requires epenthesis and this epenthetic vowel prevents the application of contour simplification that otherwise occurs with falling melodies. An important caveat in this account, though, is that we must ensure that tone in Dinka is generally *replacive*, so that affix tone is realised in favour of any tones associated with the root, without triggering epenthesis to preserve all input tones. Our analysis requires constraints independent of MAXTONE that enforce a replacive logic, such as the tonal overlay constraints in McPherson (2014) and McPherson and Heath (2016), the basemap correspondence of Rolle (2018), or Trommer’s (2022) contiguity constraints. But our account should be compatible with all of these approaches, since all of them employ additional constraints that force replacive tone that can outrank MAXTONE.³³

³³In Trommer’s (2022) account, replacive tones are circumfixal, so that we would have to amend our representations for vocalic suffixes to incorporate a tonal prefix doubling the suffix tone.

In this view, extended exponence in the 2SG and the passive is only apparent. As in the 2PL, there is no need to posit multiple morphemes. What looks like a suffix is an epenthetic vowel inserted to realise a complex tonal contour. We take these facts to constitute evidence for an item-based approach, which explains the absence of true extended exponence.

5 Lowering and fronting in CV metathesis

This section shows how our positional licensing account generates the lowering and fronting patterns in Dinka vowel grades. We have already introduced the basics of our account of lowering: the same constraints that generate word-level harmony before 2PL *-ka* will generate lowering under metathesis. Partial fronting in Grade 2 and the shift from creaky to breathy voice in some morphological categories can be modeled as what Zaleska (2020) calls “reductive” coalescence: both features of the root and suffix vowel may be preserved, depending on the relative ranking of $\text{MAX}[\alpha F]$ constraints.

5.1 Competition in coalescence

In section 3.3, we developed a positional licensing approach to vowel contrast in Dinka, in which all vowel features are preferentially linked to the root. Root and suffix vowels compete for access to the root position for the realisation of vowel contrast. As in Rotuman CV metathesis, a variety of outcomes occur, depending on the vowels involved: diphthong formation, ablaut or vowel deletion.

Since Dinka only allows for one set of vowel features to be linked to a syllable, competition between the root and suffix vowel results in reductive coalescence in the sense of Zaleska (2020): the coalesced vowel may express features of both input vowels depending on the relative ranking of $\text{MAX}[\alpha F]$ constraints. We discuss each type of vowel feature in turn below.

First, recall from section 2.3 that the centripetal and applicative shift the root to breathy voice (44).

(44)	Unmarked	Unmarked centripetal	Unmarked applicative	Meaning
	b̥ər	b̥ɛr	b̥ɛr	‘take along’
	m̥it	m̥iit	m̥it	‘pull’
	(Agar Dinka; Andersen 2017:10,13)			

There is no morphological category that shifts a breathy root to creaky. We proposed in section 4.1 that creaky vowels have no specification for voice quality and breathy vowels have a privative [spread glottis] feature. The suffix vowels marking the centripetal and applicative are underlyingly breathy, and

the [spread glottis] feature is trivially realised on the root vowel as a result of coalescence. MAX[spread glottis] ensures the preservation of this feature.

Table 11. Dinka vowel grades, without glides.

	Creaky					Breathy				
Grade 1	i	e	a	ɔ	o	ĩ	ẽ	ã	ɔ̃	õ
Grade 2	i	e	ɛ	ɔ	o	ĩ	ẽ	ɛ̃	ɔ̃	õ

Next, we show how this account generates fronting in Grade 2. Consider again the profile of Grade 2 in Table 11. All Grade 1 vowels remain unchanged in Grade 2, except the low vowel *a* which fronts to *ɛ*. Tableau (45) demonstrates fronting with the verb *càm* ‘eat’. The faithful candidate (44b) does not satisfy positional licensing. Since MAX[-ATR] is high-ranked, candidates like (44c) with [+ATR] front vowels are ruled out. At first, it may seem that MAX[+front] must also outrank MAX[+low], to ensure the low root vowel does not surface. However, candidate (44d), with deletion of the suffix vowel *-i*, incurs a violation of the same conjoined constraint that derives partial lowering before 2PL *-kə* in section 4.2. As a result, the winning candidate (44a) preserves frontness at the expense of [+ATR].

(45) **Tableau for fronting *a* → *ɛ* with Grade 2 3SG suffix**

Input: /cam+i _{3SG} /	C ₁	V ₂	C ₃	V ₄	MAX [-ATR]	M[+ATR] & M[-low]	LICENSE ([vF], Rt)	MAX [+low]	MAX [+front]	MAX [-front]
a. cèem		$\begin{matrix} [-ATR] \\ [-front] \\ [+low] \end{matrix}$		$\begin{matrix} [+ATR] \\ [+front] \\ [-low] \end{matrix}$				*		*
b. cà-m-í		$\begin{matrix} [-ATR] \\ [-front] \\ [+low] \end{matrix}$		$\begin{matrix} [+ATR] \\ [+front] \\ [-low] \end{matrix}$			*!			
c. cìim		$\begin{matrix} [+ATR] \\ [+front] \\ [-low] \end{matrix}$			*!			*		*
d. càam		$\begin{matrix} [-ATR] \\ [-front] \\ [+low] \end{matrix}$				*!			*	

The low vowel *a* fronts because it is central. Back vowels are not fronted in Grade 2. We propose that MAX[+back] is ranked above MAX[+front]. Note that the conjoined constraint MAX[+ATR] & MAX[-low] will not force fronting, because all back vowels are also [-low] and so this feature is preserved. (46) illustrates the lack of fronting with back vowels for a Grade 2 affix on *kɔ̌ɔ̌ɔ̌* ‘scratch’.

(46) **Tableau for $\varrho \rightarrow \varrho$ with Grade 2 3SG suffix**

Input: /kɔ̌ɔ̌ɔ̌ɔ̌+3SG/	[-ATR] [-front] [+back] C ₁ V ₂ C ₃ V ₄	[+ATR] [+front] [-back]	MAX [-ATR]	M[+ATR] & M[-low]	LICENSE ([vF], Rt)	MAX [+back]	MAX [+front]
a. kɔ̌ɔ̌ɔ̌ɔ̌	[-ATR] [-front] [+back] C ₁ V _{2,4} C ₃						*
b. kɪɪɪɪ	[+ATR] [+front] [-back] C ₁ V _{2,4} C ₃		*!			*	
c. kɛɛɛɛ	[-ATR] [+front] [-back] C ₁ V _{2,4} C ₃					*!	

Fronting candidates (46b) and (46c) lose out because they incur a violation of MAX[-ATR] and MAX[+back] respectively. Since no other features of the front vowel *i* are favoured by high-ranked constraints, the winning candidate (46a) faithfully realises the root vowel. The same explanation extends to other [-low] vowels.

5.2 Coalescence and harmony in Grade 3

We proposed an account of most of the changes that occur in Grade 3 in our treatment of the 2PL suffix *-ka*. The same lowering effects are found in Grade 3 when derived by CV metathesis.³⁴ Zaleska (2020) points out that, in some languages, language-general assimilatory preferences also dictate the outcome of coalescence. Chumburung (Niger-Congo; Ghana), for example, has a rule lowering a high vowel after a low vowel, illustrated with *i* after *a* (47a). The same lowering effect occurs in coalescence (47b).

³⁴ Andersen (1992:15) notes one possible difference. Before the 2PL, lowering to *a* with underlying *ɔ* is optional in short verbs. This pattern aligns with the distinction we made between [-ATR] harmony and parasitic [+low] harmony, though we do not know why [+low] harmony would be optional in short forms. It is hard to tell also whether this difference distinguishes metathesis from word-level harmony, since metathesis never results in a short verb.

(47) *Coalescence in Chumburung follows the logic of assimilation:*

- a. pàŋ ‘lose’
 í-sánnî ‘sheep’
 ò pàŋ ɛ́-sánnî ‘s/he will lose sheep’
- b. ɲà get
 í-sánnî ‘sheep’
 ò-ɲɛ́-sánnî ‘s/he will get sheep’

(Zaleska 2020:700,703)

In Dinka too, the word-level harmony we proposed in section 4.2 generates the right outcomes in coalescence. (48) provides an example of a root with underlying $\mathfrak{c}$ ($k\mathfrak{c}\mathfrak{c}\mathfrak{t}$ ‘scratch’) with a Grade 3 affix. The winning candidate (48a) loses out to a candidate (48b) that preserves $\mathfrak{c}$ because $\text{MAX}[\text{+low}]$ is ranked above $\text{MAX}[\text{-low}]$. A candidate (48c) with harmony violates $\text{DEP}(\text{LINK})$ (LINEARITY is low-ranked).

(48) **Tableau for $\mathfrak{c} \rightarrow a$ in Grade 3 metathesis**

Input: $/k\mathfrak{c}\mathfrak{c}\mathfrak{t}+\mathfrak{a}_{1\text{SG}}/$	$\begin{matrix} [-\text{ATR}] \\ [-\text{low}] \end{matrix}$ C ₁ V ₂	$\begin{matrix} [-\text{ATR}] \\ [\text{+low}] \end{matrix}$ C ₃ V ₄	MAX [-ATR]	$\text{LIC}([\text{VF}]/$ [-ATR],Rt)	DEP (link)	LIC ([\text{VF}],Rt)	MAX [+low]	MAX [-low]
a. $k\mathfrak{a}\mathfrak{a}\mathfrak{t}$	$\begin{matrix} [-\text{ATR}] \\ [\text{+low}] \end{matrix}$ C ₁ V _{2,4}	C ₃						*
b. $k\mathfrak{c}\mathfrak{c}\mathfrak{t}$	$\begin{matrix} [-\text{ATR}] \\ [-\text{low}] \end{matrix}$ C ₁ V _{2,4}	C ₃					*!	
c. $k\mathfrak{a}\mathfrak{a}\mathfrak{t}-\mathfrak{a}$	C ₁ V ₂	$\begin{matrix} [-\text{ATR}] \\ [\text{+low}] \end{matrix}$ C ₃ V ₄			*!			*

Similarly, [+ATR] vowels become [-ATR] because of the licensing constraint favouring [-ATR] vowels (49). The winning candidate (49a) displays [-ATR] harmony, but not full lowering, because such a candidate (49b) violates the conjoined constraint introduced in section 4.2. (49c), which preserves [+ATR], runs afoul of high-ranked $\text{MAX}[\text{-ATR}]$.

(49) Tableau for $\varrho \rightarrow \varrho$ in Grade 3 CV metathesis

Input: /gɔɔr+ā _{1SG} /	$\begin{matrix} [+ATR] \\ [-low] \end{matrix}$ C ₁ V ₂	$\begin{matrix} [-ATR] \\ [+low] \end{matrix}$ C ₃ V ₄	MAX [-ATR]	M[-low] & M[+ATR]	LIC([vF]/ [-ATR],Rt)	DEP (link)	MAX [+low]	MAX [+ATR]
a. gɔɔr	$\begin{matrix} [-ATR] \\ [-low] \end{matrix}$ C ₁ V _{2,4}	C ₃					*	*
b. gāaar	$\begin{matrix} [-ATR] \\ [+low] \end{matrix}$ C ₁ V _{2,4}	C ₃		*!				*
c. gɔɔoor	$\begin{matrix} [+ATR] \\ [-low] \end{matrix}$ C ₁ V _{2,4}	C ₃	*!				*	
d. gɔɔr-ā	$\begin{matrix} [-ATR] \\ [-low] \end{matrix}$ C ₁ V ₂	$\begin{matrix} [-ATR] \\ [+low] \end{matrix}$ C ₃ V ₄			*!	*		*
e. gɔɔor-ā	$\begin{matrix} [+ATR] \\ [-low] \end{matrix}$ C ₁ V ₂	$\begin{matrix} [-ATR] \\ [+low] \end{matrix}$ C ₃ V ₄			*!*			

In our lowering harmony analysis, we did not address breaking. High vowels undergo breaking in Grade 3. We suggest that breaking of high vowels into a glide-vowel sequence in Grade 3 allows for preservation of the feature [+high] for an input high vowel. This is illustrated in (50). Candidates (50c–e) lose due to violation of high-ranked MAX[-ATR] and conjoined faithfulness constraints introduced previously. While both candidates (50a) and (50b) with ε satisfy these higher-ranked constraints, (50a) wins due to satisfaction of low-ranked MAX[+high]. Breaking, which we treat as the splitting of the root vowel into a C and V slot, allows for [+high] to remain in the output even if not associated to the original V.

(50) Tableau for $i \rightarrow j\epsilon$ with Grade 3 1SG affix

Input: /mîit+â _{1SG} /	$\begin{matrix} [+ATR] \\ [+high] \\ [-low] \end{matrix}$ C ₁ V ₂ C ₃ $\begin{matrix} [-ATR] \\ [-high] \\ [+low] \end{matrix}$ V ₄	MAX [-ATR]	M[-low] & M[+ATR]	LIC([VF]/ [-ATR],Rt)	MAX [+low]	MAX [+high]
a. mjèèet	$\begin{matrix} [+high] \\ [-high] \\ [-low] \end{matrix}$ C ₁ C ₂ V _{2,4} C ₃				*	
b. mèèet	$\begin{matrix} [-ATR] \\ [-high] \\ [-low] \end{matrix}$ C ₁ V _{2,4} C ₃				*	*!
c. mèèet	$\begin{matrix} [+ATR] \\ [-high] \\ [-low] \end{matrix}$ C ₁ V _{2,4} C ₃	*!			*	*
d. mîiit	$\begin{matrix} [+ATR] \\ [+high] \\ [-low] \end{matrix}$ C ₁ V _{2,4} C ₃	*!			*	
e. màaat	$\begin{matrix} [-ATR] \\ [-high] \\ [+low] \end{matrix}$ C ₁ V _{2,4} C ₃		*!			*

High onset glides are possible underlyingly in roots as well. Dinka only permits high glides, so that other height features cannot be preserved by breaking. Ranking MAX[-high] above MAX[+high] ensures that vowels do not raise to high in order to be able to break.³⁵

6 Cyclicity and the ban on cumulative lengthening in multiple affixation

In this section we extend our account to multiple affixation. When a root takes multiple affixes belonging to different grades, the outermost grade wins. Our analysis explains this observation if the outcome of affixation is evaluated cyclically. We also discuss the absence of cumulative lengthening, which we interpret as the avoidance of a sequence of identical suffixes, resolved via mora coalescence.

³⁵Note that Max[+high] would favour an output like *[cjèem] over [cèem] in (45) for an input /cam+i/, to preserve the [+high] feature of the Grade 2 suffix vowel. However, the mapping of /cam+i/ → *[cjèem] violates ADJACENCY, because the onset C and root vowel are no longer adjacent in the output, thus preventing non-local breaking.

6.1 Cyclicity in multiple affixation

The previous section outlined our approach to the vowel changes that occur when a root combines with a Grade 2 or Grade 3 suffix. We now turn to configurations of multiple affixation. When a root combines with a Grade 2 and a Grade 3 suffix, it is the grade of the outermost affix that wins out. For example, the combination of Grade 2 centripetal with a Grade 3 1SG results in a Grade 3 form (51). The prioritization of Grade 3 is evident with the root vowel *a*, which does not surface as fronted *ε*, as in Grade 2.

(51)	Unmarked form	Unmarked centripetal (2)	1SG centripetal (2+3)	Meaning
	t̪ɛl	t̪ɛɛl	t̪ɛɛl	‘pull’
	b̪ar	b̪ɛɛr	b̪ar	‘take along’
	m̪iit	m̪iɛit	m̪jɛɛet	‘pull’

(Agar Dinka; Andersen 2017:13–14)

The inflectional 1SG is higher than the derivational centrifugal, and so we suggest that this outcome is a cyclicity effect: the demands of the outermost affix win out.³⁶

The constraint hierarchy we have proposed so far captures this pattern if each instance of affixation happens on a different cycle of evaluation of the phonological constraint grammar. The following tableau, (52), illustrates this for the verb *b̪ar* ‘take along’, assuming an input /b̪ar+i_{CP}+a_{1SG}/. The first cycle includes only the root and the centrifugal and generates fronting of *a* to *ε*.

³⁶There are no configurations of a Grade 2 affix outside of a Grade 3 affix in verbs. However, Andersen (2002:13) provides examples of Grade 3 nouns that shift to Grade 2 when combined with Grade 2 case morphology, following the same logic.

(52) 1st cycle for Grade 2 suffixation followed by Grade 3 suffixation

1st cycle - Grade 2 derivational suffix											
Input: /b̤ar+i _{CP} /		[-ATR] [-front] [+low] ⋮ C ₁	[+ATR] [+front] [-low] ⋮ V ₂	C ₃	V ₄	M _{AX} [-ATR]	M[-low] & M[+ATR]	M _{AX} [+low]	M _{AX} [+front]	M _{AX} [+ATR]	M _{AX} [-low]
a. b̤eɛr		[-ATR] [+front] [-low] ⋮ C ₁	V _{2,4}	C ₃				*		*	
b. b̤aɛr		[-ATR] [-front] [+low] ⋮ C ₁	V _{2,4}	C ₃			*!		*	*	*
c. b̤iɪr		[+ATR] [+front] [-low] ⋮ C ₁	V _{2,4}	C ₃			*!	*			

As discussed in section 5.1, the conjoined constraint MAX[+ATR] & MAX[-low] ensures that the features of the front vowel suffix cannot fully be deleted, resulting in fronting.

Now the output of the first cycle is fed into input of the second cycle in (53). The same constraints now generate lowering to *a*, the expected outcome in Grade 3. The importance of cyclicity lies in the fact that the conjoined constraint MAX[+ATR] & MAX[-low] no longer favours retention of any features of the underlying Grade 2 suffix, since the feature [+ATR] was deleted in the previous cycle. Under a parallel model, the conjoined constraint would always exclude the winning candidate which expresses the features of the Grade 3 suffix (see (52b)).

(53) 2nd cycle of Grade 2 suffixation followed by Grade 3 suffixation

2nd cycle - Grade 3 inflectional suffix						
Input: [bɛ̃ɛr+a _{1SG}]	$\begin{matrix} [-ATR] \\ [+front] \\ [-low] \end{matrix}$ C ₁ V ₂ C ₃	$\begin{matrix} [-ATR] \\ [-front] \\ [+low] \end{matrix}$ V ₄	MAX [-ATR]	M[-low] & M[+ATR]	MAX [+low]	MAX [+front] MAX [-low]
a. bɛ̃ar	$\begin{matrix} [-ATR] \\ [-front] \\ [+low] \end{matrix}$ C ₁ V _{2,4} C ₃					* *
b. bɛ̃ɛr	$\begin{matrix} [-ATR] \\ [+front] \\ [-low] \end{matrix}$ C ₁ V _{2,4} C ₃				*!	

Note that there is no lengthening by another degree on the second cycle, despite metathesis occurring, which we discuss in the next section.

As long as multiple affixation involves multiple cycles of evaluation, our account of fronting and lowering generates the right results. All such configurations involve Grade 2 affixes that realise derivational morphemes low in the clause, such as associated motion marking or the applicative, but Grade 3 affixes that realise higher material, agreement or information structure morphology. As a result, this conclusion is compatible with a range of different conceptions of cyclicity. The derivational cycle could correspond to the stem domain in Stratal OT. If cyclic domains are identified with phases, the inner cycle could correspond to VoiceP (aligning with syntactic evidence in Van Urk 2015). Finally, an approach in which each instance of affixation is a separate cycle of evaluation also generates the correct outcome.

6.2 Multiple affixation as mora coalescence

A surprising observation about multiple affixation is the absence of multiple steps of lengthening. Morphological categories like the 1SG centripetal, which combine two categories that trigger lengthening, do not lengthen twice (see also Table 5). With short roots, we expect lengthening from short to long to overlong. But no cumulative lengthening is found, and short roots only lengthen to long (54).

(54)	Unmarked form	1SG centripetal	Meaning
	t̪ɛl	t̪ɛɛl (*t̪ɛɛɛl)	‘pull’
	jòr	jwòor (*jwòoor)	‘water’
	b̪ar	b̪aar (*b̪aaar)	‘take along’
	(Agar Dinka; Andersen 2017:13–14)		

Roots are not restricted to a single affix, because the 1SG centripetal is distinct from the 1SG transitive. The effects of the first Grade 2 cycle are visible in (54), since the centripetal imposes a low tone and shifts voice quality to breathy. Only the second step of lengthening is absent.

We conclude that cumulative lengthening is banned in Dinka (Flack 2007; Trommer 2015). Flack (2007) proposes a requirement that suffixal moras are adjacent to a root mora, while Trommer (2015) posits that a vowel can only be associated to moras of at most two different morphemes. We provide a different rationale, because we do not know of clear crosslinguistic evidence for either constraint. Instead, we treat the absence of cumulative lengthening as *affix haplology* (Yip 1998; Felice 2022). Configurations of multiple affixation like the 1SG centripetal involve underlying affixes belonging to different grades, but, after coalescence, affixal moras are linked to the same features and V slot and so are surface-identical. Following other work on haplology (Menn and MacWhinney 1984; Pierrehumbert 1993; Yip 1998; Felice 2022), we adopt a constraint that bans a sequence of identical morphemes (55).

(55) OCP(affix): Assign a violation mark for a sequence of identical morphs.

Importantly, OCP(affix) bans only adjacent *morphemes* that are identical and so the root vowel, despite sharing the same vowel features, does not incur a violation. Note that, as is evident below, it is important under this analysis that suffixal material continues to be distinguishable from root material on further cycles, so that at least some information about morphological affiliation must be retained (van Oostendorp 2006; Trommer 2015).

Haplology effects vary crosslinguistically in whether morphological identity matters. A similar type of affix haplology occurs in Kabyle (Felice 2022). The feminine suffix *-t* and diminutive suffix *-t* give rise to haplology (56a). In contrast, a root-final *t* does not trigger haplology (56b).

(56) *Haplology of -t suffixes in Kabyle:*

a.	t-addar-t,	*t-addar-t-t	
	FEM-house-FEM/DIM	FEM-house-FEM-DIM	
	‘house, little house’		(Kossman 2014, cited in Felice 2022:192)

- b. t-ifrit-t
FEM-bird-DIM
'little bird'

(Quitout 1997, cited in Felice 2022:193)

Haplology involving derived identity also occurs in multiple reduplication avoidance (Zimmermann 2021). In Nuu-chah-nulth (Wakashan, British Columbia), for instance, only one reduplicating morpheme surfaces in forms with multiple triggers of reduplication (the underlined suffixes) (57).

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

As in Dinka, haplology effects in Kabyle and Nuu-chah-nulth are limited to affixes.

This haplology account also allows for an explanation of the fact that Dinka permits morphemes that trigger lengthening of short roots to overlong by themselves. Andersen (1992:37–38) points out that the causative and multiplicative lengthen short roots to overlong. This difference follows if these categories involve a bimoraic affix, since OCP(affix) cares only about a sequence of two identical morphemes.

A problem now arises, however. An affix could also circumvent haplology by not undergoing CV metathesis. Some vowels are preserved when linking to the root is impossible, as in CV suffixes (section 4.2). We must ensure then that OCP(affix) does not force one affix to undergo metathesis while the other remains a suffix. We draw on de Lacy's (2000) proposal that haplology resolution does not result in deletion, but in coalescence of the offending morphs (see also Zimmermann 2021).

In our metathesis account, the V slots of root and suffix vowels coalesce, in violation of UNIFORMITY_V. We have similarly assumed throughout that identical features linked to this slot coalesce, presumably reflecting the low ranking of a UNIFORMITY[F] constraint. To regulate coalescence of moras, we define a constraint UNIFORMITY_μ, which regulates the correspondence of input and output moras (58).

- (58) UNIFORMITY_μ: Assign one violation mark for every mora in the output that has more than one correspondent in the input.

UNIFORMITY_μ prevents mora coalescence in the cases analysed so far, but we propose that high-ranked OCP(affix) forces violations of UNIFORMITY_μ, yielding featural and moraic coalescence of the offending suffixes rather than a return to overt suffixation.

Consider again the second cycle of affixation described in (53), focusing now on the realisation of moras. Candidate (59b) with overlength results in two suffixal moras (μ₂, μ₃) linked to the same features

and so violates high-ranking OCP(affix). Candidate (59c) with deletion of the outer suffix violates MAX μ . Given this, (59a) with coalescence of features and moras is preferred over candidates with suffixation, which violate the constraint against spreading (59d), or do not satisfy positional licensing (59e).

(59) **Tableau for Grade 2 centripetal and Grade 3 1SG suffix on *b̥ar* ‘take along’**

Input: [b̥ɛr+a _{1SG}]	$\begin{array}{c} b \quad \acute{e} \quad r \quad -a_{1SG} \\ \swarrow \quad \downarrow \quad \\ \mu_1 \quad \mu_2 \quad \mu_3 \end{array}$	OCP (affix)	MAX μ	DEP (link)	LICENSE ([VF],Rt)	UNIF μ	LIN
a. b̥aar	$\begin{array}{c} b \quad \acute{a} \quad r \\ \swarrow \quad \downarrow \\ \mu_1 \quad \mu_{2,3} \end{array}$					*	*
b. b̥aar	$\begin{array}{c} b \quad \acute{a} \quad r \\ \quad \swarrow \quad \downarrow \\ \mu_1 \quad \mu_2 \quad \mu_3 \end{array}$	*!					*
c. b̥ar	$\begin{array}{c} b \quad \acute{a} \quad r \\ \swarrow \quad \downarrow \\ \mu_1 \quad \mu_2 \end{array}$		*!				
d. b̥ar-á	$\begin{array}{c} \quad \quad \quad [+low] \\ \quad \quad \quad \swarrow \quad \downarrow \quad \\ b \quad \acute{a} \quad r \quad -\acute{a}_{1SG} \\ \swarrow \quad \downarrow \quad \\ \mu_1 \quad \mu_2 \quad \mu_3 \end{array}$			*!			
e. b̥ɛr-á	$\begin{array}{c} b \quad \acute{e} \quad r \quad -\acute{a}_{1SG} \\ \swarrow \quad \downarrow \quad \\ \mu_1 \quad \mu_2 \quad \mu_3 \end{array}$				*!		

This account extends to other instances in which multiple lengthening is possible, such as when a long root combines with multiple affixes. In the applicative, a bimoraic template is enforced (Andersen 1992; Flack 2007; Trommer 2015), which we attribute to a morpheme-specific markedness constraint that penalizes overlength, Flack’s (2007) * $\mu\mu\mu_{Appl}$.³⁷ In each situation, mora coalescence is preferred over overt suffixation, because an overt suffix vowel violates positional licensing.

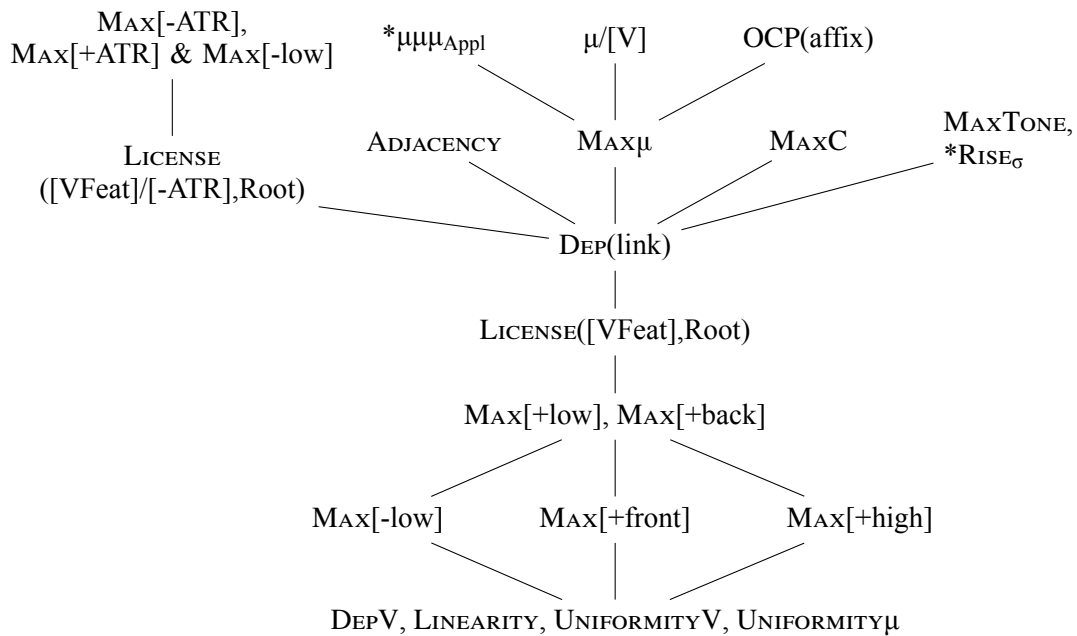
Concluding remarks

Nonconcatenative morphology in Western Nilotic languages like Dinka has been cited as a problem for purely item-based approaches to morphology, such as Trommer (2011), Bermúdez-Otero (2012), and Bye and Svenonius (2012). In this paper, we argue that an item-based analysis of Dinka morphology, in fact, captures key generalisations about the system: exactly those phonological properties that are expressed nonconcatenatively in the root are restricted in overt suffixes. On this basis, we developed an analysis of Dinka vowel grades in which nonconcatenative morphology in Dinka is the result of vocalic suffixes

³⁷This ban is not phonologically general or additive, and so Sande’s (2022) diagnostics imply a process-based analysis.

that undergo metathesis into the root, driven by the positional licensing of phonological contrasts in a morphologically prominent position (Crosswhite 2001, 2004; Walker 2005; Kaplan 2008, 2015). The full Hasse diagram with proposed constraint rankings is shown in (60).

(60) *Hasse diagram for Dinka:*



This analysis explains the additive nature of Dinka nonconcatenative morphology and why there are no genuine cases of extended exponence. In a process-based account, the direct relationship between wellformedness of suffixation and nonconcatenative processes is incidental. In addition, the Dinka patterns above are derivable using phonologically general constraints (cf. Sande 2022). Dinka morphology offers evidence then that nonconcatenative morphology is underlyingly item-based, since such a view posits a direct relationship between the wellformedness of suffixation and nonconcatenative processes.

Finally, while we do not take up the task of accounting for nonconcatenative morphology across Western Nilotic, we think the perspective presented here extends to other strongly monosyllabic systems. Anywa, Nuer, Shilluk, and Thok Reel all make frequent use of lengthening and typically restrict suffixes to short vowels. In Nuer, verbal categories are marked by the addition of breathy voice, and breathy voice is not distinctive in suffixes (it is dependent on [ATR] value) (Reid 2019). Similarly, a number of Shilluk categories are marked by a change to [+ATR], and suffixes only permit [-ATR] vowels (Remijsen et al. 2015, 2016).³⁸ All in all, our item-based account based on positional licensing provides a rationale for *why* these languages might prefer nonconcatenative morphology.

³⁸One difference, though, is that Anywa, Nuer, and Thok Reel subject agreement is exclusively suffixal, suggesting that the morphological domain in which the nonconcatenative preference holds excludes these forms.

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