

Dinka plural morphology is concatenative and regular

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1 The problem of Dinka plural morphology

- ▷ Dinka (Nilotic, South Sudan) has been cited as a challenge for item-based approaches to morphology, since its inflectional system is primarily expressed through **changes to the root** (e.g. Aronoff and Fudeman 2011:54; Inkelas 2014:72; Arkadiev and Klamer 2018:450).
- ▷ A variety of changes mark the plural, for instance, including lengthening, shortening, raising, lowering, as well as alternations in voice and tone (1a–j). These changes frequently do and do not co-occur, potentially requiring a multitude of autosegmental affixes.

(1)	Singular	Plural	Root	Singular	Plural	Root	
a.	ŋěet	ŋěeet	‘razor’	f.	pâaac	pěec	‘stubble’
b.	gèeŋ	gêeŋ	‘hat’	g.	adwòok	adòook	‘gourd’
c.	ḍòok	ḍàak	‘boy’	h.	ŋôok	ŋàak	‘catfish’
d.	dòoot	dòt	‘gravel’	i.	rjěem	rím	‘blood’
e.	abèet	abát	‘waterlily’	j.	ajít	ajíit	‘chicken’

- ▷ Dinka number morphology is particularly difficult, because it has been argued to be essentially irregular (Ladd et al. 2009), raising the question of whether any consistent affixes can be posited:¹

– Ladd et al. (2009:660): “[D]ata from the noun number-marking system of Dinka ... make[s] it appear entirely possible for a rich inflectional system not to have any patterns that can be identified as regular at all.”

This talk: Dinka plural morphology is **concatenative** and **regular**.

¹Andersen (2014) recognizes 21 recurrent patterns of number marking in 66% of his corpus, but he does ultimately view the number inflection of a noun as unpredictable.

There are two key components to our concatenative analysis:

1. **Dinka has tripartite number:** Many Nilotic languages have a **tripartite number system** (Dimmendaal 2000), in which nouns either combine with a plural suffix only (2a), a singular suffix only (2b), or a suffix in both numbers (2c):

(2)	Singular	Plural	Meaning	
	kùl	kùl-àk	‘warthog’	<i>Inherently singular</i>
	wèer-ìṭ	wèer	‘wing’	<i>Inherently plural</i>
	tíib-ú	típ-án	‘shadow’	<i>Numberless</i>

(Surkum, Andersen 2014:240–241)

2. **Floating affixes:** We identify **three types of floating affixes** that mark singular and plural in Dinka:

▷ Lengthening to a long, trimoraic vowel:

(3)	Singular	Plural	Meaning
	kàl	kâaal	‘town, fence’
	còol	còool	‘charcoal’

(4)	Singular	Plural	Meaning
	akḵḵoon	akḵḵon	‘elephant’
	agḵḵuuk	agḵḵuk	‘dove’

▷ Vowel raising and lengthening to a mid, bimoraic vowel:²

(5)	Singular	Plural	Meaning
	ràaṅ	rḵḵeṅ	‘grave’
	kwác	kwḵḵec	‘leopard’

(6)	Singular	Plural	Meaning
	abèeṭ	abát	‘waterlily’
	lḵḵej	làaj	‘animal’

▷ Vowel lowering and lengthening to a mid, bimoraic vowel:

(7)	Singular	Plural	Meaning
	kóm	kàm	‘worm’
	ṅèej	ṅèej	‘bran’

(8)	Singular	Plural	Meaning
	tḵḵok	tḵḵok	‘goat’
	kḵḵec	kíc	‘bee’

⇒ As long as we allow for an affix-specific ban on long vowels, these processes are straightforwardly additive. In addition, we show that each process represents a **coherent declension class** within which alternations in tone and voice are **regular**.

²Note that we will see that some forms with vowel raising do permit lengthening to long in the plural, providing one source of systematic ambiguity.

2 The expression of number in Dinka

2.1 Constraints on Dinka roots

- ▷ Dinka is a Nilotic language spoken in South Sudan. We focus here on the Luanyjang dialect, as described by Remijsen and Ladd (2008), Ladd et al. (2009), and Remijsen and Manyang (2009).
- ▷ We make use of the corpus of 363 native noun singular-plural pairs examined by Ladd et al. (2009) from the Luanyjang dialect (Remijsen 2013). Unless a source is provided, all data is taken from there.
- ▷ Dinka roots are generally **monosyllabic with an obligatory onset and coda**, as illustrated with some nouns and verbs in (9a–h):

(9)	Noun	Meaning	Verb	Meaning
	a. jòom	‘wind’	e. máaan	‘hate.NF’
	b. kít	‘color’	f. kóoot	‘care.for.NF’
	c. pjèen	‘viper’	g. kwǎat	‘wrap.NF’
	d. gwèel	‘collar bone’	h. tět	‘pick.NF’

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

Andersen (1993:2) and Remijsen and Manyang (2009:114) provide the following template:

- (10) **Template for Dinka roots:**
C (w) (j) V (V) (V) C

Length, voice, and tone in Dinka roots

- ▷ Dinka vowels display a **ternary contrast in length**, between short, medium, and long vowels. Some near-minimal triplets appear in (11):³

(11)	Short		Medium		Long	
	láj	‘k.o. berries’	lǎaj	‘k.o. berry’	lǎaaj	‘slave’
	kít	‘color’	kîit	‘colors’	kîiit	‘cloth bag’
	cól	‘mouse’	cöol	‘charcoal’	cöool	‘charcoal.PL’

³Dinka roots also may contain one or two glides. These glides do not affect vowel length and can serve as codas, so may be best analyzed as part of the onset (see Andersen 1993).

- ▷ Also, Luanyjang Dinka distinguishes **four tones**: high /^ó/, low /^ò/, rising /^ǒ/, and falling /^ô/. Finally, vowels show a binary contrast between **modal/creaky voice (unmarked) and breathy voice /^{◌̤}/**, in all vowels except *u*:

(12)	Creaky		Breathy	
	jáak	‘pelican’	jääl	‘visitor, guest’
	gwét̤	‘Nile perch’	gwét̤	‘bead’
	ŋéɛɛr	‘k.o. gazelle’	nwɛ̤ɛɛr	‘Nuer’
	kiiir	‘big river’	kiiir	‘thorny k.o. tree’
	tóoc	‘swamp’	tòon	‘pot’
	rwòon̤	‘stone of fruit’	rwòon̤	‘year’
			wúuk	‘wing’

Note: We mark voice and tone only on the first vowel, following Andersen.

Polysyllabic nouns

- ▷ There is one class of polysyllabic nouns prefixed with *a-*, historically likely derived from a nominalizing morpheme but non-transparent in a number of cases:

(13)	agòr	‘river bank’
	awán	‘jackal’
	aŋóow	‘cat’
	agèek	‘road’
	atúuuc	‘messenger’
	amàaal	‘sheep’

- ▷ The final syllable of these nouns shows the same range of contrasts as monosyllables, and inflectional changes are confined to the final syllable also.

2.2 On the irregularity of Dinka number marking (Ladd et al. 2009)

- ▷ In both the nominal and verbal domain, Dinka often makes use of changes to the root to express inflectional morphology.
- ▷ It has often been noted that Dinka plural marking looks highly irregular (Mitterrutzner 1866:15; Beltrame 1880:22–24; Nebel 1948:3,34; Tucker 1981:296, all cited in Andersen 2014:226; Ladd et al. 2009).
- ▷ Plurals can be marked through changes in voice (14a), tone (14b), lengthening (14c), shortening (14d), vowel raising (14e), vowel lowering (14f), suppletion (14g), and a change in the coda consonant (14h).

(14)	Singular	Plural	Root
a.	gèeŋ	gêeŋ	‘hat’
b.	gòoŋ	góoŋ	‘hedgehog’
c.	aʝìt	aʝiit	‘chicken’
d.	dòoot	dót	‘gravel’
e.	jàaŋ	jjêeŋ	‘Dinka’
f.	gòol	gàal	‘wild dog’
g.	tiik	djàaar	‘woman’
h.	jiic	jiit	‘ear’

- ▷ Ladd et al. (2009) investigate regularity in Dinka plurals in a corpus of 373 native noun pairs from the Luanyjang dialect.⁴
- ▷ They note **81 different combinations of change** from the singular to the plural, with the most common one occurring in 12% of nouns (a one-step change in length and an alternation between a H and L tone).

⇒ They identify a number of probabilistic generalizations, but conclude that plural morphology is **in essence irregular**: “Though there clearly some tendencies and probabilistic generalizations about how the phonological differences can be combined, it does not appear possible to identify any phonological or semantic motivation for the choice of number-marking pattern.” (Ladd et al. 2009:668)

(But see Ladd and Blum to appear a converging view that there are important subregularities.)

⁴Note that Ladd et al. include in their results 10 pairs of singular-collective forms. For eight of these nouns, there is a distinct plural, which is listed as a separate pair. As discussed by Andersen (2014:sec. 9), collective forms are distinct from plurals and so we exclude them from our examination of singular-plural marking. The remaining two collective pairs involve liquids, *cáa-cáaak* ‘milk’ and *pjiw-pjêew* ‘water’. Andersen notes that these are plural-collective pairs, with no true singular, in the Agar dialect.

3 Tripartite number and Dinka vowel grades

3.1 Tripartite number

Can an inflectional system be fully irregular?

- ▷ A first step in making sense of Dinka plural morphology is **to adopt a synchronic tripartite number analysis of Dinka**, contra Andersen (2014). An important source of the complexity of Dinka plurals is that the number marking system derives historically from a **tripartite number system** (Ladd et al. 2009; Andersen 2014), common in Nilotic languages.
- ▷ In Surkum (Sudan, Nilotic), for example, there are **three patterns of number marking**: i) inherently singular nouns, only suffixed in the plural, ii) inherently plural, only suffixed in the singular, and iii) “numberless” nouns, with suffixes in both the singular and plural:

(15)

Singular	Plural	Meaning	
kùl	kùl-àk	‘warthog’	<i>Inherently singular</i>
wèer-ìt	wèer	‘wing’	<i>Inherently plural</i>
tíib-ú	típ-án	‘shadow’	<i>Numberless</i>

(Surkum, Andersen 2014:240–241)

- ▷ Inherently plural nouns frequently refer to entities that naturally occur in pairs or pluralities, like wings, while inherently singular nouns refer to items and individuals that tend to occur in isolation.
- ▷ As described by Andersen, Dinka once had a similar system of number suffixes, which triggered assimilatory processes in the root. These suffixes were subsequently lost, triggering compensatory lengthening of the root. As a result, we can identify the same three classes of nouns:

(16)

Singular	Plural	Meaning	
jòom	jòoom	‘wind’	<i>Inherently singular</i>
ḡḡuur	ḡḡr	‘heel’	<i>Inherently plural</i>
adwàək	adòook	‘kind of gourd’	<i>Numberless⁵</i>

⇒ Within an autosegmental approach to phonology, the processes of assimilation and lengthening can be identified with **floating affixes**. We adopt this idea and propose that Dinka has a **synchronic tripartite number system**. (See Appendix A for a detailed discussion of Andersen’s 2014 arguments against a synchronic tripartite analysis, which we show are not problematic.)

⁵This pair reflects a numberless noun, because the singular is marked by vowel lowering and the plural by lengthening.

3.2 Vowel raising and lowering in Dinka vowel grades

What kind of assimilatory processes occur in Dinka roots?

In order to understand inflectional morphology in Dinka, it is important to understand the processes of **vowel lowering and raising** that many morphological categories make use of.

Andersen (1993) describes these changes in terms of **three distinct vowel “grades”**. Each morphological category falls into Grade 1, Grade 2, or Grade 3, which are outlined in Table 1:

(17) **Table 1. Dinka vowel grades.**⁶

	Creaky					Breathy					
Grade 1	i	e	a	ɔ	o	ĩ	ẽ	ã	ɔ̃	õ	ũ
Grade 2	i	e	ɛ	ɔ	o	ĩ	ẽ	ɛ̃	ɔ̃	õ	ũ
Grade 3	jɛ	ɛ	a	a	wɔ	jẽ	ɛ̃	ã	ã	ɔ̃	wɔ̃

Each row lists all vowels found in a grade. Each column indicates how vowels correspond across grades.

- ▷ **Grade 1:** This vowel grade is considered basic, and assumed to reflect the underlying vowel in the root, since it is most frequent and surfaces in unmarked forms (see Andersen 1993, 2017 for more arguments).
- ▷ **Grade 2:** A number of different inflectional and derivational categories shift the underlying vowel to Grade 2, raising *a* to *ɛ*, but leaving all other vowels unaffected.⁷ We see this pattern in 3rd person singular subject agreement and non-topical subject inflection, for example:

(18)

Underlying form	3SG	Non-topical subject	Meaning
lêer	lèeer	léeer	‘roll’
ɲáaɲ	ɲèɛɛɲ	ɲéɛɛɲ	‘open’
côɔl	còɔɔl	cóɔɔl	‘call’

(Agar Dinka; Andersen 1993:20)

⁶See Ladd and Blum (to appear:sec. 2.1.2) for a discussion of some minor differences in how these vowel grades function in Luanyjang.

⁷As a result, both *ɛ* and *ɛ̃* only surface in Grade 2 and 3. We will see, however, that there are a handful of noun pairs that have an *ɛ* vowel in the singular and in the plural in the absence of clear evidence for an alternation in grades, which we will treat as exceptional Grade 1 forms.

- ▷ **Grade 3:** Other morphological categories systematically involve **vowel lowering**. Grade 3 inflection triggers vowel lowering and breaking except when the root vowel is *a*. 1SG subject agreement is marked by Grade 3, for instance, and it is also triggered by the 2PL subject clitic:

(19)

Underlying form ⁸	1SG	2PL	Meaning
pîk	pjèek	pjék-kà	‘push’
bùt	buòot	buót-kà	‘build’
bòk	bòok	bók-kà	‘throw at’
lât	làat	lát-kà	‘insult’

(Agar Dinka; Andersen 1993:11–12)

Historically, these assimilatory processes reflect vowel suffixes that have since been lost. Andersen (2014:239) points out that these vowel suffixes are preserved in other Nilotic languages, as in Surkum (Sudan):

(20)

Unmarked	1SG (Grade 3)	3SG (Grade 2)	Meaning	
lòok	làaak	lòok	‘wash’	<i>Agar Dinka</i>
càm	càam	cèem	‘eat’	
lók	lóg-á	lóg-è	‘wash’	<i>Surkum</i>
?àm	?àm-à	?àm-è	‘eat’	

Key points:

- ▷ A vowel grade does not represent a single morpheme or morphological category, but is a way of describing assimilatory processes that are used frequently in Dinka morphology.
- ▷ In an item-based approach to morphology, Grade 2 and Grade 3 potentially reflect **different underlying vowel affixes** which trigger assimilation in the root vowel.

⁸The underlying form is based on the root types proposed by Andersen. See Trommer (2011:sec. 5.2) for a proposal that posits slightly different tones.

3.3 Vowel grades in number marking

Grade 2 and Grade 3 are frequently used in Dinka number marking as well, both in the singular and in the plural (Ladd et al. 2009; Andersen 2014; Ladd and Blum to appear).

(21) **Grade 2 in the singular:**

Singular	Plural	Meaning
abèɛɛ̄	abáɛ̄	‘waterlily’
gwè̄ɛ̄l	gwá̄l	‘collar bone’
wê̄ɛ̄ɛ̄r	wà̄r	‘cow dung’

(22) **Grade 2 in the plural:**

Singular	Plural	Meaning
màac	mê̄ɛ̄c	‘bullet’
gáac	gê̄ɛ̄ɛ̄c	‘kind of basket’
aŋâaŋ	aŋê̄ɛ̄ɛ̄ŋ	‘poor person’

Note: Identifying Grade 2 is not always easy, since many vowels remain unchanged, so we have to look for a change from *a* to *ɛ*. Similarly, we do not necessarily know whether the plurals in (21) or the singulars in (22) are in Grade 1 or Grade 3.

(23) **Grade 3 in the singular:**

Singular	Plural	Meaning
ṭòok	ṭòok	‘goat’
kj̣ɛ̄c	kj̣ɛ̄c	‘bee’
akwòom	akù̄m	‘stopper’

(24) **Grade 3 in the plural:**

Singular	Plural	Meaning
ṭj̣il	ṭj̣è̄ɛ̄l	‘thistle’
ḍòok	ḍà̄ak	‘boy’
ŋèej	ŋè̄ej	‘bran’

Note: Identifying Grade 3 is easier because most vowels lower, except for *a*. But, again, the plurals in (23) and the singulars in (24) can in principle be Grade 1 or 2.

As in the verbal domain, Andersen (2014:241–242) observes that other Nilotic languages preserve vowel suffixes in the same environments:

(25)	Singular	Plural	Meaning	
	màac	mê̄ɛ̄c (Grade 2)	‘fire’	<i>Agar Dinka</i>
	kòol	kà̄al (Grade 3)	‘hole’	
	rj̄ɛ̄ɛ̄m (Grade 3)	rím	‘blood’	
	lè̄c (Grade 2) ⁹	lèc	‘tooth’	
	máac	má̄ɛ̄-í̄ṭ	‘fire’	<i>Surkum</i>
	kà̄l	ká̄t-á̄n	‘hole’	
	rím-á̄ṭ	rím	‘blood’	
	lè̄g-í̄ṭ	lék	‘tooth’	

Our proposal: The vowel grade effects reflect **floating -V suffixes**, integrated into the root as the result of the templatic requirements on Dinka nouns and triggering assimilation.¹⁰

In this view, the forms in (21)–(24) **represent at least four different -V suffixes**, of which two trigger the Grade 2 raising process and two trigger the lowering that characterizes Grade 3:

(26) **Singular suffixes:**

	Singular	Plural	Meaning
<i>Surface form</i>	abèɛ̄t̩	abát̩	‘waterlily’
<i>Underlying form</i>	abát̩ + -V ₂	abát̩	
<i>Surface form</i>	kjěec	kíc	‘bee’
<i>Underlying form</i>	kíc + -V ₃	kíc	

(27) **Plural suffixes:**

	Singular	Plural	Meaning
<i>Surface form</i>	màac	mêɛc	‘bullet’
<i>Underlying form</i>	màac	màac + -V ₂	
<i>Surface form</i>	ɖòok	ɖàak	‘boy’
<i>Underlying form</i>	ɖòok	ɖòok + -V ₃	

See also Ladd and Blum (to appear), who also posit these four nominal classes.

4 Grade 2 and Grade 3 suffixes are regular

4.1 Grade 3 suffixes contribute one mora and are low-toned

Do Grade 2 and Grade 3 number suffixes have a consistent form?

We start with Grade 3 suffixes, which are easiest to identify. To determine the form of Grade 3 suffixes, we **extracted 115 noun pairs that unambiguously involve Grade 3**. These are forms that exhibit lowering (excluding underlying *a*).

1. Grade 3 suffixes lengthen to a medium vowel.

In both the singular and the plural, the majority of Grade 3 nouns **contain a medium vowel** (90/115 nouns). As a result, we posit that Grade 3 suffixes **lengthen the root by one mora** (*cf.* Ladd and Blum to appear). Many roots with a short vowel are lengthened to medium (41 nouns):

⁹It is not obvious at this point that the form *lêec* is Grade 2. But we will see below that only Grade 2 suffixes add breathy voice, allowing this grade to be diagnosed even when the underlying vowel is not *a* in some cases.

¹⁰How exactly to implement the vowel lowering/raising processes is not necessarily straightforward, especially Grade 3, which involves a kind of chain shift. See, for example, Kirchner (1996), Łubowicz (2003), Mortensen (2006), and Trommer (2011) for discussion of chain shifts.

(28) **Grade 3 on inherently singular CVC nouns:**

Singular	Plural	Meaning
cól	cwòl	‘mouse’
lòn	lwòɔn	‘kind of small animal’
kíl	kjèel	‘rhinoceros’

(29) **Grade 3 on inherently plural CVC nouns:**

Singular	Plural	Meaning
rwòɔn	rùn	‘year’
kjèec	kìc	‘bee’
akwòom	akùm	‘stopper’

With roots that contain a medium vowel, there is **no apparent lengthening** (39 nouns):

(30) **Grade 3 on inherently singular CVVC nouns:**

Singular	Plural	Meaning
tíil	tjèel	‘thistle’
d̀̀òk	d̀̀ak	‘boy’
ɲèej	ɲèej	‘bran’

(31) **Grade 3 on inherently plural CVVC nouns:**

Singular	Plural	Meaning
tjèet	tjít	‘sorcerer’
d̀̀el	d̀̀el	‘skin’
awwòow	awúuw	‘millet’

Finally, there are 13 long Grade 3 nouns that end in *r*:

(32) **Long Grade 3 nouns with coda *r*:**

Singular	Plural	Meaning
tír	tjèer	‘bloodfeud’
péer	pèer	‘bushbuck’
djèer	diiir	‘leg’
gjèer	gír	‘kind of tree’

But Remijsen and Gilley (2008:330–332) show that there is no distinction between medium and long vowels phonetically before *r*.¹¹ If the nouns in (32) too are taken to involve medium vowels underlyingly, then **103/115 Grade 3 nouns are bimoraic**.

⇒ We propose then that both the singular Grade 3 suffix and the plural Grade 3 suffix are associated with **an affix-specific ban on long vowels template**. Andersen (2014) notes the same behavior for the benefactive in the verbal domain (see Flack 2007 and Trommer 2015 for implementations).¹²

¹¹Instead, the duration of a medium/long vowel before *r* is analogous to the duration of a long vowel, suggesting that underlying medium vowels undergo a process of lengthening to long in this context.

¹²Trommer’s account avoids affix-specific phonology by treating affixes like the benefactive as moraic circumfixes, also adopting a constraint that requires moras from the same morpheme to be contiguous (effectively causing all intervening root moras to be deleted).

2. **Grade 3 suffixes carry a low tone.**

In both the singular and the plural, Grade 3 nouns predominantly carry a low tone (76/115):

(33) **Grade 3 with low tone on inherently singular nouns:**

Singular	Plural	Meaning
t̪iil	t̪jèɛl	‘thistle’
d̪òk	d̪àak	‘boy’
ɲèej	ɲèej	‘bran’

(34) **Grade 3 with low tone on inherently plural nouns:**

Singular	Plural	Meaning
t̪òk	t̪òk	‘goat’
djèeer	diiir	‘leg’
akwòm	akùm	‘stopper’

We propose that the underlying tone of Grade 3 suffixes is a **low tone**, which can overwrite the stem tone.

3. **Grade 3 nouns with a complex tone.**

The remaining Grade 3 nouns mostly **carry a complex tone**. Only 8 nouns carry a high tone, which we treat as exceptional. The other nouns obey the pattern in (35):¹³

(35) **Tonal alternations with complex tones in Grade 3:**

Grade 3 nouns with a rising tone have a rising or high tone in the root (14/17)

Grade 3 nouns with a falling tone have a falling or low tone in the root (7/8)

We suggest that the choice between a low tone and the pattern in (35) reflects an **underlying difference in Dinka roots**.

⇒ Gjersøe (2020), working on plurality in closely related Nuer (Eastern Jikany), posits a distinction between *stable stems*, whose lexical tones are preserved, and *unstable stems*, whose lexical tones are overwritten. We adopt this distinction, but propose that it manifests differently in Dinka. In particular, we propose that Dinka stable stems **combine their lexical tone and the suffix tone to form a complex tone**.¹⁴

(36) **Low tone on root maps to falling tone:**

$j\dot{\omega}k \rightarrow j\hat{a}ak_3$ ‘god’:
 $C\check{V}VC + -\check{V}_3 \rightarrow C\hat{V}V_3C$

(37) **High tone on root maps to rising tone:**

$bj\acute{o}k \rightarrow bj\check{\jmath}ok_3$ ‘animal hide’:
 $C\check{V}VC + -\check{V}_3 \rightarrow C\check{V}V_3C$

¹³We exclude here six nouns that are part of the numberless nouns discussed in Appendix B, because these are marked in the plural with a low tone associated with the long plural, obscuring the underlying lexical tone.

¹⁴Why does a low tone map to a falling tone and a high tone to a rising tone? Remijsen and Ladd (2008:181) show that both rising/high and falling/low are difficult to distinguish in certain contexts in Luanyjang. Both low and falling tones involve a fall in pitch, but at different points in the syllable. This difference is difficult to perceive in short vowels. High and rising tones are very similar in citation forms and at the end of a declarative, where the rising tone is realized as a mid tone with a level f0, like the high tone. We propose then Dinka stable stems map their lexical tone to their “most similar” complex tone (cf. Steriade 2008).

Grade 3 suffixes have a consistent representation, as **low toned -V suffixes with a ban on long vowels**. Also, these generalizations extend to 14 nouns with underlying *a*, which does not lower in Grade 3:¹⁵

(38)	Singular	Plural	Meaning
	cwàṅ	cwàṅ	‘liver’
	jál	jàal	‘courtyard’
	apàac	apác	‘floating swamp grass’
	làaṅ	láṅ	‘kind of berry’

4.2 The form of Grade 2 suffixes

We examine 43 nouns with unambiguous Grade 2 in the singular or plural (pairs with *a* alternating with *ε*):¹⁶ Grade 2 suffixes have many of the same effects on length and tone as Grade 3 suffixes. We propose that Grade 2 suffixes are **also low-toned and contribute one mora** (see also Ladd and Blum to appear).

1. Grade 2 suffixes contribute one mora.

Like Grade 3 suffixes, Grade 2 suffixes **result in lengthening**. Short vowels lengthen to medium in Grade 2 (11 nouns):

(39)	Singular	Plural	Meaning
	abèèṭ	abát	‘waterlily’
	gwèèl	gwál	‘collar bone’
	awán	awëen	‘jackal’
	kwác	kwëec ¹⁷	‘leopard’

The patterns with medium vowels are discussed in more detail below.

¹⁵Although these forms are in principle ambiguous, we will show that all Grade 1 suffixes lengthen vowels to long. In our analysis, these forms must then involve Grade 3 underlyingly.

¹⁶Note that the set of unambiguous Grade 2 nouns is much smaller, since Grade 2 only affects underlying *a*.

¹⁷As discussed by Andersen (2017), Grade 2 *ε* raises to *e* after a glide.

2. **Grade 2 suffixes contribute a low tone or map to a complex tone.**

14 Grade 2 nouns carry a **low tone** (40). Only two Grade 2 nouns carry a high tone, which we again suggest is exceptional.

(40) **Grade 2 suffixes with low tone:**

Singular	Plural	Meaning
abèɛɛɛ	abáɛɛ	‘waterlily’
gwèɛl	gwál	‘collar bone’
awâaj	awèɛɛj	‘salt’
gáac	gèɛɛc	‘kind of basket’

The remaining nouns **carry a complex tone**. The relationship between these complex tones and the lexical tone of the root noun is the same as proposed for stable stems for Grade 3 suffixes:¹⁸

(41) **Tonal alternations with complex tones in Grade 2:**

Grade 2 nouns with a rising tone have a rising or high tone in the root (8/8)

Grade 2 nouns with a falling tone have a falling or low tone in the root (7/8)

⇒ Although they trigger distinct assimilatory processes, Grade 2 suffixes have the same underlying form as Grade 3 suffixes. The singular and plural Grade 2 suffix are both **low-toned vowel suffixes**, which interact in the same way with stable stems.

¹⁸We are excluding for this count here 11 nouns which are Grade 2 plurals, but which we will show carry a Grade 1 morpheme in the singular, as evident by the long vowel they carry. This Grade 1 suffix displays tonal polarity, obscuring the underlying tone of the root.

4.3 Grade 2 suffixes and stable/unstable stem distinction

In Grade 2 plurals, a split emerges with roots with medium vowels.¹⁹ Some medium vowels retain their length (42), but others become long (43).

(42) **Grade 2 plurals not lengthening to long:**

Singular	Plural	Meaning
màac	mễec	‘bullet’
aláaṭ	alễeṭ	‘item of clothing’
ràaŋ	rễeŋ	‘grave’
náaŋ	ñễeŋ	‘crocodile’
ḡàaŋ	ḡễeŋ	‘gun’
jàaj	jễej	‘ceremony’
ǰaaŋ	ǰjễeŋ	‘Dinka’

(43) **Grade 2 plurals lengthening to long:**

Singular	Plural	Meaning
awâaj	awè̃ej	‘salt’
gáac	gè̃ec	‘kind of basket’
aŋâaŋ	aŋè̃eŋ	‘poor person’
aǰàak	aǰjè̃ek	‘rich person’
ap̄aaràak	ap̄aarè̃ek	‘adult’

- ▷ Strikingly, the Grade 2 nouns that do not lengthen in (42) are **all stable stems**, carrying complex tones following the same correspondences observed with Grade 3 nouns. In addition, these forms all **acquire breathy voice**, if not underlying.
- ▷ The Grade 2 nouns that lengthen to long are **all unstable stems**, with their lexical tone overwritten by a low tone and no obvious change in voicing.

Our proposal: In the plural, the Grade 2 suffix **has two allomorphs**, which are sensitive to the distinction between stable and unstable stems:²⁰

1. **With stable stems:** The Grade 2 plural is associated with a **ban on long vowels** and **breathy voice**.

(44) *màac - mē̃ec* ‘bullet’:
 $C\hat{V}VC + -\check{V}_2 \rightarrow C\hat{V}V_2C$

2. **With unstable stems:** The Grade 2 plural always lengthens by one mora (short to medium, medium to long).

(45) *awâaj - awè̃ej* ‘salt’:
 $C\hat{V}VC + -\check{V}_2 \rightarrow C\hat{V}V_2C$

¹⁹In the singular, there are only two unambiguous Grade 2 forms for which the root carries a medium vowel.

²⁰This effect is absent in Grade 3 except perhaps in forms with *e*. Stable stems *jít-jjễeṭ* ‘neck’ and *tjễen-t̄in* ‘breast’ acquire breathy voice. In unstable stems, breathy voice is even exceptionally lost at times, in forms like *mễeṭ-m̄iṭ* ‘child’ and *r̄ic-rjè̃ec* ‘ageset’. This pattern is clearly reminiscent of the Grade 2 voicing pattern, although there are only a handful of relevant examples.

Grade 2 suffixes have a consistent representation, as **low toned -V suffixes**, with allomorphy based on stem type in the plural.

⇒ These generalizations extend to 49 noun pairs that show no change in the vowel but the same alternations in voice and tone, which we analyze as Grade 2 also:

(46)	Singular	Plural	Meaning		Singular	Plural	Meaning
	ḳɛt	ḳɛt	‘shoulder’		aguṃùt	aguṃùt	‘owl’
	g̣ɛm	g̣ɛm	‘cheek’		g̣ɛɲ	g̣ɛɲ	‘hat’
	kẉiic	kẉiic	‘ankle’		ḷɛk	ḷɛk	‘kind of fish’
	ɲɛp	ɲɛp	‘corner of mouth’		ḳɛc	ḳɛc	‘gourd used to hold water’

5 Long suffixes

Can we identify a default strategy for number marking?

- ▷ The final declensions we discuss mark singular and plural by lengthening vowels to long without any change in the vowel. This effect occurs in the singular and the plural.
- ▷ In addition, we show that the long plural is the **default strategy for number marking**, productively applying to loanwords as well as nominalizations (Ladd et al. 2009; Andersen 2014).
- ▷ We diverge here from Ladd and Blum (to appear), who treat all the forms with no raising/lowering discussed in this section as part of a Grade 2 alternation (if the vowel is not *a*) or a Grade 3 alternation (if the vowel is *a*) also. As a result, we will end up positing two additional inflection classes.²¹

²¹We believe that there is a significant payoff to this move. One, we can recognize a default number marking strategy, the long plural, which is productive in loanwords (otherwise, it is not clear why most loanwords do not show vowel lowering/raising, since they must be analyzed as a mix of Grade 2 and Grade 3 forms). In addition, the generalizations we identified about the behavior of tone and length in Grade 2 and Grade 3 are difficult to state if we do not separate out the long plurals and long singulars. The lack of lengthening of medium vowels in unambiguous Grade 2 and Grade 3 forms then cannot be attributed to a ban on long vowels and the tonal generalizations are weakened by the long singular class, which we will see displays tonal polarity.

5.1 Long plural

- ▷ There are 58 noun pairs which form the plural by lengthening the root vowel to long, without evidence of the assimilatory processes associated with Grade 2 or 3:

(47)	Singular	Plural	Meaning
	kàl	kâaal	‘town, fence’
	pìj	pîij	‘place, ground’
	còol	còool	‘charcoal’

- ▷ 37 plural nouns **surface with a low tone**:

(48)	Singular	Plural	Meaning
	pǎal	pàaal	‘knife’
	jáak	jàaak	‘pelican’
	cǒol	còool	‘charcoal’

- ▷ The remaining 21 nouns all **carry a falling tone**, corresponding to a low tone in the root in 20 cases:²²

(49)	Singular	Plural	Meaning
	kàl	kâaal	‘town, fence’
	pìj	pîij	‘place, ground’
	tìim	tîim	‘tree’

Proposal: We posit a -VV plural suffix that lengthens all vowels to long and displays the tonal interaction with stable stems previously described. This plural suffix is regular in 57 out of 58 noun pairs.

²²Interestingly, almost all stems that are CVC in the singular fall in this class (10/11), suggesting another morphophonological correlate of the unstable/stable stem distinction.

Loanwords

- ▷ As noted by Ladd et al. (2009) and Andersen (2014), there is evidence from loanwords that a **long, low-toned plural is the default strategy for number marking**. There are ten loanwords in the Luanyjang corpus, of which nine make use of this plural strategy:

(50)

Singular	Plural	Meaning
biḡà	biḡàaa	‘fishhook’
duḡgulḡit	duḡgulḡiit	‘westerner’
galàm	galàaam	‘pen’
garnêet	garnèeet	‘grenade’
kumbâaj	kumbàaaj	‘cup’

(51)

Singular	Plural	Meaning
maḡgàa	maḡgàaa	‘mango’
niwàn	niwàaan	‘aidworker’
ṭukṭul	ṭukṭuul	‘school’
ṭurumbiil	ṭurumbiil	‘car’

- ▷ Andersen (2014:245–246) makes the same observation for loanwords in Agar Dinka. In addition, he notes that this strategy is used to form plurals of nominalized verbs in Agar also:

(52)

Singular	Plural	Meaning
dé-kṭuṇ	dé-kṭuuṇ	‘helper’
dé-pṭoooc	dé-pṭoooc	‘teacher’
amé-tṭuc	amé-tṭuuc	‘messenger’

(Agar Dinka; Andersen 2014:246)

⇒ The long plural is the **default strategy for number marking** and it is regular in the right contexts. These facts suggest a view of Dinka as a tripartite language with a few inflection classes for each number class. For example, for the inherently singular nouns, which only take a suffix in the plural, we can now **posit three inflection classes**:

(53) **Table 2. Inflection classes for inherently singular nouns.**

	Singular	Plural	Proportion of regular nouns
I.	∅	- Long PL	57/58
	<i>jáak</i>	<i>jàaak</i> ‘pelican’	
II.	∅	- Grade 2 PL	25/33
	<i>awán</i>	<i>awǽen</i> ‘jackal’	
III.	∅	- Grade 3 PL	60/66
	<i>ṭiil</i>	<i>ṭjèel</i> ‘thistle’	

5.2 Long singular

▷ There is also a class of inherently plural nouns that form the singular **with a long suffix**, in 57 noun pairs:

(54)	Singular	Plural	Meaning
	mèeen	mẹn	‘forked support’
	akḥḥoon	akḥḥon	‘elephant’
	rḥaal	rḥal	‘nerve’
	agḥuuk	agḥuk	‘dove’

- ▷ We saw previously that the Grade 2 and Grade 3 singular suffixes are associated with a bimoraic template, so these are not analytically ambiguous in the view we propose.
- ▷ This class of singular nouns is **not consistently associated with a particular tone**. The singular forms surface with all four tones, which is distinct from the underlying tone in all but one pair.
- ▷ More precisely, we can distinguish **four distinct patterns of tonal alternation** in this class:

(55)	Low singular - high plural (23 nouns): ²³
	mèeen mẹn ‘forked support’
	nòoon nóon ‘grass’
	gḥḥoor gḥḥor ‘green kind of snake’

(57)	Rising singular - Falling/low plural (9 nouns): ²⁴
	agḥuuk agḥuk ‘dove’
	kḥeer kḥer ‘branch’
	kwăaar kwàr ‘ancestor’

(56)	Falling singular - Rising/high plural (12 nouns):
	kḥoot kḥot ‘kind of acacia tree’
	acḥḥoot acḥḥot ‘cattle without horns’
	akḥḥoon akḥḥon ‘elephant’

(58)	High singular - Rising plural (9 nouns):
	lḥoom lḥom ‘rib’
	njḥeel njḥel ‘python’
	cḥḥoc cḥḥoc ‘end of rope’

Our proposal: We suggest that this pattern reflects a **tonal polarity effect**. More precisely, we posit a -VV singular suffix that lengthens all roots to long and **carries a dissimilatory tone**, which overwrites the root tone.²⁵

²³The fact that this class contains a large number of nouns with this tonal pattern is probably not significant, because 12 of these nouns are *r*-final, which may carry medium vowels underlyingly and so could also be analyzed as unstable stems carrying a Grade 2 singular suffix.

²⁴The patterns in (56) and (57) suggest that the simplex tones (low and high) can dissimilate to complex tones. We tentatively suggest that such stems are stable stems, triggering dissimilation to the most dissimilar complex tone. In support of this idea, note that 10/14 stems of this type are CVC and there appears to be a correlation between CVC roots and stable stems across inflection classes.

⇒ In this view of inherently plural nouns, we end up with **three inflection classes**, much like for inherently singular nouns:

(59) **Table 3. Inflection classes for inherently plural nouns.**

	Singular		Plural		Proportion of regular nouns
IV.	Long SG <i>agúuuk</i>	-	∅ <i>agúk</i>	'dove'	53/57
V.	Grade 2 SG <i>gèem</i>	-	∅ <i>gèm</i>	'cheek'	36/44
VI.	Grade 3 SG <i>rjěem</i>	-	∅ <i>rím</i>	'blood'	39/52

The resulting picture:

- ▷ Dinka is a tripartite number language, with a few inflection classes per number class. What is unusual only is that all affixes are floating vowel suffixes, integrated into the root.
- ▷ (We do not discuss the third class of nouns in detail, numberless nouns, which have an affix in the singular and in the plural. Appendix B identifies a set of 28 nouns that fall in this class.)

⇒ These rules account for 338/363 (93.1%) native noun pairs in the corpus. The remaining 25 irregular nouns show a variety of patterns, including suppletion, coda alternation, and unpredictable changes in the vowel. See Appendix C.²⁶

²⁵The difference between (56) and (58) is surprising here, showing that a rising tone may trigger the expected dissimilatory falling tone, but also a high tone. Remijsen and Ladd (2008) discuss the fact that a falling tone is simplified to a high tone by a process of Contour Simplification in some morphological categories. We propose that the long singular may trigger this tonal operation. In accordance, we note that the corresponding singular nouns in the Agar dialect all carry the expected falling tone.

²⁶As noted there, 13/25 out of the irregular forms show the tonal and length pattern of a long plural. So these 25 pairs could be included in inflection class I without affecting the conclusions about regularity.

6 Regularity

How can we assess the claim that this is a regular system?

- ▷ We claim that this is a rule-governed and regular system, fundamentally no different from gender systems with multiple declension classes.
- ▷ We assess the regularity of Dinka morphology using the Tolerance Principle from Yang (2016). Yang proposes that the productivity of a rule can be evaluated with the formula in (60).

(60) **Tolerance Principle (Yang 2016):**

A rule is productive for a set of lexical items N iff the number of exceptions does not exceed $\frac{N}{\ln N}$

How does the Tolerance Principle apply to inflectional classes?

- ▷ Yang argues that, given sufficient evidence, learners create subdivisions in lexical categories when there is no general productive rule. The Tolerance Principle then applies within an inflection class.
- ▷ Table 4 assesses our six inflection classes using the Tolerance Principle. Numberless nouns are counted as belonging to a singular and plural inflection classes, with exceptions counted double where the source of irregularity is not unambiguous.²⁷

(61) **Table 4. Inflection classes for Dinka number.**

	Singular	Plural		Regular nouns (Permitted exceptions)		Singular	Plural		Regular nouns (Permitted exceptions)
I.	∅	-	Long PL	68/69 (16.3)		Long SG	-	∅	68/73 (17)
	<i>jáak</i>		<i>jàaak</i>			<i>agũuuk</i>		<i>agũk</i>	
			‘pelican’					‘dove’	
II.	∅	-	Grade 2 PL	35/47 (12.2)		Grade 2 SG	-	∅	36/44 (11.6)
	<i>awán</i>		<i>awęen</i>			<i>gęem</i>		<i>gęm</i>	
			‘jackal’					‘cheek’	
III.	∅	-	Grade 3 PL	63/69 (16.3)		Grade 3 SG	-	∅	48/63 (15.2)
	<i>tjil</i>		<i>tjèel</i>			<i>rjęem</i>		<i>rim</i>	
			‘thistle’					‘blood’	

²⁷The Tolerance Principle is most permissive when evaluating small classes, so larger numbers are a better test. But nothing hinges on this choice. If we ignore the numberless nouns, or treat the numberless nouns as their own inflection classes, each inflection class is still governed by a regular rule in accordance with the Tolerance Principle.

⇒ Dinka plural morphology is **regular** and **concatenative**:

- ▷ Although the Dinka system is complex, it does not require positing a fully irregular inflectional system.
- ▷ Despite the large variety of phonological changes that occur in the root, they can be accounted with a simple set of floating vowel affixes, which always lengthen the root.

Conclusion

Our main claims

- ▷ In this talk, we have shown that, although Dinka morphology has been cited as a challenge to item-based approaches to morphology, it makes use of **fully concatenative processes** (see Trommer 2011 for discussion of the verbal domain).
- ▷ In addition, when we recognize the importance of tripartite number as well as a handful of inflection classes, we can see that Dinka nominal morphology is **regular**.

On learnability

- ▷ In this view, Dinka number morphology is not necessarily any more complex than plural marking in a language like German (Wiese 1996; Wunderlich 1999; Trommer 2021), in which the productive number marking strategy with loanwords is also not a pattern that obtains with the majority of nouns.
- ▷ Although the root-internal morphology is complex, the learner is aided by a number of factors (see Appendix D for more detail):
 1. Vowel raising/lowering and lengthening always signal an underlying affix
 2. The inventory of floating affixes is small and many of the processes involved occur in verbal morphology as well
 3. Like gender, tripartite number has a semantic basis

⇒ There may not be any morphological systems that are fully irregular. In addition, Western Nilotic systems do not necessarily pose a challenge to a concatenative view of morphology (*cf.* Ladd and Blum to appear on Dinka and Gjersøe 2020 and Baerman and Monich to appear on Nuer).

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Appendix A: Andersen's arguments against a tripartite analysis

Andersen (2014) argues that Dinka is no longer synchronically a tripartite number system. He presents a few arguments in favor of this conclusion:

1. The singular is the citation form.

Andersen points out that native speakers supply **the singular as citation forms always**, even for nouns which are historically marked in the singular.

⇒ But Kouneli (2020) reports the same for the tripartite number system of Kipsigis (Kenya, Nilotic), which retains overt number suffixes. Speakers provide a singular citation form for inherently singular nouns (62a), but also for inherently plural nouns (62b):

(62) *Singular is the citation form in Kipsigis:*

- a. laak-wa-it
child-TH-SEC
'child'
 - b. ngeend-yaan-ta-it
bean-SG-TH-SEC
'bean'
- (Kipsigis; Kouneli 2020:13–14)

2. Variation in the plural.

Andersen observes that there is variation in the plural, with speakers sometimes giving multiple forms (63). In contrast, there is no apparent variation in the singular.

(63) **Singular** **Plural**
n̄j̄aaal n̄j̄ɔ̄ɔl, n̄j̄ɛel 'knee'
w̄um w̄uuum, ww̄om 'nose'
bw̄ɔ̄ɔl bw̄ɔ̄ɔl, bj̄aal 'rabbit, hare'
(Agar Dinka, Andersen 2014:248)

⇒ As Andersen acknowledges, Ladd et al. (2009) appear to find less variation for Luanyjang Dinka. In addition, Kouneli reports variation in the plurals for Kipsigis as well (Appendix A).²⁸

²⁸Also, when we compare dialects, we do occasionally find variation in the singular as well. For example, inherently plural *t̄in* 'breast' has the singular *t̄in* in Agar Dinka, but the singular *t̄j̄en* in Luanyjang.

3. No evidence for semantic differences.

Andersen shows that there is no evidence for semantic differences between unmarked and marked nouns. For example, there are a number of collective predicates which may combine with a singular subject to give a plural reading, regardless of the number class.²⁹

(64) *All singular nouns can have a collective readings:*

- a. **láj** à-gwèeer làaan.
animal.SG D-go.all.CP side.DEM.LOC
'Animals are coming this way.'
- b. **cjéec** à-lùt.
bee.SG D-move.as.large.group
'A swarm of bees is flying.'
(Agar Dinka, Andersen 2014:250)

⇒ But Kouneli (2020) similarly shows that inherently singular and plural nouns do not differ in their semantics in Kipsigis either. For example, both inherently plural nouns and marked plural nouns have inclusive readings:

(65) *An inherently plural noun can have an inclusive reading:*

- Q: Í-géer-é sólòb-êek-i?
2SG-see-IPFV cockroach-TH.SEC-Q
'Do you see cockroaches?'
- A: Êe, á-géer-é àgêengè?
yes 1SG-see-IPFV one
'Yes, I see one.'
(Kipsigis; Kouneli 2020:16)

Takeaway: The comparison with Kipsigis tells us that tripartite number does not necessarily have consequences for the semantics of number. The fact that Dinka treats the singular as default is not an argument against a morphologically tripartite analysis.

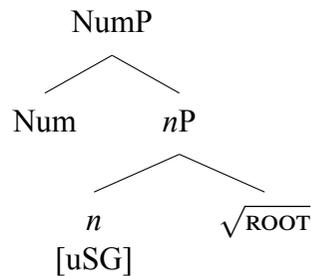
²⁹Note that, as we will demonstrate, *láj* is an inherently singular noun (the plural *láj* is marked by lengthening), while *cjéec* is an inherently plural noun (it is derived through lengthening and vowel lowering from the plural root *cjɛc*).

What kind of view of tripartite number explains the lack of semantic effects?

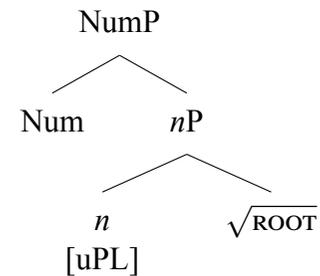
Harbour (2007, 2011) and Kouneli (2020):

- ▷ We know from gender systems that conceptual properties of noun can serve as a basis for classifying nouns into often arbitrary classes.
- ▷ Harbour and Kouneli argue that inherent number too can function as **a conceptual basis for classifying nouns**. In this view, tripartite number system have three number-based “genders”.
- ▷ In this view, inherently singular and inherently plural nouns **have the same structure**, but come with different uninterpretable features, just as in gender systems (which Kouneli locates on *n*):

(66) *Inherently singular nouns:*



(67) *Inherently plural nouns:*



These number features have no effect on the semantics, but influence the spell-out of interpretable number features on Num, resulting in different affixation patterns.

Appendix B: Numberless nouns

- ▷ A key property of tripartite number systems is the existence of a class of “**numberless**” nouns, nouns which take both singular and plural marking.
- ▷ Now that we understand the singular and plural inflection classes in Luanyjang Dinka, we can demonstrate that this class exists in Dinka too:

1. Inflection class VII: Long SG - Grade 2.

First, there are 14 noun pairs that show a Grade 2 suffix in the plural, and a long singular suffix in the singular:

(68)	Singular	Plural	Meaning
	lăaaŋ	lèeŋ	‘slave’
	amàaal	amǵel	‘sheep’
	wàaat	wěet	‘whip’

2. Inflection class VIII: Grade 3 - Long PL.

Next, there are 11 noun pairs with a Grade 3 suffix in the singular and a long plural:

(69)	Singular	Plural	Meaning
	uḷam	uḷòom	‘thigh’
	adwòok	adòook	‘kind of gourd’
	jwôom	jòoom	‘bone’

3. Inflection class IX: Long SG - Grade 3.

Finally, there are three noun pairs that have a Grade 3 suffix in the plural and a long singular:

(70)	Singular	Plural	Meaning
	děeek	dǵek	‘small kind of antelope’
	ŋôok	ŋàak	‘kind of catfish’
	ŋwèeel	ŋwèel	‘glans of penis’

⇒ In Dinka, as in other tripartite number languages, numberless nouns combine **with the same number suffixes** that are found in inherently singular and inherently plural nouns. As a result, these numberless nouns show the same tonal and lengthening behavior.

The three classes of numberless nouns are summarized in Table 5:

(71) **Table 5. Inflection classes for numberless nouns.**

	Singular	Plural		Proportion of regular nouns
VII.	Long SG <i>wàaat</i>	- Grade 2 <i>wěet</i>	‘whip’	10/14
VIII.	Grade 3 <i>adwə̀ɔk</i>	- Long PL <i>adòok</i>	‘kind of gourd’	9/11
IX.	Long SG <i>ɲə̀ɔk</i>	- Grade 3 <i>ɲàak</i>	‘kind of catfish’	3/3

Appendix C: Suppletion and irregularity

▷ There are **25 exceptional noun pairs**. Within these, 4 pairs are highly frequent nouns that are **suppletive**:

(72)

Singular	Plural	Meaning
tìik	djàaar	‘woman’
ràaan	kóoc	‘person’
mòoc	ròoor	‘man’
wéey	uyòok	‘cow’

▷ 4 nouns seem to take the long plural but with **unpredictable changes in the vowel**:

(73)

Singular	Plural	Meaning
ɲòm	ɲîim	‘head’
ɲàa	ɲîir	‘girl’
dòm	dûuum	‘field’
dòow	dèew	‘heifer’

- ▷ The biggest class of irregular forms consists of twelve nouns in which the coda consonant *-t* alternates with a glide, likely a remnant of a plural suffix:³⁰

(74)	Singular	Plural	Meaning
	aŋɔ́w	aŋàaaɬ	‘cat’
	jíic	jiit̪	‘ear’
	ɲów	ɲòot̪	‘udder’

Although this set could be treated as another inflection class of the plural, it shows a considerable degree of irregularity. Almost all plurals are low-toned, but lengthening is variable. Also, the plural may trigger vowel raising, vowel lowering, or display no change in the vowel at all, without a clear pattern.

- ▷ And, finally, there are a 4 pairs that do not clearly belong to any class:³¹

(75)	Singular	Plural	Meaning
	kòk	kòk	‘hole in tree’
	wà	wàt	‘son’
	ról	ròt	‘throat’
	rèel	rèt	‘anthill’

⇒ As in most languages, Dinka has a small number of nouns that are truly irregular. In support of the idea that the long plural is the default strategy of marking number, note that half of these irregular nouns (13/25) have a long plural, mostly with a low tone (10/13) or a predictable complex tone (2/3).

³⁰There is one pair *wèeet-wèew* in which the *-t* appears in the singular.

³¹The one remaining pair is *tjèek-tjèek* ‘marriage’, which seems to form a plural through reduplication.

Appendix D: Class-specific generalizations

How does the language learner sort nouns into this inflectional system?

We identify **three sources** of reliable cues that a language learner can use to master this system:

1. Phonological markedness (length, voice, complex tones)
2. Semantic generalizations at the basis of the tripartite number system
3. Class-specific phonological and semantic generalizations

Phonological cues

The learner is aided by a number of **morphophonological features of our analysis** in determining the presence and form of a floating affix:

- ▷ In the view we develop, **phonological markedness corresponds to morphological markedness** in most cases:
 - Lengthening of a root always signals the presence of an underlying affix. In addition, long vowels in isolation are a sufficient cue for an affix (with the exception of *r*-final nouns).
 - A change from creaky to breathy voice signals the presence of a Grade 2 morpheme.
 - Vowel lowering/raising always reflects an underlying morpheme. Note also that, within the Dinka vowel grade system, it is never ambiguous whether we are dealing with lowering or raising.³²
 - Tonal alternations are always the result of an underlying affix. In addition, the exponent of inflectional tone is almost always either a low tone or a complex tone. High tone is a reliable cue for the root form of a noun.
- ▷ In addition, because Grade 2 and Grade 3 suffixes come with a ban on long vowels with most stems, there is little room for misanalysis. The main source of systematic ambiguity arises between Class I and Class II, for CVVC unstable stems.
- ▷ Finally, the **inventory of underlying affixes is small**, with many inflection classes using the same processes of assimilation and lengthening and the same tonal alternations. Although the system of vowel grades is complex, the same vowel grade system is used frequently in the verbal domain. Similarly, the verbal system makes use of the same operations of lengthening, as well as affix-specific prohibitions on long vowels.

³²In particular, the only instance of vowel raising is *a* to *ε*, but, since *ε* is only present in Grade 2, it is never the input to lowering.

Tripartite number

How does the learner sort nouns into number classes?

- ▷ Dinka is a **tripartite number system**. Like gender systems, this way of sorting nouns is grounded is often arbitrary:

(76) **Inherently singular nouns:**

Singular	Plural	Meaning
abāaar	abèèer	‘orphan’
dóoor	dwòòr	‘member of Equatorian tribe’
kùul	kwòol	‘lower leg’

(77) **Inherently plural nouns:**

Singular	Plural	Meaning
ɲwòol	ɲúl	‘single child’
nwèèer	nwár	‘Nuer person’
djèèer	diir	‘leg’

- ▷ At the same time, the tripartite number classification is **frequently predictable**. Nouns which naturally occur in pairs or groups are more likely to be treated as inherently plural, while nouns that refer to entities that prototypically occur as individuals are more likely to be inherently singular.³³
- ▷ We demonstrate with a number of reliable conceptual distinctions in Luanyjang Dinka (based on suggestions by Grimm 2012 and Moodie 2019 for other tripartite systems):

1. Trees and plants.

Four, mostly generic, words for trees and plants are inherently singular, but 22/26 nouns referring to vegetation are marked in the singular:³⁴

(78) **4 inherently singular nouns for trees/plants:**

Singular	Plural	Meaning
tìim	tíim	‘tree (generic)’
bút	bwòot	‘shrub (generic)’
rúp	rwòop	‘group of trees in plain’
tíil	tjèel	‘thistle’

(79) **20 inherently plural nouns for trees/plants:**

Singular	Plural	Meaning
kìiir	kír	‘thorny kind of tree’
tāaar	tár	‘sisal plant’
rìiir	rír	‘kind of tree’
tìiit	tíit	‘mahogany tree’
kōoot	kōot	‘acacia tree’
tjèep	tjèp	‘kind of tree’
tjèet	tjít	‘kind of plant’
gjéèer	gír	‘kind of tree with hard wood’
ɲòòr	ɲór	‘kind of timber tree’
apàac	apác	‘floating swamp grass’
...

³³We haven’t been able to identify a semantic property reliably associated with numberless nouns.

³⁴One such noun is numberless.

2. Body parts.

Naturally singular body parts are marked in the plural (9/10) (80), while body parts that naturally occur in pairs or groups are marked in the singular (29/34) (81):

(80) Inherently singular nouns for body parts:

Singular	Plural	Meaning
tòok	tòook	‘mouth’
wùum	wùuum	‘nose’
tèeɲ	tèeɲ	‘groin’
cwáɲ	cwáɲ	‘liver’
jíɬ	jjěeɬ	‘neck’

(81) Inherently plural nouns for body parts:

Singular	Plural	Meaning
lǝɔm	lǝɔm	‘rib’
ɲjàaan	ɲján	‘testicle’
cǐin	cìn	‘hand’
cǝok	cǝk	‘foot’
rjǝɔp	rjǝp	‘nail’

3. Animacy.

The more animate a noun, the more likely it is inherently singular. 26/40 nouns referring to people are marked in the plural. Similarly, 37/55 nouns referring to animals are marked in the plural.³⁵ Conversely, insects are usually inherently plural (9/11) (*acàaak-acjěek* ‘tick’ is a numberless noun):

(82) 2 Inherently singular nouns for insects:

Singular	Plural	Meaning
kòm	kàam	‘worm’
góot	gàat	‘grasshopper, also: hill’

(83) 9 Inherently plural nouns for insects:

Singular	Plural	Meaning
acùuuk	acùk	‘biting kind of black ant’
aɲiic	aɲic	‘kind of ant’
diiir	dír	‘cricket’
tòoor	tór	‘kind of midge’
kjěeɬ	kíɬ	‘scorpion’
mìiit	míit	‘firefly’
rùuɲ	rúɲ	‘breeze fly’
ɲǝk	ɲǝk	‘louse’
kjěec	kíc	‘bee’

⇒ Conceptual properties of the noun are a useful, if somewhat imperfect, guide to the tripartite number classification.

Note: There may additionally be phonological cues that are associated with tripartite number. For instance, low-toned CVVC roots are frequently inherently singular (45/56).

³⁵It is not surprising to find considerable variation in this domain, since we may expect to find differences between solitary and herd animals as well.

Class-specific generalizations

How does the learner sort nouns into inflection classes?

A final question is whether there are cues that help the learner identify which noun goes into which inflection class. There are no obvious generalizations about numberless nouns, but inflection class I–VI are all associated with phonological and/or semantic generalizations:

1. Inflection class I.

- ▷ 21/29 inherently singular nouns with a complex tone in the root belong to Class I.

2. Inflection class II.

- ▷ 13/46 nouns in Class II start with *a-*. As noted in the introduction, the most common class of polysyllabic nouns is formed with an *a-* prefix. There are 31 such nouns that are marked in the plural, but note that there are 7 *a-*nouns that are ambiguous between Class I and Class II. If these nouns belong to Class II, then close to half of the Grade 2 nouns would be *a-*nouns.
- ▷ 9/46 nouns in Class II are roots ending in *ŋ*. Out of six other such roots, three are ambiguous between Class I and Class II. Potentially then, 12/15 *ŋ*-final roots are in Class II.

3. Inflection class III.

- ▷ Inherently singular roots with a high tone are usually Class III (44/63).
- ▷ Class III contains a number of apparently **masculine nouns** (84),³⁶ as well as nouns associated with initiation rites, hunting, or warfare (85):

(84)	Singular	Plural	Meaning
	ɖ̀òk	ɖ̀àak	‘boy’
	ɖ̀ùuk	ɖ̀wòk	‘gentleman’
	ŋ̀òk	ŋ̀àak	‘male goat’
	b̀áŋ	b̀àaŋ	‘chief’
	ɖ̀úuw	ɖ̀wòow	‘in-law’
	ɖ̀òk	ɖ̀àak	‘god’
	ɖ̀èeŋ	ɖ̀èeŋ	‘groin’

(85)	Singular	Plural	Meaning
	r̀íc	r̀jèec	‘ageset’
	ẁít	ẁjèeɛt	‘arrow, needle’
	ẁút	ẁwòot	‘cattle camp’
	kẁiil	kẁjèel	‘eyetooth’
	t̀ír	t̀jèeer	‘bloodfeud’
	ŋ̀wèeel	ŋ̀wèel	‘glans of penis’ (Class IX)
	r̀in	r̀jèen	‘name’

³⁶Compare with ɖ̀òk-ɖ̀òok ‘goat’, ɖ̀jòp-ɖ̀jòop ‘female in-law’, ŋ̀wòt-ŋ̀ùt ‘female animate entity’, all members of Class VI.

4. Inflection class IV.

- ▷ 18/24 inherently plural roots with a complex tone are in Class IV.
- ▷ 19/33 *a*-nouns that are marked in the singular are in Class IV.
- ▷ Class IV also contains a large number of nouns referring to **trees, plants, and items made of wood**:

(86)	Singular	Plural	Meaning
	ḳịiir	ḳịr	‘thorny kind of tree’
	ṭaaar	ṭaar	‘sisal plant’
	aṭṭṭoon	aṭṭṭon	‘kind of plant with round edible root’
	ṛịiir	ṛịr	‘kind of tree’
	ṭịiit	ṭịit	‘mahogany tree’
	ḳọoot	ḳọot	‘acacia tree’
	ṇ̇aaap	ṇ̇ǽep	‘sycamore tree’ (Class VII)
	ḳǽeer	ḳêr	‘branch’
	p̣aaat	p̣aat	‘bark of tree’
	aṇ̇uum	aṇ̇um	‘base of trunk, hips’

(87)	Singular	Plural	Meaning
	ag̣ǽep	ag̣ǽep	‘deleb palm tree’
	ṇoon	ṇoon	‘grass’
	ṇ̇oor	ṇ̇or	‘kind of timber tree’
	uṭ̣aaak	uṭ̣aaak	‘dried out dead tree’
	uṭ̣oor	uṭ̣or	‘ambush wood’
	j̣ook	j̣ook	‘flower’
	ag̣een	ag̣en	‘board’
	ṃeen	ṃen	‘forked support’
	p̣uur	p̣ur	‘hoe, spade’
	ṭooc	ṭooc	‘stool’

5. Inflection class V.

- ▷ High CVVC inherently plural roots tend to be in Class V (19/30).
- ▷ Class V contains a large number of **typically dual or plural body parts**:

(88)	Singular	Plural	Meaning
	ṇ̇iip	ṇ̇iip	‘incisor’
	ṇ̇eep	ṇ̇eep	‘corner of mouth’
	c̣iin	c̣iin	‘hand’
	c̣ook	c̣ook	‘foot’
	g̣eem	g̣eem	‘cheek’
	ḳook	ḳook	‘arm’

(89)	Singular	Plural	Meaning
	ṛj̣op	ṛj̣op	‘fingernail/toenail’
	ḷec	ḷec	‘tooth’
	ḳeet	ḳeet	‘shoulder’
	kẉiic	kẉiic	‘ankle’
	ṛook	ṛook	‘kidney’
	ḳoor	ḳor	‘elbow’
	ṇ̇uur	ṇ̇ur	‘heel’

6. Inflection class VI.

- ▷ Long *r*-final inherently plural roots are in Class VI (4/4).
- ▷ Class VI contains a number of **feminine nouns** or generic nouns with a masculine counterpart in class III (90), in addition to nouns associated with food (91):

(90)	Singular	Plural	Meaning
	ḍjóp	ḍjòop	‘female in-law’
	ḥwót	ḥút	‘female animate entity’
	tjêen	tjìn	‘breast’
	tòok	tòok	‘goat’
	mèet	mìit	‘child’

(91)	Singular	Plural	Meaning
	lwǎw	lów	‘yeast, from fermented sorghum’
	awwǎw	awúuw	‘millet’
	akwèem	akwém	‘bean (generic)’
	ḥwǎol	ḥól	‘maize’
	ḥwǎom	ḥúm	‘sesame’
	twǎḥ	tóḥ	‘egg’
	agwǎt	agót	‘small grey kind of bean’

⇒ Learners can draw on a variety of morphophonological and semantic sources to identify the number class and inflection class of a noun.