On the systematic nature of Dinka noun number morphology

Abstract: We present an analysis of noun number marking in Dinka, based on Andersen’s system of vowel grades and a new system of tone classes. Assuming that the ‘unmarked’ grade 1 form can be either singular or plural, we show that the morphology is more systematic than has been previously suggested. Roughly half of our dataset can be treated as synchronically regular, and in more than half the remainder the only exceptional features are simple alternations of lexical quantity or voice quality. Less than a quarter exhibit more unpredictable irregularities. With regard to tone, we posit nine classes that describe the patterns of tonal alternation between the grade 1 form and the more marked form of the noun; 60% of our dataset fall into just three of these classes. The tone classes show considerable cross-dialect validity even between a four-tone dialect (Luanyjang, Rek cluster) and a three-tone dialect (Agar).

Keywords: Dinka; grammatical tone; non-concatenative morphology; number marking; vowel alternation

Abstract in Dinka: È waragënwë ee dënëyic de nyooth de wët ye rin në Thoŋ de Jiëŋ yic. È dënëyicë anyooth kaam de yïi kajuëc kenë katöök, man kon jam në këde akeer, yin yaa bëër ka cik (pëk) den, ku jol yaa tôoon den. Wuööc në akeeriic, ku pëk de cït den aake gei në luçi da dugër ye col Torben Anderthen, yen man nootë tôoon de wël ke ye kän yam. Ètëné, ayuku jäl nyuœcë ke thëm de juëc ka lïk de wël ye rin në Thoŋjiënc eekë ci rət juuir awëëët wëår yenë ye tak thin, në ‘Abër de 1’ man lëu bî ya kajuëc ka tôk. Agut nhunh de juëëët de luçi da alëu bë tûn ke ci rət nyiec dhïïk, ku jal kë wëëët biäk de ñuan yaa yen è tiec ke ñëwëac. Ayuku nyuœcë ke abëëë ke tôoon de wët kee dhoëjuan aa lëu bïk wël ye rin luœl bïi kedhia. Ye cääëëëic èe ciët yic në kë tî yen në thook wäac ke Dëŋka keeërö: yïi Luënyjënc (de Rek) kenë Agaar.
1 Introduction

1.1 Dinka number morphology

The morphology of Dinka (Thuŋŋjäŋ; Western Nilotic, South Sudan), and of the Nilotic languages generally, is known for its complexity and irregularity. The complexity is due in part to the fact that many of the morphological contrasts are not signalled by affixation, but by stem-internal modification of vowels, consonants, and suprasegmental features. For the transitive verb morphology, Andersen (1992–94, 2017) has shown clearly that modified stems can themselves be modified, which allows a complex system of morphological distinctions to be conveyed almost exclusively by stem-internal modification. Much the same is true in the noun morphology (Andersen 2002), where morphologically related singular and plural stems can be further modified for grammatical distinctions such as case. In this paper we consider only the system of number marking, primarily because we do not have reliable data about other morphological categories (such as the ‘construct state’) that are derived from the basic singular and plural forms.

Dinka noun stems are mostly closed monosyllables. There is also a substantial proportion of disyllabic (or occasionally trisyllabic) but nevertheless monomorphic words beginning with /a-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or /al-/ or 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of suffixes, but it is well-established that in Dinka (and to some extent in the closely related languages Nuer and Shilluk) the suffixes have been lost and that formerly allophonic differences of vowel length conditioned by the suffixes have been phonologised. The loss of suffixes, and more generally the relation between present-day Dinka number marking and the systems of other Western Nilotic languages, is explored in detail by Andersen (1990) and Storch (2005).

All this has the consequence that given the **SG** form of a Dinka noun it is difficult to predict the **PL**, and vice-versa. Storch (correctly, in our view) continues to view the problem as primarily a matter of predicting the marked form from the unmarked form, and does not simply equate ‘unmarked’ with singular; she assumes that the Nilotic tripartite system is still relevant in Dinka despite the loss of suffixes. Andersen, however, focuses on relating plural to singular, and explicitly states that the ‘tripeartite’ basis of the system is probably best regarded as a matter of etymology rather than synchronic structure (Andersen 2014: 244). This was also the assumption of Ladd et al. (2009), who discussed the implications of Dinka number marking for Pinker’s dual-route hypothesis about inflectional morphology (Pinker 1999; Pinker and Ullmann 2002). According to the dual route hypothesis, inflectional morphology involves a clear distinction between a regular rule-governed pattern (or patterns) and irregular forms; regular patterns can be applied to new lexical items and processed ‘online’ during speaking and listening, while irregular forms must be stored individually in the mental lexicon. The point of Ladd et al.’s discussion was that Dinka noun number morphology poses a problem for the dual route hypothesis, for the simple reason that there is no regular pattern.

It is not the purpose of the present article to argue that there is after all a default regular pattern to Dinka noun number marking; in our opinion, the problem that the language poses for the dual-route hypothesis is real. Rather, our aim is to show that the system affords the same kinds of systematicity and ‘islands of reliability’ (Albright 2002) found in other complex systems of inflectional morphology – systematicity that Pinker himself discusses at some length in connection with English irregular verb morphology (1999, Chapter 4). The challenge of committing hundreds or thousands of singular-plural pairs to long-term storage in the mental lexicon – if that is indeed what is involved – might usefully be compared to acquiring the ‘principal parts’ of a Latin verb; it is far less serious than was implied by Ladd et al. (2009).

There are two keys to discerning the system’s regularities.\(^2\) The first is to subsume the alternations of vowel quality and vowel length under Andersen’s 1993

\(^2\) The work reported here is completely independent of the work by Monich and Baerman (2019) on the closely related Western Nilotic language Nuer, but some of our assumptions and conclusions mirror theirs. It is also independent of the work by van Urk and Sun (2021) on number marking in Dinka.
system of vowel grades and his fundamental distinction between lexically long and short stems. These distinctions figure prominently in the analyses of Storch (2005), and failure to appreciate their importance was the primary shortcoming of the analysis presented by Ladd et al. (2009) and of a more recent paper on noun number by Mayom (2014), which treat vowel height, vowel backness, vowel length, and vowel ‘breaking’ as four independently variable dimensions. In particular, as we shall show below, we believe it is crucial to maintain the clear lexical quantity distinction between long and short stems that is central to Andersen’s description of the verb morphology; Andersen himself effectively abandons this distinction in his papers on noun morphology, particularly his 2014 paper on number in Dinka.3

The second key follows from the first: once the alternations of both vowel length and vowel quality are analysed together in terms of Andersen’s vowel grade system, we can treat number inflection in nearly all Dinka nouns as an alternation between a form with a grade 1 vowel and a form with the corresponding grade 2 or 3 vowel. This may be regarded as the fundamental regularity of the system. Furthermore, such an analysis makes clear that the regularities of number morphology are best expressed in terms of the difference between vowel grades rather than the difference between SG and PL: because of the legacy of Nilo-Saharan tripartite number, ‘high tone in the singular’ tells us little about which tone to expect in the plural, whereas ‘high tone on the grade 1 form’ gives us a much firmer basis for predicting the tone on the grade 2 or grade 3 form. The form with the grade 1 vowel, which may be either SG or PL, can be regarded as morphologically basic. In saying this we do not ignore the evidence that Andersen (2014: 244) cites in favour of regarding the singular as basic in all nouns, and we emphasise that we are not attempting to offer an alternative account to Storch’s suggestions about the historical sources of the present-day system. We suggest only that a synchronic analysis that treats grade 1 as basic allows us to distinguish the genuinely irregular from the merely complicated.

1.2 Data sources

Our primary data source is the 400-noun dataset from Luanyjang Dinka that was used by Ladd et al. in their discussion of Pinker’s dual-route hypothesis. The dataset itself was the work of Bert Remijsen and Caguor Adong Manyang. Our analysis completely excludes 37 items from the original list: 17 morphologically

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3 Storch’s 2005 analysis also assumes a clear split between long and short stems and is in many ways compatible with what we propose here, but for reasons that are beyond the scope of this paper it is complicated to compare her analysis directly with ours.
complex forms, ten recent loanwords from English and Arabic, and ten items that involve special morphology for liquids (specifically ‘milk’ and ‘water’) and uncountable groups (of both people and domestic animals). We have also not attempted to account for four suppletive items (words for ‘man’, ‘woman’, ‘person’, and ‘cow’). Our generalisations are therefore based on 359 \( \text{SG-PL} \) pairs.

Although we focus on the Luanyjang data, we have drawn insights from detailed comparison with other Dinka dialects, and we have attempted to describe the Luanyjang system in a way that is broadly applicable to the language as a whole.\(^4\) In particular, we have made a detailed comparison of our Luanyjang forms with a dataset of almost 250 forms from the Agar dialect, gleaned from the many publications of Torben Andersen. Of the 359 Luanyjang \( \text{SG-PL} \) pairs in our dataset, we have Agar cognates for 101, or nearly 30%. There are also 33 Agar cognates for which we have only a \( \text{SG} \) form or a \( \text{PL} \) form, and more than 100 further Agar items (including 59 \( \text{SG-PL} \) pairs) for which we have no Luanyjang cognate. We have also been able to evaluate our conclusions in the light of preliminary data recently elicited from speakers of Bor dialects.

In their work on Nuer, Monich and Baerman (2019) comment on the difficulty of relying on past published work, because the transcriptions are so often incomplete or simply incorrect – especially with regard to vowel length and often also tone, but sometimes voice quality and even vowel quality as well. Similar problems are present in past work on Dinka as well. However, we feel reasonably confident in relying on our Luanyjang and Agar data, first because both sources are based on the same understanding of Dinka’s unusual three-way vowel length contrast (Andersen 1987; Remijsen and Gilley 2008), and second because, comparing cognates across the two datasets, we find that the transcriptions so often agree. It is of course possible or even likely that the sources contain a few errors; we believe that our analysis has succeeded in revealing enough regularities that it highlights forms that could usefully be rechecked with language consultants.

### 1.3 Notational and terminological conventions

Dinka orthography in its present state does not adequately represent vowel length and does not represent tone at all. For transcribing Dinka forms, we follow the

\(^4\) Dinka is traditionally divided into four major dialect groups: Rek, Agar, Bor, and Padang. Luanyjang (also known as Luac; Luanyjang means simply ‘Luac Dinka’) belongs to the Rek group. Andersen’s extensive investigations since the 1980s are all based on Agar; author MLB’s ongoing research is based on speakers of Bor varieties, in particular Bor South. Padang is the only variety about which we have little information (but see Remijsen 2014), though MLB is also currently investigating the Padang Ngok dialect.
surface phonemic IPA notation used in the original Luanyjang 400-noun dataset. Andersen’s transcriptions, though they have varied somewhat over the years, are fairly similar. The only significant difference for our purposes is that Andersen explicitly marks both breathy and modal (Andersen’s ‘creaky’) voice quality whereas the 400-noun dataset leaves modal voice quality unmarked. In other respects the two are equivalent. The three vowel lengths are indicated by using one, two or three vowel symbols; in long and overlong vowels, tone and voice quality are indicated only on the first vowel symbol, e.g., důum ‘fields.’ Vowel on-glides and semivowel syllable onsets are both transcribed with /w/ and /j/, unlike in Dinka orthography, where onsets are written with <w> and <y> and on-glides with <u> and <i>.

Given the rarity of phonemic voice quality in the world’s languages, and given that both voice quality and vowel quality alternations are involved in Dinka morphology, we have found that – in anything other than slow and careful reading – it is easy to overlook the difference between the two terms. Consequently, in what follows we invariably abbreviate voice quality as VQ, and refer wherever possible to vowel grade or root vowel rather than vowel quality in order to avoid the latter term almost completely.

Three-tone dialects of Dinka, like Agar, are normally said to have high, low, and falling tones; four-tone dialects, like Luanyjang, also include a rising tone. Andersen consistently abbreviates the three Agar tones as H, L, and F, and in line with this usage we abbreviate Luanyjang’s rise as R. No phonological significance should be attached to this notation, which we use solely for brevity and clarity. The sentence-level tonal phonology of Dinka dialects, where it may make sense to treat fall as HL and rise as LH (see, e.g., Remijsen and Ladd 2008 on Luanyjang), lies well beyond the scope of the present description.

As we have already suggested, we draw a consistent terminological distinction between vowel length and lexical quantity. Quantity refers only to an abstract property of individual stems, which can be either long or short; vowel length refers to the observable three-way phonemic distinction, which (as we shall see in Section 2.1) arises from the interaction of lexical quantity with grade-related vowel length alternations (Remijsen and Gilley 2008). Various terms have been used for the three phonemic vowel lengths, but usage appears to be settling on short (V), long (VV), and overlong (VVV). We use these terms here, but to avoid ambiguity we normally supplement references to phonemic vowel length with the shorthand notations V, VV, and VVV.

Finally, because we treat the alternation between a grade 1 form and a corresponding grade 2 or 3 form as the essence of Dinka number marking, and because in this context there appears to be no functional difference between grade 2 and
grade 3, we frequently simply distinguish between ‘grade 1’ and ‘marked grade’ when the difference between grade 2 and grade 3 is not at issue.

2 An outline of the system

2.1 Vowel grade

In view of its centrality, we begin by describing the vowel grade system. The pattern of grade alternations was first described in detail by Andersen (1993), which dealt with transitive verbs of the Agar dialect. However, the system appears to be broadly similar throughout the language, and Andersen’s achievement in understanding the workings of this aspect of Dinka morphology should be clearly acknowledged.

2.1.1 Morphological grade, lexical quantity, and phonemic vowel length

Before we consider the grade system’s effect on vowel quality, it is important to emphasise that grade alternations affect both vowel quality and vowel length. The grade 2 form commonly has the same quality as grade 1 but is longer, while the grade 3 form is both longer than grade 1 and is lowered or diphthongised as well. As already mentioned, Dinka exhibits a typologically unusual three-way contrast of phonemic vowel length involving short (V), long (VV) and overlong (VVV) vowels (Andersen 1987; Remijsen 2014; Remijsen and Gilley 2008). This three-way contrast arises because the lengthening effects of vowel grade alternations interact with the lexical quantity distinction between short stems and long stems. In lexically short stems, the grade 1 vowel is short (V), and the lengthening effect of the grade alternations means that the grade 2 and grade 3 vowels are long (VV). In lexically long stems, the grade 1 vowel is long (VV) and grade-related lengthening yields overlong (VVV) vowels in the corresponding grade 2 and grade 3 forms. In other words, the three-way phonemic vowel length distinction is based on a $2 \times 2$ system of morphophonological distinctions involving an interaction between lexical quantity and morphological grade. This is illustrated in Table 1, which shows examples of three different near-minimal sets of noun data from our dataset.\(^5\) The two cells in Table 1 with heavy borders exhibit identical vowel length but represent opposite combinations of grade and lexical quantity.

\(^5\) Because sg and pl. forms often differ in tone and sometimes in VQ, it has not been possible to find perfectly minimal sets. Two of the sets also have small segmental differences as well.
Remijsen and Gilley showed clearly that long (VV) vowels have the same duration regardless of whether they represent a long (marked) grade of a short stem or the short grade (grade 1) of a long stem. Their study left open the possibility that there might be other subtle phonetic cues to the grade difference, but established beyond doubt that the three-way length distinction is the principal manifestation of the interaction between lexical quantity and morphological grade. Nevertheless, the lexical and morphological contrasts remain clearly distinct in the system as a whole, and any given long (VV) vowel form is therefore potentially ambiguous phonologically. In order to perceive the regularities of the system, it is essential to recognise the existence a basic difference of lexical quantity between long and short stems. The significance of this point will become clearer as we go on.

Remijsen and Gilley’s work was inspired by the notion of ‘syllable stress’ (Tucker 1939), which has been said to shorten affected syllables, and Gilley’s 2003 study of Dinka, like Storch’s, ascribed the effects of vowel grade on vowel length to stress rather than directly to the grade system. Here we follow Andersen and Remijsen and Gilley.

Table 1: Interaction of lexical quantity and morphological grade manifested in phonemic vowel length.

| Morphological | short grade (grade 1) | long (marked) grade (grade 2/3) |
|---------------|-----------------------|----------------------------------|
| **Lexical**   |                       |                                  |
| short stem    | short (V) vowel       | long (VV) vowel                  |
|               | cín ‘hand PL’          | cín ‘hand sg’                    |
|               | kít ‘colour sg’        | kít ‘colour PL’                  |
|               | wàal ‘plant PL’        | wàal ‘plant sg’                  |
| long stem     | long (VV) vowel        | overlong (VVV) vowel             |
|               | cjín ‘intestine sg’    | cjín ‘intestine PL’              |
|               | kíít ‘cloth bag PL’    | kíít ‘cloth bag sg’              |
|               | uqáal ‘hole sg’        | uqáal ‘hole PL’                  |
2.1.2 Vowel grade and root vowel

The system of vowel grades is based on six root vowels, which we denote with upper case versions of the corresponding IPA symbols. The system is displayed in Table 2. Table 2 shows the realisation of the three vowel grades for each of the six root vowels for modal and breathy VQ separately, but there are few differences; the most obvious is that root vowel {U} only ever occurs breathy (Andersen 1987; Remijsen and Manyang 2009). As noted above, grade 1 is always represented by the root vowel, grade 2 by a lengthened root vowel, and grade 3 by a lowered and sometimes diphthongised lengthened vowel.

That generalisation needs to be qualified for the root vowel {A}: There is no separate root vowel series {ɛ}, but there is a close connection between the root vowel {A} and the phoneme /ɛ/, and it may make sense to regard the {A} root series as equivalent to an {ɛ} series. At the shortest vowel length there is no surface distinction between /a/ and /ɛ/; the grade 2 form of {A} involves the vowel quality /ɛ/ and grade 3 involves /a/. Following both Andersen and Remijsen and Gilley, we write the short (V) form of {A} with /a/, but Andersen stresses that the choice is arbitrary, and we note some inconsistency in the transcriptions in the 400-noun

Table 2: Dinka vowel grades.

| grade | root | modal | breathy |
|-------|------|-------|--------|
| short |      |       |        |
|       | I    | i     | i      |
|       | E    | e     | e      |
|       | A    | a     | a      |
|       | J    | jee   | jee    |
|       | O    | o     | o      |
|       | U    | -     | u      |
| long  |      |       |        |
|       | I    | ii    | ii     |
|       | E    | ee    | ee     |
|       | A    | aa    | aa     |
|       | J    | jee   | jee    |
|       | O    | ooo   | ooo    |
|       | U    | -     | uu     |
dataset, where some nouns are transcribed with short /a/ and a few with short /ɛ/.
This is a matter for further investigation.7

Table 2 diverges slightly from Andersen’s 1993 presentation of the grade system, in part because it is based on our Luanyjang data. However, for the most part it applies to Agar as well. There are three main points of difference.

First, we assume that the long \{A\} series is like all the others, and specifically that it occurs in long breathy stems. That is, we find the same relation between grade 1 /aː/, grade 2 /ɛɛ/, and grade 3 /aa/ in lexically long stems as between grade 1 /a/,, grade 2 /ɛ/,, and grade 3 /aa/ as shown in Table 2 for lexically short stems. For Agar verbal morphology, by contrast, Andersen (1993: 15–16) posits a rounding rule whereby /aː/ is rounded to /ɔː/ in grade 1, and he consequently omits a long breathy \{A\} series from his account. It is unclear whether this reflects a difference between nominal and verbal morphology or a difference between Luanyjang and Agar. Whatever the explanation, in our Luanyjang noun data the breathy \{A\} series is definitely present in both lexically short and lexically long stems.

The second divergence almost certainly reflects a genuine difference between Luanyjang and Agar, namely that grade 3 of the breathy \{U\} series has /wɔ(o)/ in Agar but /wɔɔ(o)/ in Luanyjang. This brings up the more general question of raising breathy vowels, to which we return briefly in Section 2.3.

The third divergence from Andersen’s presentation is that we show the grade alternations as a function solely of the root vowel. Many Dinka stems contain an on-glide /j/ or /w/ between the onset consonant (which may also be /j/ or /w/) and the vowel. As can be seen from Table 2, for example, on-glides occur regularly in the grade 3 form of \{l\} and \{U\} and of modal but not breathy \{O\}. But on-glides may also simply be part of the stem’s lexical form, as for example in kwééer ‘path’, bajó ‘rabbit, hare’, or cwáŋ ‘liver,’ and these are the cases we consider here.

Andersen’s papers consistently treat combinations of on-glide and vowel (here referred to as GV sequences) as separate entries in tables of grade alternations, in effect treating, e.g., cwáŋ ‘liver’ as part of a separate root vowel series based on \{wa\} as distinct from \{A\}. We find that this is unnecessary. For one thing, our Luanyjang noun data contain a few GV sequences that are absent from Andersen’s 1993 article, and we suspect that in principle any root vowel can be preceded by

7 It is possible that there is some degree of neutralisation between /a/ and /ɛ/ in grade 1 more generally, not just in short (V) vowels. We follow others in writing /aa/ for grade 1 lexically long \{A\}, but we note that there are a few items in the 400-noun dataset transcribed with an alternation between /ɛɛ/ and /aaa/. These should be impossible, but would make sense as a grade 1 ~ grade 3 alternation if lexically long grade 1 \{A\} is phonetically variable or ambiguous between /aa/ and /ɛɛ/. However, in the relevant examples in our online database we have chosen not to pursue this analysis, and leave the matter for future research.
either on-glide (/w/ or /j/), though certainly not all combinations are attested, and
some (notably /wu/ and /ji/) are probably systematically excluded. More impor-
tantly, with a few statable exceptions, the grade alternations of GV syllable nuclei
are completely predictable from the glide and the root vowel. Specifically, the
exceptions are as follows:

1. When preceded by an on-glide (either /j/ or /w/), root vowel /ɔ/ (both modal
and breathy) can only appear with the on-glide /j/ in grade 3. Concretely, modal
or breathy /j+ɔ/ and /w+ɔ/ yield /ja/, /ja̱/ (appropriate length) in grade 3,
ever /wa/, /wa̱/.

Apart from these three conditions, there is no need to posit separate root vowel
series for lexemes with a GV syllable nucleus.

2.1.3 ‘Regular’ number marking

As we have already stated, we treat number marking in Dinka as an alternation
between a grade 1 form and a marked grade form of the root vowel of the stem; the
grade 1 form can be either SG or PL. Of the 359 SG-PL pairs in our dataset, only eight are
difficult or impossible to account for in this way – four because they have different
root vowels in the SG and PL, and four because of other irregularities. The only
unpredictable feature of the vowel alternation is whether the marked grade form is
in grade 2 or grade 3. This is why it is misleading to consider vowel height,
backness, length and ‘breaking’ (e.g. /i/ ~ /je/) to be independently variable
aspects of number marking; once we assume that each SG-PL pair involves one form
with a grade 1 vowel, the root and grade system almost completely constrains the
vowel quality and vowel length in the other form.

By contrast, other phonological features that differ between SG and PL are
appropriately regarded as properties of stems rather than direct correlates of number
marking. Specifically, lexical quantity, voice quality (VQ) and tone can all be treated
as characteristic of subclasses of nouns, somewhat comparable to different
decension classes and verb conjugation classes in Latin and the Romance lan-
guages. Andersen’s analysis of Agar transitive verb morphology already treats
quantity and VQ in this way, in the sense that the details of the vowel alternations
depend on distinguishing long stems from short stems and breathy stems from non-
breathy stems. Andersen also posits two distinct tone classes in both long and short verb stems. Our analysis carries this basic approach over to the noun morphology.

Table 3 displays examples of what might be called ‘regular’ number marking in Luanyjang nouns. Our analysis carries this basic approach over to the noun morphology. Table 3 displays examples of what might be called ‘regular’ number marking in Luanyjang nouns. Our analysis carries this basic approach over to the noun morphology. Our analysis carries this basic approach over to the noun morphology.

Table 3: Examples of ‘regular’ number marking in Luanyjang nouns.

|   | Gloss                      | Singular | Plural |
|---|----------------------------|----------|--------|
| 1 | ‘neck of gourd’            | wél (1)  | wêel (2) |
| 2 | ‘collar bone’              | gwêel (2)| gwâl (1) |
| 3 | ‘rhinoceros’               | kïl (1)  | kïjëel (3) |
| 4 | ‘kind of berry’            | làan (3) | làn (1)  |
| 5 | ‘dog’                      | jà (1)   | jëjok (2) |
| 6 | ‘foot’                     | cëkok (2)| cëk (1)  |
| 7 | ‘debt’                     | kâñ (1)  | kâañ (3) |
| 8 | ‘bee’                      | kijëec (3)| kjęc (1) |
| 9 | ‘spear’                    | tçøñ (1) | tçøññ (2) |
| 10| ‘grass’                    | nòoon (2)| nòon (1) |
| 11| ‘tobacco’                  | tâap (1) | tâap (3) |
| 12| ‘firstborn’                | kàaaj (3)| kàaaj (1) |
| 13| ‘swelling’                 | bûut (1) | bûut (2)  |
| 14| ‘rib’                      | lçøom (2)| lçøom (1) |
| 15| ‘day’                      | nîjìn (1)| nîjëeen (3) |
| 16| ‘kind of fruit’            | tâaaw (3)| tâaaw (1) |
necessary only to specify its tonal class in order to know which tones appear on which of the two forms.

However, to a far greater extent than in transitive verb inflection, in nouns there are quite a few irregularities to the patterns just outlined. For the most part we treat these irregularities as a matter of variable lexical properties. In nouns both VQ and lexical quantity are subject to some variability, which sometimes results in irregular deviations from the patterns illustrated in Table 3. For example, approximately 90% of the nouns in the dataset have consistently modal or consistently breathy VQ, but 10% show modal VQ in one form (normally the grade 1 form) and breathy VQ in the other. We treat this as a lexical idiosyncrasy of the affected items rather than as an essential mark of number as such. In the same way, while many nouns are consistently lexically long or lexically short, we find others that are long in grade 1 and short in the marked grade, or vice-versa.8 Tonal irregularities are, once again, somewhat more complicated but we adopt the same strategy of identifying a regular pattern and specifying certain restricted types of deviation from that pattern. The details of this approach are presented in the following subsections of the paper (Sections 2.2–2.4).

Table 4: Examples of lexical quantity alternations.

|   | Gloss                      | Singular       | Plural        |
|---|----------------------------|----------------|---------------|
| 1 | ‘hippopotamus’             | ròw (1l)       | ròot (2s)     |
| 2 | ‘sorcerer’                 | tjìët (3s)     | tît (1l)      |
| 3 | ‘tail’                     | jàìl (1l)      | jàal (3s)     |
| 4 | ‘kind of crow’             | gàak (1l)      | gëkk (2s)     |
| 5 | ‘field’                    | dòm (1s)       | dòuum (2l)    |
| 6 | ‘town’*                    | kàl (1s)       | kàaal (3l)    |
| 7 | ‘small hoe’                | lèl (1s)       | lëeel (2l)    |
| 8 | ‘place, ground’            | pìñ (1s)       | pìlìn (2l)    |
| 9 | ‘gravel’                   | dhëoot (2l)    | dòt (1s)      |
|10 | ‘nerve’                    | ràaal (3l)     | ràl (1s)      |
|11 | ‘board’                    | agëeen (2l)    | agèn (1s)     |
|12 | ‘hair of animal’s tail*’*  | wijëeel (3l)   | wìl (1s)      |

*Agar: ‘fence’ **Agar: ‘bristle’.

8 Compare noun number morphology in Dutch, where there are two large classes of nouns, marked by the plural suffixes -s and -en. Stem vowel quantity, which can be either long or short, is unaffected by the choice of suffix, except that in a small group of short vowel nouns the stem vowel is lengthened before -en. This is a simple analogue of our proposal to treat lexical quantity in Dinka as subject to irregular variability.
2.2 Lexical quantity

Nearly two-thirds of all nouns can be unambiguously described as lexically short (with a short (V) grade 1 form and a long (VV) grade 2 or 3 form) or lexically long (with a long (VV) grade 1 form and an overlong (VVV) grade 2 or 3 form). This is the pattern illustrated in Table 3. Lexically long and lexically short nouns appear to be about equally frequent (in our dataset, 115 long nouns and 121 short).

However, the remaining one-third of the nouns in our Luanyjang dataset deviate somewhat from this regular pattern. While nearly all of them exhibit alternations in vowel quality that are consistent with the vowel grade series shown in Table 2, they nevertheless show various irregularities of vowel length. Most of these irregularities fall into one of two patterns: 77 nouns in our dataset have a long (VV) vowel in both SG and PL, while 21 have a short (V) vowel in one form and an overlong (VVV) vowel in the other. Some examples are given in Table 4. The number after each form in the Table indicates its grade, and the letter abbreviation is the lexical quantity (s = lexically short, l = lexically long).

The simplest analysis of these cases – though perhaps not the most obvious – is to treat them as exhibiting variable lexical quantity: one form is lexically short and the other is lexically long. Specifically, nouns like nos. 1–4 in Table 4, which have a long (VV) vowel in both SG and PL, can be analysed as being lexically long in grade 1 and lexically short in the marked grade, while those like nos. 5–8 and 9–12 in Table 4, with one short (V) and one overlong (VVV) vowel, will be treated as lexically short in grade 1 and lexically long in the marked grade.

Lexical quantity alternation could obviously be regarded as a figment of our analysis. In particular, it would be possible instead to describe the nouns like nos. 1–4 in Table 4 as simply being of fixed (VV) vowel length – after all, this is what we see on the surface. However, there are several reasons not to do this. First, the notion of lexical quantity alternation provides a simple way of linking nouns with surface long (VV) vowels in both SG and PL (like nos. 1–4, Table 4) to nouns that have an overlong (VVV) vowel in one form and a short (V) vowel in the other (like nos. 5–12, Table 4). These cases would otherwise appear completely unrelated (as indeed they do in Andersen’s 2014 analysis of noun number). Furthermore, if ‘fixed length’ were a regular part of the system, we might expect to find fixed-length short (V) and overlong (VVV) cases as well, but these almost never occur (in our dataset, there are four nouns with short vowels in both forms and one with overlong vowels in both). It is of course possible that there are historical explanations for why some nouns now

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9 This count excludes a number of nouns with coda /-r/ where both forms are transcribed VVV in the 400 noun dataset, because the phonetic difference between VV and VVV before coda /-r/ is neutralised or at least extremely variable (Remijsen and Gilley 2008: 327).
have long (VV) vowels in both **sg** and **pl**, but we note that such stems for which we have cognates in other Dinka dialects and/or other Nilotic languages do not appear to show any consistent pattern of suffix marking.

More importantly, comparison between Luanyjang and Agar shows that more than a third of the 101 cognate pairs in our dataset exhibit some sort of discrepancy in lexical quantity between the two dialects. Several of the Luanyjang items that we treat as having variable quantity show a regular pattern of grade-related vowel length (either lexically long or lexically short) in Agar; conversely, several items with regular grade-related vowel length alternations in Luanyjang have Agar cognates that exhibit one of the two patterns we analyse as variable lexical quantity (i.e. either VV in both **sg** and **pl**, or V in grade 1 and VVV in marked grade). There are also a few cognate pairs that differ in other ways linked to lexical quantity, such as stems that are consistently lexically long in one dialect and short in the other. This variety of examples is displayed in Table 5; as in Table 4, the number after each form indicates its grade, and the letter abbreviation shows the lexical quantity (s = lexically short, l = lexically long). We believe these data lend plausibility to the conclusion that lexical quantity is less stable or otherwise more subject to variability than other features.

Most important, though, is the fact that the vowel quality alternations in the 98 Luanyjang nouns that we treat as showing variable quantity are in all other respects like the vowel quality alternations in the 236 unambiguously long or unambiguously short nouns. Except for the anomalous surface vowel length, they exhibit the same combinations of vowel quality shown in Table 2. We therefore believe it makes sense to describe them as involving the same vowel grade alternations and to note that in some nouns lexical quantity is not constant but can vary between the grade 1 form and the marked grade form. As we have already pointed out, this analysis is linked to the most significant point of difference between our proposal and the analysis of noun number presented by Andersen (2014). While in principle he bases his treatment of the vowel quality alternations on the grade system, he dispenses with any notion of lexical quantity and analyses all differences of vowel length involved in noun number morphology in terms of surface vowel length (short, long, overlong) alone. With this change he effectively removes the principal basis for the grade analysis.

Finally, we note the existence of a smaller set (31 items, or less than 10% of the dataset) of surface vowel length anomalies that cannot be accounted for in terms of variable lexical quantity. The majority of these are cases involving alternations between what appear to be a grade 1 and a grade 3 vowel, except that the grade 1 vowel is overlong (VVV) (e.g. gr. 3 atjéep, gr. 1 attilip ‘roof, shade **sg/pl**’), or the grade 3 vowel is short (V) (e.g. gr. 1 pijool, gr. 3 pijal ‘cloud’), or occasionally both (e.g. gr.1 aguuk, gr. 3 agwiek ‘dove **sg/pl**’). As we have seen, grade 1 vowels should only ever be short or long (V or VV), and grade 3 vowels should only ever be long or overlong (VV or VVV). To account for these exceptional vowel lengths, we borrow a
| Gloss         | Luanyjang sg/pl | Agar sg/pl |
|---------------|-----------------|------------|
|               | Variable        | Regular    | Variable        |
| 1 'guinea fowl' | wéel (1l)  | wéel (2l)  | wéel (1l)  |
|               | wéel (3s)     | (VV–VV)    | wéel (2l)    |
| 2 'bird'      | díit (1l)    | díit (1s)  | díit (1s)   |
|               | díit (3s)     | (VV–VV)    | díit (3s)   |
| 3 'tail hair*'| wjééel (3l)  | wjééel (3l)| wjééel (3l) |
|               | wíl (1s)     | (V–VVV)    | wíl (1l)    |
| 4 'town'**    | kál (1s)     | kál (1s)   | kál (1s)    |
|               | káal (3l)    | (V–VVV)    | káal (3l)   |
|               | Variable      | Regular    | Variable      |
| 5 'deaf person'| miíŋ (1l)    | miíŋ (1l)  | miíŋ (1l)   |
|               | miíŋ (2l)    | (lexically long) | miíŋ (2s) |
| 6 'mud'***    | tjóop (3s)   | tjóop (3s) | tjóop (3s)  |
|               | tjóop (1s)   | (lexically short) | tjóop (1l) |
| 7 'spear'     | tóŋ (1l)     | tóŋ (1l)   | tóŋ (1l)    |
|               | tóŋ (2l)     | (lexically long) | tóŋ (2l) |
| 8 'year'      | rwóon (3s)   | rwóon (3l) | rwóon (3l)  |
|               | ríŋ (1s)     | (lexically short) | ríŋ (1s) |
| 9 'nose'      | wíum (1l)    | wíum (1l)  | wíum (1s)   |
|               | wíum (2l)    | (lexically long) | wíum (1s) |

*Agar: 'bristle' **Agar: 'fence' ***Agar: 'soil'.
notion from Andersen’s analysis of Agar verb morphology, in which he posits both grade ‘1.1’ (grade 1 vowel quality, but one degree longer than expected for the lexical quantity) and ‘3.1’ (grade 3 vowel, but one degree shorter than expected). In the Agar verb morphology, these exceptional grade categories show up in predictable places in the paradigm (e.g. grade 3.1 is expected in the 2nd person plural form). There appears to be no such systematicity behind the occurrence of these anomalous vowel lengths the noun number morphology. However, this analysis allows us to specify very precisely where the irregularity in these nouns lies: all of them show an alternation between a grade 1 and a grade 3 form, with the expected vowel quality alternations, and what is irregular is the length of one (or occasionally both) of the two forms.

### 2.3 Voice quality

Voice quality (VQ) is a property of both nominal and verbal stems in Dinka, and the grade alternations for both breathy and modal stems are largely the same. The main difference, as we saw in Table 2, is that in a few cases the breathy forms may involve a higher vowel than the corresponding modal form (e.g. /jẹẹ/, the grade 3 form of the breathy {I} series, corresponds to /jɛɛ/ in the modal {I} series). These differences play no specific role in the morphology, but are simply intrinsic to the grade alternations of stems with the two VQs.

However, some 10% of noun stems (36 lexical items in the Luanyjang dataset) show an alternation in VQ between the SG and the PL forms, comparable to the alternations in lexical quantity just discussed in Section 2.2. As with lexical quantity, strictly speaking this VQ alternation is irregular, but there are certain generalisations that are consistent with the morphophonology of VQ in other areas of the grammar. First, stems with alternating VQ almost always have modal VQ in the grade 1 form and breathy VQ in the marked grade form. In fact, in alternating stems breathy VQ is more specifically linked to grade 2: in 30 of the 36 items in our

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10 Alternations of VQ are productive in the verbal morphology of Dinka (Andersen 1992–94, 2014, 2017); specifically, breathiness can be used productively in derivational processes that yield the stems for certain verbal inflectional categories. In the noun morphology there is no analogous systematic exploitation of breathiness, but it is possible that the ‘irregular’ VQ alternations under discussion here represent vestiges of previous derivational processes.

11 The two exceptions (rèel, rèt ‘anthill’ and tjàal, tjét ‘shell used as spoon’) are irregular in another way, namely in the alternation of the coda consonant. Such coda alternations – usually involving the replacement of a sonorant coda consonant in the SG by /t/ in the PL form, usually without any accompanying VQ alternation – occur in only 15 of the nouns in the Luanyjang dataset.
dataset with a VQ alternation, the breathy form involves grade 2 rather than grade 3. A similar correlation between breathy VQ and grade 2 is also found in the verbal system (Andersen 2017: 44). We also observe sporadic raising of mid vowels in the breathy forms of these alternating stems; that is, grade alternations that would normally involve the lower mid vowels /ɛ/ and /ɔ/ (specifically, the {A} and {ɔ} series) sometimes show the corresponding higher mid vowel (/e/ or /o/) in the breathy form instead. A few examples of this vowel raising are shown in Table 6. As with the link to grade 2, raising of breathy mid vowels is found elsewhere in the morphology (Andersen 2017). In Table 6, all the singular forms are grade 1 and all the plural forms are grade 2, but in examples 2, 3, and 4 the breathy vowels are raised relative to the expected grade alternation, and examples 2, 4, and 6 also involve lexical quantity alternations.

2.4 Tone

2.4.1 The place of tone in Dinka morphology

To at least some extent, tone operates independently of vowel grade and quantity in the morphology. For example, in Andersen's analysis of the transitive verb morphology, there are two classes of lexically short verbs and two classes of lexically long verbs, each class showing somewhat different patterns of tone in their inflectional paradigms. Andersen identifies these classes by the tone on the non-finite form (F and L in the lexically short verbs and F and H in the lexically long ones), in much the same way as verb conjugation classes in the Romance languages can be identified by the vowel of the infinitive ending. This tone shows up only in certain morphological contexts; in many cases, verbs of all classes all use the same tone (for example, 1SG and 3SG forms always have L tone). Once we allow for the existence of these different tone classes, the deployment of tone in the verb morphology is largely regular.
This is the general approach we take here in analysing the use of tone in noun number marking. Ladd et al. (2009) provided only a set of very rough statistical generalisations (e.g., p. 666: ‘the most common combination of tones in number marking is L in one form and H in the other (...nearly 40% of our sample’). They also noted that tone shows some sort of connection with vowel length and vowel quality. Pursuing this line of analysis, Andersen (2014) identifies 21 common classes of noun, based on combinations of features of tone with vowel quality and length, which account for two-thirds of his sample of 326 Agar nouns. However, the remaining one-third of cases exhibit 62 additional patterns, and in any case Andersen explicitly notes that ‘the patterns in Ladd et al. (2009) are not directly comparable’ to his set of 21 patterns, because of the fact that Luanyjang has four tones and Agar only three.

In the remainder of this part of the paper, we show that it is possible to improve considerably on Andersen’s analysis. While he observes various correlations between vowel quality and tone, we show that, in the system as a whole, the classes are best defined in terms of combinations of vowel grade and tone irrespective of whether a form is sg or pl. That is, as we suggested in the introduction, the classes are not defined by attributes like ‘H tone in the sg’ but rather ‘H tone with the grade 1 form’. The resulting analysis of Luanyjang is presented in Section 2.4.2. By defining tonal classes in terms of combinations of tone and grade, we identify only nine tonal classes, of which the three most frequent cover 60% of the dataset. Furthermore, pace Andersen, we can see clearly by comparing cognate nouns in Luanyjang and Agar that there are systematic correspondences between the tonal patterns of the two dialects, and that it is therefore possible to undertake a direct cross-dialect comparison despite the difference between the Luanyjang four-tone system and the three-tone system of Agar. This comparison is presented in Section 2.4.3.

2.4.2 Tone classes in Luanyjang nouns

Just as Andersen (1993) identifies tonal classes of verb inflection based on the tone of the non-finite verb form, so we identify three broad classes of nouns according to the tone on the grade 1 form. We refer to this tone as the ‘theme tone’ on the analogy of the ‘theme vowel’ in Romance verb conjugations. To permit cross-dialect comparison (which we discuss in Section 2.4.3), we refer to these classes simply as Class 1, Class 2, and Class 3. In Luanyjang, the theme tones of the three classes are L (Class 1), H (Class 2), and R (Class 3); as we shall see, the theme tones in Agar differ in Class 2 and Class 3 but the system of classes itself is essentially the same. We do not treat Luanyjang F as the theme tone for any class, because with some exceptions H and F are in complementary distribution: in general H occurs with grade 1 forms and F with marked grade forms, whereas L and R occur equally frequently with both. We return to this point shortly.
Each tonal class can be subdivided into sub-classes according to which tone occurs on the corresponding marked grade form. Again in order to permit cross-dialect comparison, we refer to these subclasses with the letters A, B and C: in Luanyjang, subclasses with L in the marked grade form are labelled A; those with F are labelled B; and those with R are labelled C. Because of the quasi-complementary distribution of F and H, we do not use the co-occurrence of H tone with grade 2 or 3 to define any subgroup, but treat such cases as exceptions.

In Table 7, each cell shows the two singular-plural tonal patterns for a given class, in the abbreviated form $T_1+T$ or $T+T_1$. $T_1$ indicates the tone of the grade 1 form and T the tone of the marked grade form; $T_1+T$ indicates that the grade 1 form occurs in the singular and $T+T_1$ means that it occurs in the plural. The numbers in square brackets indicate the number of nouns in the Luanyjang dataset that follow a given pattern. Altogether these nine classes account for approximately 85% of the nouns in the dataset; the three most common classes (which together cover 60% of the dataset) are set off in the table by a thicker border.

### Table 7: Nine tone classes in Luanyjang nouns.

| GROUP A (grade 2/3 L) | CLASS 1A  |
|-----------------------|-----------|
| L+L [38]              | kān/kān ‘debt’ |
| L+L [7]               | tōk/tōk ‘goat’ |

| GROUP B (grade 2/3 F) | CLASS 1B  |
|-----------------------|-----------|
| L+L [35]              | awēet/awēet ‘crane’ |
| F+L [11]              | gēem/gēm ‘cheek’ |

| GROUP C (grade 2/3 R) | CLASS 1C  |
|-----------------------|-----------|
| L+R [8]               | aŋwēm/aŋwēm ‘buttock’ |
| R+L [17]              | rēc/rēc ‘fish’ |

| CLASS 2A  |
|-----------|
| H+L [63]  | bǐm/bjēem ‘virgin, unmarried girl’ |
| L+H [72]  | dwējī/dūl ‘hump of cattle’ |

| CLASS 2B  |
|-----------|
| H+F [4]   | bān/bān ‘chief’ |
| F+H [8]   | mjēel/mūl ‘husk’ |

| CLASS 2C  |
|-----------|
| H+R [11]  | awān/awēn ‘jackal’ |
| R+H [17]  | kōj/kōj ‘small stone’ |

| CLASS 3A  |
|-----------|
| R+L [20]  | pāal/pāal ‘knife’ |
| L+R [3]   | kwōot/kōot ‘k.o. gourd’ |

| CLASS 3B  |
|-----------|
| R+F [1]   | bjēt/bjiēt ‘fishing spear’ |
| F+R [7]   | aŋkōn/akōn ‘elephant’ |

| CLASS 3C  |
|-----------|
| R+R [1]   | jāŋ/jjēŋ ‘Dinka’ |
| R+R [0]   | N/A |

Each tonal class can be subdivided into sub-classes according to which tone occurs on the corresponding marked grade form. Again in order to permit cross-dialect comparison, we refer to these subclasses with the letters A, B and C: in Luanyjang, subclasses with L in the marked grade form are labelled A; those with F are labelled B; and those with R are labelled C. Because of the quasi-complementary distribution of F and H, we do not use the co-occurrence of H tone with grade 2 or 3 to define any subgroup, but treat such cases as exceptions.

In Table 7, each cell shows the two singular-plural tonal patterns for a given class, in the abbreviated form $T_1+T$ or $T+T_1$. $T_1$ indicates the tone of the grade 1 form and T the tone of the marked grade form; $T_1+T$ indicates that the grade 1 form occurs in the singular and $T+T_1$ means that it occurs in the plural. The numbers in square brackets indicate the number of nouns in the Luanyjang dataset that follow a given pattern. Altogether these nine classes account for approximately 85% of the nouns in the dataset; the three most common classes (which together cover 60% of the dataset) are set off in the table by a thicker border.
Table 7 shows the overall system of tone classes, with examples of each of the nine groups. The examples are chosen to illustrate both types of cases, i.e. nouns with the grade 1 form (and hence the theme tone) in the **sg** and those with grade 1 in the **pl**. For each of the nine groups Table 7 also shows the number of nouns in the Luanyjang dataset that belong to that group. It can be seen that Class 1 and Class 2 are both common, and Class 3 considerably less so: of the 359 nouns in the Luanyjang dataset, about a third have L tone on grade 1 (Class 1) and nearly half have H (Class 2), while only about 12% have R (Class 3). Moreover, roughly 60% of the nouns in the Luanyjang dataset fall into only three subclasses, 1A, 1B, and 2A. Classes 1A and 1B have L tone on the grade 1 form and either L (1A) or F (1B) on the marked grade form. Class 2A has H in grade 1 and L in marked grade. A further quarter of the dataset falls into four other subclasses involving the R tone: 1C, 2C, 3A, and 3B.

As we stated above, the analysis summarised in Table 7 assumes complementary distribution between H and F, such that H occurs with grade 1 forms and F with marked grade forms. However, this analysis is motivated in part by comparison with the Agar data, which we discuss in the next section; in Luanyjang itself the complementary distribution is certainly not exceptionless. Specifically, in the dataset there are 175 grade 1 forms with H and only 18 with F; among grade 2 and 3 forms, there are 67 with F and 25 with H. We treat the 43 exceptional forms (i.e. the forms with H in grade 2 or 3 and/or F in grade 1) as irregular and exclude them from the item counts shown in Table 7. This means that our analysis accounts for about 85% of the 359-noun Luanyjang dataset. However, we emphasise that these are almost the only tonal irregularities in the dataset: if there were independent explanations for their unexpected tone, the grade 1 F cases could be added to Class 2, and the grade 2 and 3 H cases to the relevant ‘B’ subgroups in the middle row. In that case the nine tonal classes would include all but four items in the dataset, one where the **pl** is formed by complete reduplication and three for which it is impossible to determine a grade 1 form. This suggests that the analysis in terms of tone classes – including the assumption that there is some degree of complementary distribution between H and F – captures the systematicity behind the superficially arbitrary tonal patterns of Dinka number marking.

Finally, we must also mention an apparent connection between R and H. In the Luanyjang dataset, R never appears on short (V) vowels. It may be that some of the items with H tone on a short grade 1 vowel should be analysed as being in complementary distribution with R rather than with F. In that case, some of the nouns that we have classified as being in Class 2A in Table 7 might better be seen as belonging to Class 3A. More extensive cross-dialect comparative data will be needed to investigate this question; this is the subject of author Blum’s ongoing research.
2.4.3 Cross-dialect comparison

The system of tone classes just described is based in part on a detailed cross-dialect comparison. Of the 359 items in the Luanyjang dataset, we have paired SG and PL forms for 101 cognate Agar nouns gleaned from Andersen’s work. Of these 101 items, 89 (just under 90%) show a direct tonal correspondence between dialects in both the SG and PL form. This suggests that the system of tone classes applies equally well to both dialects.

The basic system of correspondences is illustrated in Table 8. Items 1–3 show that Luanyjang R corresponds to Agar H. This correspondence is exceptionless in our data: every Luanyjang form with R tone for which we have an Agar cognate has H tone in Agar. (The correspondence is not necessarily reversible, in the sense that Agar H does not always correspond to Luanyjang R.) Items 4–6 show that Luanyjang L corresponds to Agar L; preliminary observation suggests that this correspondence is valid across Dinka dialects generally. This correspondence is therefore mostly reversible, though there are a few exceptions in both directions.

Items 7–14 show the rather complex relation between H and F tones. Within Luanyjang, H occurs mostly on grade 1 forms (items 7–10) and F on grade 2 and 3

| Gloss              | Grade | Luanyjang | Agar  |
|--------------------|-------|-----------|-------|
| 1 sheaf, knot SG   | 1     | ʁyuk      | ʁyuk  |
| 2 hand SG          | 2     | ciin      | ciin  |
| 3 fish SG          | 3     | ʁɛɛc      | ʁɛɛc  |
| 4 tail SG          | 1     | jɔɔl      | jɔɔl  |
| 5 small drum PL    | 2     | teeen     | teeen |
| 6 tail PL          | 3     | jaal      | jaal  |
| 7 shoe PL          | 1s    | wár       | wár   |
| 8 chief SG         | 1s    | bɛŋ       | bɛŋ   |
| 9 sorcerer SG      | 1l    | ʁɔɔt      | ʁɔɔt  |
| 10 small drum SG   | 1l    | lɛɛn      | lɛɛn  |
| 11 tooth SG        | 2     | lɛɛc      | lɛɛc  |
| 12 room PL*        | 2     | uŋoott    | uŋoott|
| 13 knee SG         | 3     | njaaal    | njaaal|
| 14 chief PL        | 3     | bɛɛŋ      | bɛɛŋ  |
| 15 eye PL          | 2     | njiiin    | njiiin|
| 16 head PL         | 2     | njiiim    | njiiim|

*Agar: ‘house’.

Table 8: Cross-dialect tone correspondences between Luanyjang and Agar.
forms (items 11–14), though as we saw in above there are quite a few exceptions. Corresponding items in Agar show that there is also an effect of lexical quantity: Agar has H tone only on lexically short grade 1 forms (items 7 and 8), but in lexically long grade 1 forms and in marked grade forms, both Luanyjang H and Luanyjang F correspond to Agar F (items 10–14). The fact that Luanyjang H can correspond to both Agar H and F depending on vowel length and grade is what drew our attention to the grade-dependent quasi-complementary distribution between H and F in Luanyjang. It is also what leads us to posit only three major tonal classes, which apply to both dialects (and which can presumably be extended to others). Positing a tonal category realised variously as H or F is also justified by the fact that, in many Dinka varieties (e.g. Agar: Andersen 1987; Luanyjang: Remijsen and Ladd 2008; Bor South: Remijsen 2013), F is indistinguishable from H in many phrase-medial contexts.

Finally, although the correspondences just listed cover roughly 90% of our cross-dialect dataset, there are a handful of exceptions and irregularities. Most of these involve forms that appear irregular in other ways as well, but two such infrequent correspondences may represent systematic sub-regularities: Luanyjang grade 2 or 3 forms with F tone occasionally correspond to Agar forms with H tone (item 15) or L tone (item 16). More cross-dialect comparison based on more data will be needed to determine whether there is anything systematic about these correspondences.

Given the correspondences illustrated in Table 8, we may say that in Agar, the theme tones for Class 1, Class 2, and Class 3 (and the defining tones of the A, B, and C subgroups) are L, F, and H, respectively, with the proviso that the Class 2 theme vowel appears as H with short grade 1 vowels. Except for the discrepancies illustrated in items 15 and 16, which affect the class membership of a few specific nouns, the correspondences between the Luanyjang four-tone system and the three-tone system of Agar are systematic and pervasive; the complexity arises primarily in the distribution of F and H with vowels in different grades. Preliminary data from four-tone Bor dialects (from author Blum’s ongoing research) and observations from Rek dialects with only three tones (Bert Remijsen, personal communication) suggest that the tone systems are all closely aligned and that forms in any given variety are largely predictable from the set of three pan-dialect tone categories for which we can identify the theme tones.

To forestall misunderstanding, we should emphasise that the tone classes we posit here are intended as a synchronic description of cross-dialect correspondences in the lexicon. We are not proposing a pan-dialect analysis of the tonal phonology (e.g. we are not proposing that H and F are allotones of a single tonal phoneme), and we are not suggesting that the groupings we propose correspond directly to historically reconstructible tone categories. For example, Remijsen
(2010) has presented evidence that three-tone dialects (like Agar) are derived historically from four-tone dialects (like Luanyjang) through the loss of the distinction between R and H. Our analysis is agnostic about such diachronic developments and is concerned only with the remarkably regular synchronic cross-dialect correspondence in the lexical distribution of tones that we observe in Luanyjang and Agar.

3 Evaluating the analysis

We have presented an analysis of the morphophonological underpinnings of number marking in Dinka nouns, which demonstrates that the system, while complex, presents a substantial set of patterns that can be generalised and regularities on which to base analogies. There are two key aspects to our approach. First, we have adopted Andersen’s analysis of Dinka morphophonology, which was originally developed for the morphology of transitive verbs, and have applied it essentially unchanged to noun number inflection. In particular, we have retained his notion of lexical quantity and the interaction between lexical quantity and vowel grade that yields the three-way vowel length distinction, whereas Andersen himself (2014), while relating the vowel quality alternations to the grade system, does not attempt to integrate his treatment of surface vowel length with any notion of lexical quantity. Second, we have shown that in virtually all nouns one member of the sg-pl pair can be treated as involving grade 1 while the other has grade 2 or 3, and that the regularities of the system are best characterised in terms of the relation between the grade 1 form and the marked grade form, rather than the relation between sg and pl. In effect, the morphophonology still requires us to treat the form with vowel grade 1 as basic in some way. The fact that we can identify substantial regularities based on the grade 1 form of the noun, irrespective of whether it is the sg or the pl form, undoubtedly represents the legacy of the Nilo-Saharan tripartite number system, in which either sg or pl can be ‘unmarked’.

To be sure, we do not suggest that noun number morphology is as regular as verb inflection. There are at least three phonological dimensions that are put to morphological use in regular ways in the verb system but are the basis of apparently idiosyncratic lexical variation in nouns. The first of these is lexical quantity. Andersen’s analysis of the Agar transitive verb morphology depends on the idea of a basic distinction between lexically short and lexically long stems, which we retain for describing noun number morphology; nevertheless, we find that in roughly a quarter of nouns the singular and the plural forms may differ in lexical quantity (Section 2.2). The second is voice quality (VQ). In Andersen’s system as in ours, stems are intrinsically either modal or breathy, but roughly 10% of the stems
in our dataset are variable, being modal in their grade 1 form and breathy in grade 2 or 3 (Section 2.3); as noted in footnote 10, it is not clear whether these items reflect the historical residue of some derivational process. The third difference between verbal and nominal morphology involves the difference between vowel grades 2 and 3: in the verb morphology certain forms are consistently grade 2 and certain others are consistently grade 3, whereas in the noun morphology we have been unable to identify any obvious factors that determine whether the marked grade form of the noun has a grade 2 or a grade 3 vowel (Section 2.1.3). This choice too is lexically idiosyncratic.

Nevertheless, it is important to emphasise that variant forms — whether alternatives within a single dialect or differences between dialects — almost always fit within the confines of the vowel grade system and the requirement for one of the two forms to have a grade 1 vowel. Our focus in this short final section is to show how such variant or alternative forms ‘make sense’ given the analysis. If the formation of plurals were as unconstrained as Ladd et al. 2009 imply, we should not have any basis for distinguishing between more and less plausible alternatives. But just as shrank and shrunk are both possible past tense forms of English shrink (whereas shrought would be surprising and shronk seems impossible), so the alternative plurals attested in our dataset are generally consistent with the constraints implicit in our analysis. In effect, the analysis allows us to identify Dinka analogues of shrank and shrunk and analogues of shrought and shronk. This suggests that even Dinka noun number morphology is based on a fundamental systematicity.

### 3.1 Alternative plural (and singular) forms

We begin by briefly considering a few of the 10 nouns with alternative plural forms in Luanyjang. A simple example is provided by màal ‘meat on hide’. The two alternative plural forms recorded in the dataset are màaal and mɛɛl. If the SG form is treated as grade 1 lexically long modal root {A}, the two PL forms simply involve the difference between grade 2 and grade 3. The tone alternation (though grade 1 F tone is irregular given the analysis presented in Section 2.4.2) is unaffected.

The case of léeŋ ‘small drum’ is similar. The SG form is grade 1 lexically long modal root {E}. The two PL forms are again grade 2 léeŋ and grade 3 lɛɛŋ, the difference being that with the grade 3 form there is also a lexical quantity alternation, with the PL form being lexically short (Section 2.2). The tone alternation (Class 2A) is again unaffected.

A rather more interesting case, which involves a tonal alternation as well as vowel grade differences, is provided by ñèep ‘corner of mouth’. Here the two
alternative plurals are ŋép and ŋēep. In both cases the root vowel is {E}. In the first case, the SG form is treated as grade 2 lexically short and the PL is the grade 1 short form ŋép; a grade 1 form in the PL is fairly common for words denoting paired or multiple body parts. In the second case it is the SG form that is interpreted as grade 1 (lexically long), while the PL involves the corresponding grade 3 form ŋēep (which, however, must be treated as lexically short, i.e. involving a lexical quantity alternation as in the immediately previous example). What is especially interesting here is that the reanalysis also apparently motivates a tonal change. In the first case, with the L tone SG form interpreted as grade 2, the H tone on the grade 1 form ŋép places the noun tone in Class 2A. In the second case, with the SG form ŋēep interpreted as grade 1 and the PL as grade 3, the noun belongs to Class 1, and the most likely PL form would therefore bear either L (Class 1A) or F (Class 1B); H would be irregular.

A similar case is provided by the alternative Agar PL forms for ‘hoof’ (Andersen 2014: 248). The SG form is mwɔɔt; the two PL forms are mwɔɔt and mjåat. The fact that in both cases both forms have a long (VV) vowel means we are dealing with a lexical quantity alternation between a lexically long grade 1 form and a lexically short marked grade form (Section 2.2). In the first case, the PL is treated as grade 1 (as would be likely for multiple body parts), while the SG is grade 2; the tone class (L+F1) is 2A. In the second case, the SG form is interpreted as grade 1, and the PL is grade 3. The tonal difference between F and L in the PL is not required for regularity, as it was in the preceding Luanyjang example, but in both dialects there is a strong tendency for grade 3 PL forms to have L tone (i.e. in this case Class 1A).

So far we have considered alternative forms within a single dialect, but cross-dialect differences also exhibit the same systematicity – that is, the variant forms are almost always consistent with the possibilities afforded by the range of dimensions we have discussed in this paper. For example, tin, ‘breast,’ has the same grade 1 form in the PL for both dialects, but varies in the SG: tjåen (grade 3) in Luanyjang and tjin (grade 2) in Agar. (Once again, we see a word for paired or multiple body parts having the grade 1 form in the PL.) In the first case, the difference between the two SG forms involves only a choice between grade 2 and grade 3. There is no difference in lexical quantity (short), tone (Class 1B), or VQ (alternating), and no reanalysis. However, it is worth noting that the Luanyjang VQ is somewhat unexpected; as we saw in Section 2.3, in stems with alternating VQ the breathy form is generally in grade 2.

In other cases, the two dialects share a marked grade form, but the grade 1 form differs. An example is provided by the word for ‘elephant’: in both Luanyjang and Agar, the SG form is akɔɔn. In Luanyjang, the PL (grade 1) is akɔɔn, while in Agar it is akɔɔn. In both dialects the stem is lexically long and lexically breathy. The tonal difference between the two PL forms reflects the invariable correspondence of
Luanyjang R and Agar H; both dialects treat this word as Class 3B. The systematic
difference between the two pl forms is a difference in the root vowel, and arises
from the fact that the /ɔɔ/ of the sg form is present in two different vowel grade
series. The Luanyjang pl form treats the sg as the grade 2 form of the breathy {ɔ}-
series (hence grade 1 ałɔɔn), whereas the Agar sg form can be analysed as grade 3
of the breathy {ɔ}-series (hence grade 1 akɔon). This type of reanalysis is com-
parable to the case of ‘corner of mouth’ in Luanyjang or ‘hoof’ in Agar: given the sg
form, both pl forms fit naturally and lawfully within the system.

3.2 Genuine irregularity

The point of the preceding section is that variability in number marking is actually
quite constrained. We have shown that variation between one vowel and another
in alternative sg or pl forms is normally based on a two-way choice between the
corresponding grade 2 and 3 forms of a given root vowel series, on alternative
morphophonological interpretations of the root vowel in a given sg-pl pair, or on a
combination of both. We have also shown that at least some tonal differences
between alternative sg or pl forms can be explained in terms of the system of tone
classes we presented in Section 2.4. This means that we are in a position to identify
certain alternations in specific nouns as genuinely irregular – and to show that
these are actually fairly rare.

There are, first of all, a few suppletive items comparable to English go/went,
such as tiǐk, dijaar ‘woman sg/pl’ and ràaan, kɔɔc ‘person sg/pl’. As we noted in
the introduction, there are four of these in the Luanyjang dataset, and we have
largely excluded them from consideration here. Of the 359 nouns we do analyse,
number marking in about 20 of them involves segmental idiosyncrasies that might
be treated as irregular. We have already mentioned that four nouns in the dataset
have different root vowels in the sg and pl. There is one noun that forms its pl using
total reduplication (tjìeek, tjìecktjìeek ‘marriage sg/pl’). About 15 others exhibit
various alternations in the coda consonant; as noted in footnote 11, many of these
involve replacement of a coda sonorant by /t/, but there are a few other alterna-
tions. There are also three nouns that have a coda consonant only in the pl (e.g. jɔ, jɔɔk ‘dog sg/pl’).

Similar things can be said about tone. As we saw in Section 2.4, roughly 85% of
the Luanyjang dataset can be assigned to one of nine tone classes, and virtually all
of the exceptions involve variation between H and F tone, which further cross-
dialect research may help to explain. There are also a few items where we do not
see the expected tonal correspondence between Luanyjang and Agar (for example,
Luanyjang nɔm, niiim ‘head sg/pl,’ Class 1B; Agar nɔm, niiim, Class 1A), and it is
possible that these should be considered irregular in some way. In most respects, however, the tone classes are as regular and consistent as the root vowel series.

The extent of irregularity involving VQ is similar. As we saw, while VQ is normally a fixed property of a given noun stem, roughly 10% of our dataset show variable VQ, usually modal in grade 1 and breathy in marked grade (usually grade 2). A further irregularity involves both VQ and vowel grade: as discussed in Section 2.3, mid vowels are often, but not always, raised in the breathy forms of nouns with alternating VQ. For the 90% of nouns that show non-alternating VQ, however, the vowel alternations follow completely regularly from the root vowel series shown in Table 2.

The only conspicuous deviation from the general picture just sketched involves variation in vowel length and lexical quantity, where irregularity is far more common. Our analysis, which preserves Andersen’s original idea of a sharp distinction between long and short lexical quantity, permits us to treat vowel length variation as ‘regular’ in about three-fifths of the nouns in our Luanyjang dataset. But this still means, as we saw in Section 2.2, that vowel length in the other two-fifths is unpredictable or irregular in some way. The situation is similar in cross-dialect comparison: in the 46 cases in our datasets where Luanyjang and Agar differ in SG, PL, or both, by far the most frequent pattern of dialect difference involves inconsistent lexical quantity or otherwise unpredictable variation in vowel length and no other differences. This is true for 23 – exactly half – of the 46 cases. Of the remaining 23, twelve involve variation in vowel length in addition to some other difference or differences. Only eleven involve other differences without any vowel length difference. It therefore seems clear that lexical quantity, and its interaction with vowel alternations in the morphological grade system, is somehow less regular or less stable than the other dimensions of alternation. Whether this is due to the demonstrated subtlety of the phonetic cues to the length distinctions (Remijsen and Gilley 2008) or to some other reason, the difference itself is very clear.

Overall, however, we believe the analysis presented here provides a basis for demystifying Dinka noun number inflection. Alternations in vowel grade, voice quality, and tone can all be reduced to a manageable number of classes or categories, and non-conforming forms are relatively few. Even in the many nouns with a lexical quantity alternation, the possibilities are limited to two patterns, and only the few stems that exhibit ‘1.1’ and ‘3.1’ forms are really anomalous. The system is complex but substantially constrained.
Abbreviations

F  Fall tone
H  High tone
GV  onglide-vowel sequence
L  Low tone
PL  plural
SG  singular
R  Rise tone
VQ  voice quality
V  short vowel
VV  long vowel
VVV  overlong vowel

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