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VOWEL HARMONY AND VOWEL ALTERNATION IN MAYAK (WESTERN NILOTIC)*

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Like several other Western Nilotic languages, the Mayak variety of Northern Burun has two sets of vowels distinguished by the feature [ATR], the [-ATR] vowels [ɪ, ɛ, a, ɔ, ʊ] and the [+ATR] vowels [i, e, ʌ, o, u]. However, the mid [+ATR] vowels [e] and [o] are variants of the mid [-ATR] vowels /ɛ/ and /ɔ/ conditioned by a following high [+ATR] vowel. This allophony is the effect of one of four general vowel harmony processes. In addition, [-ATR] root vowels exhibit grammatically conditioned alternation which affects either [ATR] or height. The mixed character of this alternation invites the hypothesis that original mid [+ATR] vowels have merged with the high [-ATR] vowels, and this hypothesis is confirmed by a comparison of Mayak with other Western Nilotic languages.

1. Introduction

Mayak is a little documented Western Nilotic language spoken in the southern part of Blue Nile Province of Sudan. It belongs to the group of languages which Evans-Pritchard [1932] called Northern Burun. Together with the Southern Burun languages, they constitute one of the three branches of Western Nilotic in Köhler's [1955] internal subgrouping of the Nilotic languages, the two other branches being the Nuer-Dinka languages and the Luo languages.

Like many other Western Nilotic languages, Mayak has a lot of vowel quality alternation. To a large extent, this alternation is similar to what is found in the Luo

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languages, where the alternation operates in terms of the feature [Advanced Tongue Root], abbreviated [ATR]. In Mayak, however, the vowel alternation sometimes involves a change in height rather than in [ATR], and in some cases these two changes combine so that a root vowel has four different alternants. In this article I shall outline the main aspects of the vowel alternation system in Mayak, and I shall argue that it consists of two historical layers of [ATR] alternation. Firstly, there is phonologically conditioned [ATR] alternation, namely [ATR] harmony, and secondly, there is grammatically conditioned alternation, which was originally a pure [ATR] alternation, but whose [ATR] character was partly distorted by a sound change that eliminated some vowels through vowel merger.

Accordingly, the article is organised as follows. Section 2 presents the vowel inventory and outlines the distribution of the vowels. Section 3 demonstrates the existence of phonologically conditioned vowel alternation, which can be accounted for by means of four rules, three of which impose vowel harmony in terms of the feature [ATR]. Section 4 demonstrates the existence of grammatically conditioned vowel alternation, which involves either [ATR] or height. Section 5 hypothesises a sound change that explains the mixed character of the grammatically conditioned vowel alternation system. Sections 6 and 7 provide comparative evidence for this hypothesis, first from Mabaan, which belongs to the Southern Burun subbranch of Burun, and then from languages of the two other branches of Western Nilotic as well. Finally, section 8 looks at the sound change in a typological perspective.

Mayak is a tone language, but since I have not yet finished working out its tonal system, my transcription does not include tone.

2. Vowels and their distribution

2.1. Word structure and syllable structure. Basically, a Mayak word consists of a stem and zero or more inflectional suffixes. The stem consists of a root and zero or more derivational suffixes. All verbal roots and many noun roots are monosyllabic and mostly have the shape CVC or CVVC, and other noun roots also begin with CVC or CVVC.[1] Syllables in Mayak normally have the structure CV(V)(C).[2]

2.2. Vowel inventory. Mayak has ten different vowel qualities. And, as in the Luo languages, they fall into two sets distinguished by the feature [ATR], as indicated in Table 1. Phonetically, [ʌ] is less open and more back than [a], but as will become clear in section 3.4, it is structurally the [+ATR] counterpart of [a], so it must be classified as a low central vowel. All ten vowels can be short or long, and length is

[1] In addition, verbs may contain one or more proclitics, and nouns borrowed from Arabic may begin with /al/ or /a/, which reflect the definite article in that language. However, such words are not relevant to the subject matter of the present article and will be ignored here.

[2] In addition, there are V(C) syllables, but they can only occur word-initially, in verbs as proclitics, see footnote 1.

Table 1. Vowel qualities in Mayak.

	[-ATR]	[+ATR]
high	ɪ ʊ	i u
mid	ɛ ɔ	e o
low	a	ʌ

contrastive. Unlike at least some Luo languages, Mayak has no diphthongs, no consonant clusters consisting of a consonant and a glide, and no syllables ending in a glide.

2.3. Distribution of vowels. Eight of the ten vowel qualities, whether short or long, occur in monosyllabic words, as exemplified by the nouns in (1) below.[3] The mid-vowel qualities of the [+ATR] set, [e] and [o], have a restricted distribution.

(1)	/i/	*ʔic*	'ear'	/ii/	*pii*	'water' (pl.)
		win	'ropes'		*riiʈ*	'smoke'
	/ɪ/	*ʔɪc*	'penis'	/ɪɪ/	*wɪɪl*	'tail'
		ŋɪn	'eyes'		*dɪɪʈ*	'goats'
	/ɛ/	*lɛp*	'tongue'	/ɛɛ/	*lɛɛc*	'elephant'
		lɛk	'teeth'		*mɛɛk*	'spider'
	/ʌ/	*ŋʌc*	'back'	/ʌʌ/	*pʌʌm*	'mountain'
		ʔʌʈ	'house'		*mʌʌn*	'females'
	/a/	*kac*	'leopard'	/aa/	*jaat̪*	'tree'
		pal	'navel'		*maac*	'fire'
	/ɔ/	*ʈɔŋ*	'spear'	/ɔɔ/	*ʔɔɔk*	'male'
		pɔk	'mouth'		*d̪ɔɔl*	'anus'
	/ʊ/	*pʊr*	'road'	/ʊʊ/	*gʊʊk*	'dog'
		kʊm	'eggs'		*bʊʊc*	'ant-hill'
	/u/	*ʈuŋ*	'horn'	/uu/	*luum*	'grass' (pl.)
		ʔum	'nose'		*t̪uut̪*	'soil'

[3] In this article my transcription of Mayak and other Western Nilotic languages conforms to IPA, so that [j] is a palatal glide and [ɟ] a voiced palatal stop. However, in order to maximise the graphical difference between the interdental stops [t̪, d̪] and the alveolar stops, I use the (retroflex) symbols [ʈ, ɖ] for the latter.

Unlike all other vowel qualities, they virtually do not occur in monosyllabic words, the only exception encountered being the word *d̪ooc* ‘five’. Apart from this exception, [e] and [o] occur only in syllables that are followed by a syllable containing either [i] or [u], i.e., a high [+ATR] vowel.[4] Their occurrence in such words is exemplified by the nouns and the pronoun in (2).

(2)	[e]	*leɣ-it̪*	‘tooth’
		ʔeð-it̪	‘faeces’ (sing.)
	[ee]	*beekum*	‘monkey’
		weejic	‘you’ (pl.)
	[o]	*kol-it̪*	‘sky’
		ʔokur	‘chickens’
	[oo]	*mooð-ic*	‘your brother’
		roon-ic	‘your maternal uncle’

Since the presence of [e] and [o] is conditioned by the presence of [i] or [u], they cannot have independent phonemic status, but must be allophones of some other vowels. This allophony can be seen as an effect of vowel harmony imposed by the high [+ATR] vowels, so we would expect [e] and [o] to be allophones of the corresponding [-ATR] vowels /ɛ/ and /ɔ/. In fact, this analysis is perfectly possible, since [ɛ] and [ɔ] do not occur before [i] and [u], as indicated in Table 2, which shows the co-occurrence of vowels in disyllabic words. Table 2 also reveals that the high [-ATR] vowels [ɪ, ʊ] do not co-occur with the high [+ATR] vowels [i, u]. The fact that [ɪ] and [ʊ] are excluded *before* [i] and [u] can be seen as an effect of the same rule as the one that changes /ɛ, ɔ/ to [e, o] before /i, u/. Thus, both phenomena are captured by a rule of vowel harmony whereby a non-low [-ATR] vowel becomes [+ATR] before a high [+ATR] vowel. On the other hand, the absence of [ɪ] and [ʊ] *after* [i] and [u] is not paralleled by [ɛ] and [ɔ], which do occur in that position. In section 3 it will be demonstrated that the gaps in Table 2 are, in fact, not accidental but are due to co-occurrence restrictions, and that they reflect two types of [ATR] harmony.[5] But Table 2 also shows that the [ATR] harmony is not complete, as some [-ATR] vowels may co-occur with some [+ATR] vowels: (i) [-ATR] vowels may co-occur with [ʌ] in either order; (ii) [a] may co-occur with [i, u] in either order, and, as already mentioned, (iii) [ɛ, ɔ] may occur

[4] In the data available to me, all instances of [e] and [o] occur in the *first* syllable, which is *immediately* followed by a syllable with [i] or [u]. It is not clear whether there are other possibilities.

[5] Moreover, the [-ATR] vowel [ʊ] seems not to occur after the low [+ATR] vowel [ʌ], and [ʊ] has not been attested after the [-ATR] vowels [ɛ, ɔ] either. It is not clear whether these gaps are systematic or accidental.

Table 2. Co-occurrence of vowels in disyllabic words.

			second syllable									
			[-ATR]					[+ATR]				
			ɪ	ɛ	a	ɔ	ʊ	i	e	ʌ	o	u
first syllable	[-ATR]	ɪ	+	+	+	+	+	-	-	+	-	-
		ɛ	+	+	+	+	?	-	-	+	-	-
		a	+	+	+	+	+	+	-	+	-	+
		ɔ	+	+	+	+	?	-	-	+	-	-
		ʊ	+	+	+	+	+	-	-	+	-	-
	[+ATR]	i	-	+	+	+	-	+	-	+	-	+
		e	-	-	-	-	-	+	-	-	-	+
		ʌ	+	+	+	+	-?	+	-	+	-	+
		o	-	-	-	-	-	+	-	-	-	+
		u	-	+	+	+	-	+	-	+	-	+

after [i, u].[6]

All of the attested vowel combinations are documented somewhere else in this article and will therefore not be illustrated separately here.

3. Vowel harmony

3.1. Regressive [ATR] assimilation. The absence of [ɪ, ʊ, ɛ, ɔ] before [i] and [u] is no coincidence, but is due to a general constraint, as evidenced by the morphology. Consider, for instance, the tense inflection of non-derived transitive verbs in clauses with the constituent order SVO, as in (3), a clause type that I call subject-oriented (S-oriented).[7] In subject-oriented clauses, a non-derived transitive verb

(3) a. *buuŋu ʔam kʊt̪ɛr* 'The hyena is eating a pig'
hyena eat pig

b. *buuŋu ʔam-u kʊt̪ɛr* 'The hyena ate a pig'
hyena eat-PST pig

[6] In this way the vowel harmony of Mayak differs from those of, for example, the Luo language Päri [cf. Andersen 1989] and the Central Sudanic language Madi [cf. Andersen 1986b]. In the latter languages the [ATR] harmony is total, except that /a/ may co-occur with [+ATR] vowels.

[7] The following abbreviations are used in interlinear translations: 1PEX = first person plural exclusive, 1S = first person singular, 2S = second person singular, 3S = third person singular, AP = anti-passive, PST = past tense, SUF = suffix.

Table 3. Present and past tense forms of non-derived subject-oriented transitive verbs with a short root vowel.

	Underlying root vowel	Present tense	Past tense	
[-ATR]	/ɪ/	*ʔɪt̪*	*ʔið-u*	'shape with an axe'
	/ɛ/	*lɛp*	*lew-u*	'open'
	/ɔ/	*kɔc*	*koj-u*	'take'
	/ʊ/	*gʊt̪*	*guð-u*	'untie'
	/a/	*ʔam*	*ʔam-u*	'eat'
[+ATR]	/i/	*t̪iŋ*	*t̪iŋ-u*	'hear'
	/ʌ/	*nʌk*	*nʌɣ-u*	'beat'
	/u/	*t̪uc*	*t̪uj-u*	'send'

Table 4. Present and past tense forms of non-derived subject-oriented transitive verbs with a long root vowel.

	Underlying root vowel	Present tense	Past tense	
[-ATR]	/ɪɪ/	*d̪ɪɪm*	*d̪iim-u*	'weed'
	/ɛɛ/	*t̪ɛɛk*	*t̪eeɣ-u*	'spear'
	/ɔɔ/	*bɔɔr*	*boor-u*	'skin'
	/ʊʊ/	*ɟʊʊc*	*ɟuuj-u*	'find'
	/aa/	*maat̪*	*maað-u*	'drink'
[+ATR]	/ii/	*wiin*	*wiin-u*	'cook'
	/ʌʌ/	*gʌʌp*	*gʌʌw-u*	'catch in the air'
	/uu/	*puur*	*puur-u*	'hoe'

stem can have a form which is identical to the bare root, as in (3a). This form, which is inflectionally unmarked, expresses the present tense, while the past tense is expressed by a suffix *-u*, as in (3b).[8] Tables 3-4 show the present and past tense forms of a verb for each of the eight possible short and long root vowels.[9] As can be observed in these tables, [-ATR] root vowels become [+ATR] before the suffix *-u*, except for the root vowel quality /a/, which retains its [-ATR] value. Notice

[8] The labels "present tense" and "past tense" are provisional, as the "tenses" should perhaps be analysed as aspects.

[9] For a description and analysis of the root-final consonant alternation that can be observed in these and some other examples, see Andersen [1999].

also that [ATR] is the only feature of the vowels that changes, the vowels retaining their height. Thus, the [+ATR] suffix vowel /u/ harmonises non-low [-ATR] vowels, [ɪ, ɛ, ɔ, ʊ], of the root into the corresponding [+ATR] vowels, [i, e, o, u]. This harmonisation has two consequences. Firstly, it neutralises the underlying contrast between [-ATR] and [+ATR] in high root vowels. Secondly, it gives rise to the vowel qualities [e] and [o], which must therefore be analysed as allophones of /ɛ/ and /ɔ/, respectively, as also suggested in section 3.2 above. The harmonisation is purely phonologically conditioned, as it takes place before any suffix that contains an underlying /u/, for instance, also the second person singular possessive suffix *-u* of nouns, as illustrated in section 3.3 below.

Suffixes with /i/, the other high [+ATR] vowel, have exactly the same effect. Consider, for instance, the subject inflection of non-derived transitive verbs in clauses in which the logical object is preverbal, as in (4), a clause type which I call object-oriented (O-oriented). As illustrated by the past tense verb forms, the first and second person singular suffixes are *-ʌr* and *-ir*, respectively, both of them with a [+ATR] vowel, while the third person singular suffix is *-ɛr*, with a [-ATR] vowel. Tables 5-6 show these three forms of a non-derived verb for each of the eight possible short and long root vowels. As can be observed in these tables, the [-ATR]

(4) a. *ʔaak maad̪-ʌr* 'I drank the milk'
milk drink:PST-1S

b. *ʔaak maad̪-ir* 'You drank the milk'
milk drink:PST-2S

c. *ʔaak maad̪-ɛr* 'He drank the milk'
milk drink:PST-3S

Table 5. Past tense verb forms with subject suffixes and a short root vowel.

	Underlying root vowel	1S	2S	3S	
	/ɪ/	*ʔɪd̪-ʌr*	*ʔid̪-ir*	*ʔɪd̪-ɛr*	'shape with axe'
	/ɛ/	*gɛb-ʌr*	*geb-ir*	*gɛb-ɛr*	'beat'
[-ATR]	/ɔ/	*nɔn-ɖ-ʌr*	*non-ɖ-ir*	*nɔn-ɖ-ɛr*	'fold'
	/ʊ/	*gʊd̪-ʌr*	*gud̪-ir*	*gʊd̪-ɛr*	'untie'
	/a/	*ʔam-b-ʌr*	*ʔam-b-ir*	*ʔam-b-ɛr*	'eat'
	/i/	*ʔib-ʌr*	*ʔib-ir*	*ʔib-ɛr*	'shoot'
[+ATR]	/ʌ/	*pʌd̪-ʌr*	*pʌd̪-ir*	*pʌd̪-ɛr*	'untie'
	/u/	*t̪uɟ-ʌr*	*t̪uɟ-ir*	*t̪uɟ-ɛr*	'send'

Table 6. Past tense verb forms with subject suffixes and a long root vowel.

	Underlying root vowel	1S	2S	3S	
	/ɪɪ/	*d̪ɪɪm-b-ʌr*	*d̪iim-b-ir*	*d̪ɪɪm-b-ɛr*	'weed'
	/ɛɛ/	*ʈɛɛg-ʌr*	*ʈeeg-ir*	*ʈɛɛg-ɛr*	'spear'
[-ATR]	/ɔɔ/	*pɔɔg-ʌr*	*poog-ir*	*pɔɔg-ɛr*	'wash'
	/ʊʊ/	*ɟʊʊɟ-ʌr*	*ɟuuɟ-ir*	*ɟʊʊɟ-ɛr*	'find'
	/aa/	*caab-ʌr*	*caab-ir*	*caab-ɛr*	'cook'
	/ii/	*wiin-ɖ-ʌr*	*wiin-ɖ-ir*	*wiin-ɖ-ɛr*	'cook'
[+ATR]	/ʌʌ/	*ʔʌʌb-ʌr*	*ʔʌʌb-ir*	*ʔʌʌb-ɛr*	'catch in the air'
	/uu/	*puur-d̪-ʌr*	*puur-d̪-ir*	*puur-d̪-ɛr*	'hoe'

suffix *-ɛr* leaves the root vowel unaffected, and so does the [+ATR] suffix *-ʌr*. In forms with the [+ATR] suffix *-ir*, by contrast, root vowels change in the same way as they do before the past tense suffix *-u*.

Again, the harmonisation triggered by the verbal suffix *-ir* is purely phonologically conditioned, as it takes place before any suffix with an underlying /i/. Thus, the same effects can be observed in singular nouns with the singulative suffix *-it*, when compared with the corresponding plural forms, which have no suffix, as in (5).[10] The plural forms reveal that the root vowel is underlyingly [-ATR] in (5a-c), and [+ATR] in (5d-e). In (5a-c) the singulative suffix harmonises non-low root vowels.

(5)		Singular	Plural	
	a.	*t̪in-it̪*	*t̪ɪn*	'breast'
	b.	*ʔeð-it̪*	*ʔɛt̪*	'faeces'
	c.	*kol-it̪*	*kɔl*	'sky (sg); clouds (pl)'
	d.	*riŋ-it̪*	*riŋ*	'meat'
	e.	*wʌr-it̪*	*wʌr*	'cow dung'

In summary, Mayak has a general rule of *Regressive [ATR] Assimilation* to the effect that a high [+ATR] vowel spreads its [ATR] value to a non-low [-ATR] vowel of the preceding syllable. In this type of vowel harmony, [+ATR] is dominant and [-ATR] is recessive. But the low vowels are neutral. Thus, [+ATR] /ʌ/ does not trigger harmony, and [-ATR] /a/ is not harmonised.

[10] An outline of the major number inflection patterns in Mayak is given in Andersen [in press b].

3.2. Regressive rounding assimilation. In the previous section, we saw that the [+ATR] vowel qualities [e] and [o] are manifestations of the underlying [-ATR] vowel qualities /ɛ/ and /ɔ/, respectively. However, a short [o] is not always a manifestation of /ɔ/. It may also be a manifestation of [+ATR] /ʌ/ if followed by [u], as illustrated by the verb forms in (6)-(7). The intransitive verbs constituting the clauses have anti-passive stems (cf. section 4 below). In the past tense forms (6b) and (7b), which have a past tense suffix *-uð* immediately after the stem, the stem vowel exhibits free variation between [ʌ] and [o].[11] However, in the corresponding present tense forms (6a) and (7a), which have the suffix *-ɪr*, the stem vowel can only be [ʌ], so [ʌ] is the basic variant, while [o] is conditioned by the following [u].

(6) a. *ʔʌm-ɪr* 'He is eating'
eat:AP-SUF

b. *ʔʌm-uð-i* ~ *ʔom-uð-i* 'He ate'
eat:AP-PST-SUF

(7) a. *t̪ʌk-ɪr* 'He is washing'
wash:AP-SUF

b. *t̪ʌk-uð-i* ~ *t̪ok-uð-i* 'He washed'
wash:AP-PST-SUF

The same variation between [ʌ] and [o] can be seen in nouns, as in the first syllable of disyllabic plural nouns with [u] in the second syllable, whether the [u] belongs to an inflectional suffix, as in (8a-b), or is part of the stem, as in (8c) (cf. section 4 below).

(8)	Singular	Plural			
a.	*naac*	*nʌj-uk*	~	*noj-uk*	'calf'
b.	*gaal*	*gʌl-uk*	~	*gol-uk*	'arm, hand'
c.	*nanaan*	*nʌnun*	~	*nonun*	'snake'

In conclusion, Mayak has a general phonological rule of *Regressive Rounding Assimilation*, whereby the rounding of [+ATR] [u] is optionally spread to a short /ʌ/ of the preceding syllable, so that /ʌ/ is realised as [o]. This is one of the reasons why /ʌ/ must be classified as [+ATR] in the first place.

[11] The past tense suffix exhibits grammatically conditioned alternation. Thus, for instance, it is *-u* in a subject-oriented transitive clause, but *-uð* before the suffix *-i* in an anti-passive clause. See also Andersen [1999].

3.3. Progressive [ATR] assimilation. In section 3.1 we saw that Mayak has a rule of Regressive [ATR] Assimilation. But vowel harmony with the opposite direction also occurs. This can be observed, for instance, in the possessive inflection of nouns. This type of inflection, which especially applies to body part nouns, is illustrated in Table 7, which shows four forms of a noun for each of the eight short root vowels: the non-possessed form, which has no suffix, and which is identical to the bare root, and forms with a vowel suffix that expresses, respectively, a first, second, and third person singular possessor. The possessive suffix is followed by the consonantal suffix *-k* if the possessed stem is plural, as in the possessive forms of the words for 'eyes' and 'teeth' in the table.

A first person singular possessor is expressed by a high front vowel, which is either [-ATR] or [+ATR]. The [+ATR] variant [i] occurs if the root vowel is [+ATR] and high, as in the possessive forms of the words for 'ear' and 'knee'; otherwise, the [-ATR] variant [ɪ] occurs. This distribution shows that the suffix vowel is underlyingly [-ATR]. So here we have a suffix vowel that does not harmonise the root vowel, but which is itself harmonised by that vowel.

Table 7. Non-possessed and singular possessive forms of nouns.

	Underlying root vowel	Non-possessed	1S	2S	3S	
	/ɪ/	*ŋɪn*	*ŋɪŋ-ɪ-k*	*ŋiŋ-u-k*	*ŋɪŋ-ɛ-k*	'eyes'
	/ɛ/	*lɛk*	*lɛk-ɪ-k*	*lek-u-k*	*lɛk-ɛ-k*	'teeth'
[-ATR]	/a/	*pal*	*pal-ɪ*	*pal-u*	*pal-ɛ*	'navel'
	/ɔ/	*wɔŋ*	*wɔŋ-ɪ*	*woŋ-u*	*wɔŋ-ɛ*	'eye'
	/ʊ/	*t̪ʊk*	*t̪ʊɣ-ɪ*	*t̪uɣ-u*	*t̪ʊɣ-ɛ*	'outer mouth'
	/i/	*ʔic*	*ʔiɗ-i*	*ʔiɗ-u*	*ʔiɗ-ɛ*	'ear'
[+ATR]	/u/	*ʔuŋ*	*ʔuŋ-i*	*ʔuŋ-u*	*ʔuŋ-ɛ*	'knee'
	/ʌ/	*ʔʌm*	*ʔʌm-ɪ*	*ʔʌm-u*	*ʔʌm-ɛ*	'thigh'

Other suffixes with an underlyingly [-ATR] /ɪ/ behaving in the same way are, for instance, the plural suffix *-ɪn* of nouns, as in (9), and the verbal suffix *-ɪr*, which will be illustrated in section 4 below.[12]

The situation is different with the second person singular possessive suffix, as illustrated in Table 7 above. This suffix is invariably [+ATR] *-u*, and as we also saw in section 3.1 above, such a suffix vowel triggers Regressive [ATR] Assimilation, whose effect can be observed in the words for 'eyes', 'teeth', 'eye', and 'outer mouth'.

12 In noun stems with more than one vowel, as in (9c), it is the features of the last vowel that determine the [ATR] value of the suffix.

(9)		Plural	Singular	
a.	/ɪ/	*kɪɪð-ɪn*	*kɪɪt̪*	'guinea-fowl'
b.	/ɛ/	*wɛlɣ-ɪn*	*wɛlɣ-ɔn*	'rib'
c.	/a/	*guƫumað-ɪn*	*guƫumat̪*	'fishing spear'
d.	/ɔ/	*ƫɔŋ-ɪn*	*ƫɔŋ*	'spear'
e.	/ʊ/	*bʊɣ-ɪn*	*bʊk*	'arm'
f.	/i/	*kiij-in*	*kiic*	'orphan'
g.	/ʌ/	*jʌŋ-ɪn*	*jaaŋ*	'crocodile'
h.	/u/	*ƫuŋ-in*	*ƫuŋ*	'horn'

A different behaviour is exhibited by the third person singular possessive suffix. This suffix is [-ATR] *-ɛ* throughout and thus is not affected by the root vowel, and it does not itself affect the root vowel either. Hence, it behaves like the third person singular subject suffix *-ɛr* illustrated in section 3.1 above.

The [-ATR] suffix vowel /ɔ/ behaves like /ɛ/. Thus, it neither affects nor is affected by the root vowel. This is shown by the first person plural exclusive (1PEX) subject suffix *-ɔnɔn* of object-oriented verbs, as exemplified by the present tense forms in (10), which also shows the corresponding inflectionally unmarked verb forms, the latter occurring in subject-oriented clauses. Again, all of the eight root vowel qualities are exemplified, except for /u/, which has not been attested with the 1PEX suffix.[13]

Some (but not all) suffixes with the [-ATR] vowel [a] behave in the same way. One example is the plural suffix *-ak* of nouns in (11), which also shows the corresponding singular forms. All of the eight underlying root vowel qualities are exemplified.

(10)		Unmarked	1PEX	
a.	/ɪ/	*gɪɪw-ɪ*	*gɪɪw-ɔnɔn*	'beat' (multiplicative stem)
b.	/ɛ/	*gɛp*	*gɛw-ɔnɔn*	'beat'
c.	/a/	*maat̪*	*maað-ɔnɔn*	'drink'
d.	/ɔ/	*nɔn*	*nɔn-ɔnɔn*	'fold'
e.	/ʊ/	*kʊʊm*	*kʊʊm-ɔnɔn*	'fill'
f.	/i/	*ʔip*	*ʔiw-ɔnɔn*	'shoot'
g.	/ʌ/	*ʔʌƫ-ɪ*	*ʔʌƫ-ɔnɔn*	'pull' (centrifugal stem)

13 While the verb forms in (10b-f) have non-derived stems, those in (10a) and (10g) have derived stems, multiplicative and centrifugal, respectively. The formation of multiplicative stems may involve a grammatically conditioned change in the quality and length of the basic root vowel, as is the case here, since the stem in (10a) is derived from the root of the non-derived stem in (10b). However, this does not affect the behaviour of the 1PEX suffix.

(11)

		Singular	Plural	
a.	/ɪ/	*bɪl*	*bɪl-ak*	'iron'
b.	/ɛ/	*t̪ɛl*	*t̪ɛl-ak*	'lower leg'
c.	/a/	*kac*	*kaj-ak*	'leopard'
d.	/ɔ/	*jɔɔk*	*jɔɔɣ-ak*	'bull with one testicle'
e.	/ʊ/	*kʊr*	*kʊr-ak*	'boat'
f.	/i/	*kic*	*kij-ak*	'bee'
g.	/ʌ/	*kʌm*	*kʌm-ak*	'elbow'
h.	/u/	*kuʈ*	*kuɗ-ak*	'nest'

Lastly, the high back [-ATR] vowel [ʊ] also occurs as a suffix vowel, but its behaviour in that position has not been investigated systematically. Given the fact that an underlying /u/ behaves like an underlying /i/ with respect to vowel harmony, one would also expect an underlying /ʊ/ to behave like an underlying /ɪ/ in this respect. But so far, I have not been able to establish whether there are any suffixes with an *underlying* /ʊ/. Other examples with [ʊ] will be discussed in section 3.4.

In summary, Mayak has a general rule of *Progressive [ATR] Assimilation* to the effect that a high [+ATR] vowel spreads its [ATR] value to a high front [-ATR] vowel of the following syllable. It is similar to Regressive [ATR] Assimilation in that [+ATR] is dominant and [-ATR] recessive. But it is more restricted, since all non-high vowels are resistant to harmonisation.

3.4. Progressive [ATR] spreading. In sections 3.1 and 3.2 we saw examples of suffixes with low vowels which exhibit no variation and which do not trigger vowel harmony, namely the first person singular subject suffix *-ʌr* and the plural noun suffix *-ak*. However, there is at least one suffix which exhibits phonologically conditioned variation between [-ATR] [a] and [+ATR] [ʌ], namely the singulative noun suffix *-at̪* ~ *-ʌt̪*, as in (12). The stem of singular forms with this suffix is underlyingly identical to the corresponding plural form. The distribution of *-at̪* and *-ʌt̪* is in agreement with, and is determined by, the [ATR] value of the root vowel. Given this variation, the vowel of *-at̪* ~ *-ʌt̪* must be underlyingly different from both of the vowels of the invariable suffixes *-ak* and *-ʌr*. My suggestion is that the vowel of *-at̪* ~ *-ʌt̪* is underlyingly unspecified for [ATR] and that it gets its surface [ATR] value from the root vowel. The vowel harmony in nouns with this suffix is progressive like the vowel harmony produced by the rule of Progressive [ATR] Assimilation. However, while suffix vowels affected by that rule do not agree in [ATR] with the low [+ATR] root vowel /ʌ/, the vowel of *-at̪* ~ *-ʌt̪* agrees in [ATR] with all three [+ATR] root vowels, as shown in (12d-f). This is what is predicted if the harmony is here not the effect of a rule that replaces an already existing [-ATR] value with the opposite value, but the effect of a rule that specifies an unspecified [ATR] value. This rule will be referred to as *Progressive [ATR] Spreading*.

(12)

		Singular	Plural	
a.	/ɪ/	*rɪm-at̪*	*rɪm*	'blood'
b.	/a/	*ɗaal-at̪*	*ɗaal*	'flower'
c.	/ʊ/	*kʊm-at̪*	*kʊm*	'egg'
d.	/i/	*ʔin-ʌt̪*	*ʔin*	'intestine'
e.	/ʌ/	*ʔʌʌw-ʌt̪*	*ʔʌʌp*	'bone'
f.	/u/	*ruuj-ʌt̪*	*ruuc*	'worm'

There is at least one other suffix whose variation is also accounted for by Progressive [ATR] Spreading, namely the plural noun suffix *-ʊk* ~ *-uk*, as in (13). Some nouns with this suffix in the plural exhibit grammatically conditioned root vowel alternation; but the relation between the stem of the plural form and that of the singular form is not pertinent to the phonological form of the suffix, and it will therefore not be dealt with until section 4. The plural suffix in (13) exhibits variation between [-ATR] [ʊ] and [+ATR] [u] in agreement with the [ATR] value of the stem vowel, including the low [+ATR] stem vowel /ʌ/, as in (13d). Again, this distribution can be explained by assuming that the suffix vowel is underlyingly unspecified for [ATR] and, hence, affected by Progressive [ATR] Spreading.

(13)

		Plural	Singular	
a.	/ɪ/	*mɪɣ-ʊk*	*mɛɛk*	'spider'
b.	/ʊ/	*gʊj-ʊk*	*gɔɔc*	'bowl'
c.	/i/	*cim-uk*	*cɪɪma*	'knife'
d.	/ʌ/	*jʌŋ-uk*	*jaaŋ*	'crocodile'
e.	/u/	*bul-uk*	*bul*	'stomach'

In section 2.2 it was claimed that although [ʌ] is phonetically higher and more back than [a], it is the [+ATR] counterpart of that vowel. But as we saw in section 3.1, /ʌ/ does not trigger Regressive [ATR] Assimilation, and as we saw in section 3.3, /a/ does not become [ʌ] by Progressive [ATR] Assimilation. These processes, therefore, do not provide any structural evidence that /a/ and /ʌ/ are [-ATR] and [+ATR], respectively, nor that they are mutual [ATR] counterparts. However, that [ʌ] is indeed the [+ATR] counterpart of [a] is clearly shown by the suffix vowel variation examined in the present subsection. Thus, the [+ATR] value of [ʌ] is revealed by the fact that a low suffix vowel underlyingly unspecified for [ATR] is realised as [ʌ] when the [+ATR] feature is spread to it, and also by the fact that /ʌ/ itself spreads this feature to suffix vowels underlying unspecified for [ATR].

3.5. Summary of [ATR] harmony processes. The previous subsections have demonstrated the existence of three different types of phonologically conditioned [ATR] harmony processes, which were labeled Regressive [ATR] Assimilation, Progressive [ATR] Assimilation, and Progressive [ATR] Spreading. Several suffixes have been used as examples. Some of them trigger Regressive [ATR] Assimilation, others are affected by either Progressive [ATR] Assimilation or Progressive [ATR] Spreading, and still others neither trigger nor are affected by any of these processes. The suffixes that have been commented upon are listed in Table 8, where they are grouped according to the [ATR] process that they trigger or undergo. The table also indicates their underlying [ATR] value, their semantic function, and the class of the words in which they occur.

Table 8. Some suffixes and their involvement in [ATR] harmony processes.

Form	Underlying [ATR] value	Function	Word class	[ATR] process
-ak	-	plural	noun	none
-ʌr	+	1S subject	verb	none
-ɛ	-	3S possessor	noun	none
-ɛr	-	3S subject	verb	none
-ɔnɔn	-	1PEX subject	verb	none
-ir	+	2S subject	verb	regressive assimilation
-it̪	+	singulative	noun	regressive assimilation
-u	+	past tense	verb	regressive assimilation
-u	+	2S possessor	noun	regressive assimilation
-uð	+	past tense	verb	regressive assimilation
-ɪ, -i	-	1S possessor	noun	progressive assimilation
-ɪn, -in	-	plural	noun	progressive assimilation
-ɪr, -ir	-	present tense	verb	progressive assimilation
-at̪, -ʌt̪	0	singulative	noun	progressive spreading
-ʊk, -uk	0	plural	noun	progressive spreading

4. Grammatically conditioned vowel alternation

In addition to the phonologically conditioned vowel alternation described above, which involves either [ATR] or rounding, there is also grammatically conditioned vowel alternation, and the latter involves either [ATR] or height. This type of alternation is regular in the derivational morphology of verbal roots, and it can be observed, for instance, when comparing non-derived transitive stems and the corresponding anti-passive stems. The latter are derived intransitive stems that lack the object of the former. The basics of the alternation system can be seen by comparing four morphologically different forms with the same transitive root. These four forms are the present tense and past tense forms of subject-oriented non-derived transitive verbs, as in (14a) and (14b), respectively, and the present tense and past tense forms of anti-passive verbs, as in (14c) and (14d), respectively.

(14) a. S-oriented, present tense

ʔɪɪr lɛp ʔaŋkat̪ɛ ‘The thief is opening the door’
thief open door

b. S-oriented, past tense

ʔɪɪr lew-u ʔaŋkat̪ɛ ‘The thief opened the door’
thief open-PST door

c. Anti-passive, present tense

ʔɪɪr lɪp-ɪr ‘The thief is opening’
thief open:AP-SUF

d. Anti-passive, past tense

ʔɪɪr lip-uð-i ‘The thief opened’
thief open:AP-PST-SUF

The sentences in (14) illustrate the behaviour of roots with /ɛ/. As shown in (15), the shift from present tense to past tense here involves a change from [-ATR] to [+ATR] in the root vowel (from /ɛ/ to /e/, and from /ɪ/ to /i/), and the shift from subject-oriented to anti-passive involves raising (from /ɛ/ to /ɪ/, and from /e/ to /i/). In roots having /ɪ/, by contrast, as illustrated in (16) with a root meaning ‘to shape with an axe’, the shift from subject-oriented to anti-passive involves a vowel change from [-ATR] to [+ATR] rather than raising.

		S-oriented	Anti-passive
(15)	Present	*lɛp*	*lɪp-ɪr*
	Past	*lew-u*	*lip-uð-i*

(16)	Present	*ʔɪt̪*	*ʔit̪-ir*
	Past	*ʔið-u*	*ʔit̪-uð-i*

Table 9 shows the four forms with one root for each of the eight underlying short root vowels. Column 1 of Table 9 contains stems in which the underlying root vowels surface unchanged. Column 2 shows stems exposed to Regressive [ATR] Assimilation, as accounted for in section 3.1 above. Column 3 shows grammatically conditioned variants of the root vowels. Note first that the pre-sent tense suffix here exhibits [ATR] variation between [ɪr] and [ir]. Underlyingly, its vowel is [-ATR] /ɪ/, which undergoes Progressive [ATR] Assimilation after stems with /i/ or /u/. The grammatically conditioned variation in the root vowels only concerns root vowels whose basic alternants are [-ATR]. High and low vowels become [+ATR] without changing their height, and mid vowels become high with-

Table 9. Vowel alternation in transitive verbal roots.

		1	2	3	4	
	Basic root vowel	S-oriented, pres. tense	S-oriented, past tense	Anti-passive, pres. tense	Anti-passive, past tense	
	/ɪ/	*ʔɪt̪*	*ʔið-u*	*ʔit̪-ir*	*ʔit̪-uð-i*	'shape'
	/ɛ/	*ɗɛc*	*ɗej-u*	*ɗɪj-ɪr*	*ɗij-uð-i*	'grind'
[-ATR]	/a/	*ʔam*	*ʔam-u*	*ʔʌm-ɪr*	*ʔʌm-uð-i*	'eat'
	/ɔ/	*kɔc*	*koj-u*	*kʊj-ɪr*	*kuj-uð-i*	'take'
	/ʊ/	*gʊt̪*	*guð-u*	*gut̪-ir*	*gut̪-uð-i*	'untie'
	/i/	*ƫiŋ*	*ƫiŋ-u*	*ƫiŋ-ir*	*ƫiŋ-uð-i*	'hear'
[+ATR]	/ʌ/	*nʌk*	*nʌɣ-u*	*nʌk-ɪr*	*nʌk-uð-i*	'beat'
	/u/	*t̪uc*	*t̪uj-u*	*t̪uc-ir*	*t̪uc-uð-i*	'send'

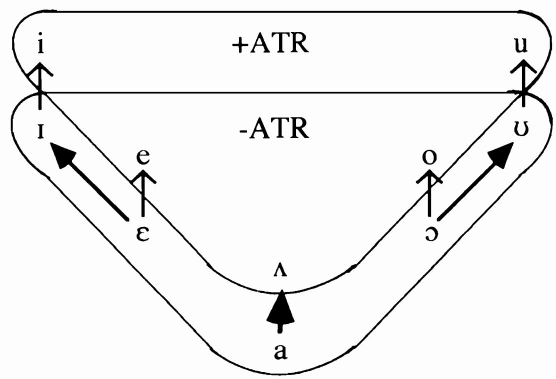
Table 10. Vowel alternation (grade system) in transitive verbal roots.

	1°	2°	3°	4°
	ɪ	i	i	i
	ɛ	e	ɪ	i
[-ATR]	a	a	ʌ	ʌ
	ɔ	o	ʊ	u
	ʊ	u	u	u
	i	i	i	i
[+ATR]	ʌ	ʌ	ʌ	ʌ
	u	u	u	u
	Underlying root vowels	Phonologically conditioned alternants	Grammatically conditioned alternants	Phonologically conditioned alternants of grammatically conditioned alternants

out changing their [ATR] value. Finally, column 4 contains stems which combine the effects of columns 3 and 2; that is, their root vowels have grammatically conditioned alternants exposed to Regressive [ATR] Assimilation.[14]

Table 10 schematises the vowel alternation system exemplified by the roots in Table 9. Since what we are dealing with may be called a vowel gradation system, the four columns of Table 10 will be referred to as grades 1 through 4, with grade 1 being the basic grade. As Table 10 shows, the number of different alternants depends on the underlying root vowel. Root vowels that are underlyingly [+ATR] do not alternate at all; underlying /ɪ/, /a/, and /ʊ/ have two alternants, underlying /ɛ/ and /ɔ/ four alternants. Using in modified form a diagram created by Labov [1994: 230], I illustrate in Figure 1 the changes involved in the vowel alternation system. Thin arrows indicate phonologically conditioned changes, thick arrows grammatically conditioned changes.

Figure 1. Phonological and grammatical changes in ATR



The same grammatically conditioned vowel alternation can be found, for instance, in number inflection of nouns, as illustrated in (17)-(19). The nouns in (17) have monosyllabic roots, and here the root vowel has grade 1 in the singular and grade 3 in the plural.[15] The five [-ATR] grade 1 vowels are exemplified here.

[14] Although not indicated in the table, stems with [ʌ] here have free variants with [o]: [ʔʌmuði] ~ [ʔomuði] 'He ate' and [nʌkuði] ~ [nokuði] 'He killed'. This is due to the rule of Regressive Rounding Assimilation, as described in section 3.2 above.

[15] Although the root vowel /u/ in *guɣ-iɲ*, or its variant *guɣ-ɪn*, 'dogs' is followed by a high [+ATR] suffix vowel, it does not belong to grade 2. The reason is that the vowel of the suffix in question is one that undergoes Progressive [ATR] Assimilation, as evidenced by the fact that it is [-ATR] after a [-ATR] vowel, as in *ʈɔŋ-ɪn* 'spears', cf. section 3.3 above.

(17)	1°	Singular	3°	Plural	
a.	/ɪ/	*ʔɪn-at̪*	/i/	*ʔin*	'hand'
b.	/ɛ/	*gɛɛl*	/ɪ/	*gɪʈ*	'lion'
c.	/a/	*jaat̪*	/ʌ/	*jʌn*	'tree'
d.	/ɔ/	*jɔɔm*	/ʊ/	*jʊm-d̪ɪn*	'type of monkey'
e.	/ʊ/	*gʊʊk*	/u/	*guɣ-iɲ*	'dog'

In (18), the singular is either a monosyllable or a disyllable ending in /a/, and the (first) root vowel has grade 1. The plural is formed from the singular by means of the suffix *-ʊk* ~ *-uk*, and at the same time word-final vowels are deleted, long root-vowels are shortened, and root vowels are shifted to grade 3. As argued in section 3.4 above, the vowel of the suffix is underlyingly unspecified for [ATR], so that it is exposed to Progressive [ATR] Spreading. In (18c) an underlying stem vowel /ʌ/ has undergone Progressive Rounding Assimilation.

(18)	1°	Singular	3°	Plural	
a.	/ɪ/	*cɪɪma*	/i/	*cim-uk*	'knife'
b.	/ɛ/	*mɛɛk*	/ɪ/	*mɪɣ-ʊk*	'spider'
c.	/a/	*bart̪a*	/ʌ/	*bort̪-uk*	'slave, servant'
d.	/ɔ/	*gɔɔc*	/ʊ/	*gʊj-ʊk*	'bowl'
e.	/u/	*bul*	/u/	*bul-uk*	'stomach'
f.	/i/	*d̪ir*	/i/	*d̪ir-uk*	'shield'
g.	/ʌ/	*mʌʌl*	/ʌ/	*mʌl-uk*	'calf of leg'
h.	/u/	*pura*	/u/	*pur-uk*	'cloth'

The examples in (19) belong to a class of nouns that have a disyllabic root and which form the plural from the singular without affixation. The singular form is identical to the root and has the shape CV(V)C(C)V(V)C with grade 1 vowels in both syllables. The first syllable of the singular forms exemplifies all five [-ATR] vowels.

The plural of such nouns is formed in the following way: Long vowels are shortened, the vowel of the first syllable is shifted from grade 1 to grade 3, and the vowel of the second syllable is replaced with a short high back vowel. The latter exhibits the same type of [ATR] variation as the short high back vowel of the plural suffix *-ʊk* ~ *-uk* in (18) above and must therefore be analysed as underlyingly unspecified for [ATR] but exposed to Progressive [ATR] Spreading. Using /U/ as a symbol for a high back vowel unspecified for [ATR], plural forms are derived as in (20), using examples from (19). The grade 3 alternant of /a/ may exhibit the additional effect of Regressive Rounding Assimilation, as also indicated in (20).

(19)

	1°	Singular	3°	Plural	
a.	/ɪ/	*ɗɪwar*	/i/	*ɗiwur*	'squirrel'
		kɪlkat̪		*kilkut̪*	'broom'
b.	/ɛ/	*rɛɛkat̪*	/ɪ/	*rɪkʊt̪*	'type of pot'
c.	/a/	*kamal*	/ʌ/	*komul*	'girl'
		nanaan		*nʌnun, nonun*	'snake'
d.	/ɔ/	*d̪ɔŋɔl*	/ʊ/	*d̪ʊŋʊl*	'cock'
		mɔrcɔŋ		*mʊrcʊŋ*	'horse'
e.	/ʊ/	*kʊt̪ɛr*	/u/	*kut̪ur*	'pig'
		ʔʊnt̪ɛl		*ʔunt̪ul*	'cotton'

(20)

Root:	ɗɪwar	rɛɛkat̪	nanaan	d̪ɔŋɔl	kʊt̪ɛr
Plural formation:	ɗiwUr	rɪkUt̪	nʌnUn	d̪ʊŋUl	kut̪Ur
Progressive [ATR] Spreading:	ɗiwur	rɪkʊt̪	nʌnun	d̪ʊŋʊl	kut̪ur
Regressive Rounding Assim.:	—	—	nonun	—	—

Note, incidentally, that the plural forms in (19) share a template with the plural forms that contain the suffix *-ʊk* ~ *-uk* exemplified in (18) above. This template has the following properties: (i) the segmental shape is CVC(C)VC, with short vowels in both syllables; (ii) the first vowel belongs to the set /ɪ, ʊ, i, ʌ, u/; and (iii) the second vowel is /U/, exposed to Progressive [ATR] Spreading. Hence, one may speculate that the plural formation strategy utilised in (19) has arisen as an analogue of the strategy utilised in (18).

5. Internal reconstruction: Sound change

We have seen that in the grammatically conditioned alternation of root vowels, only underlying [-ATR] vowels alternate. The three non-mid vowels, /ɪ, a, ʊ/, become [+ATR] and thus change to /i, ʌ, u/. By contrast, the two mid vowels, /ɛ, ɔ/, become high and thus change to /ɪ, ʊ/. This mixed character of the alter-nation system needs a historical explanation. Assuming that the alternation was originally an [ATR] alternation throughout, we must hypothesise that /ɛ, ɔ/ originally alternated with */e, o/, but that at some later point in the past, */e, o/ underwent an unconditional change to /ɪ, ʊ/.

Table 11 diagrams the history of the root vowel alternants in accordance with this hypothesis. As we see in column 3, the original [ATR] alternation created [+ATR] alternants of underlying [-ATR] vowels throughout, and the mid [+ATR] vowels were later changed, while the others remained unchanged. Column 4 shows that some instances of /i/ and /u/ reflect three changes: first a change from [-ATR]

Table 11. History of root vowel alternants

	1°	2°			3°					4°						
	ɪ	i	←	ɪ	i		i	←	ɪ	i				i	←	ɪ
	ɛ	e	←	ɛ	ɪ	<	e	←	ɛ	i	←	ɪ	<	e	←	ɛ
[-ATR]	a	a		a	ʌ		ʌ	←	a	ʌ				ʌ	←	a
	ɔ	o	←	ɔ	ʊ	<	o	←	ɔ	u	←	ʊ	<	o	←	ɔ
	ʊ	u	←	ʊ	u		u	←	ʊ	u				u	←	ʊ
	i	i			i					i						
[+ATR]	ʌ	ʌ			ʌ					ʌ						
	u	u			u					u						
	Root vowel	New [ATR] harmony					Old [ATR] alternation			New [ATR harmony				Old [ATR] alternation		

Key: "←" indicates a change due to a phonological rule, and "<" indicates a diachronic development.

to [+ATR], then a change from mid [+ATR] to high [-ATR], and finally, again, a change from [-ATR] to [+ATR].

6. Comparative evidence: Mayak-Mabaan vowel correspondences

The hypothesis that pre-Mayak */e, o/ have changed to /ɪ, ʊ/ implies that Mayak /ɪ/ is a merger of pre-Mayak */ɪ/ and */e/, and that Mayak /ʊ/ is a merger of pre-Mayak */ʊ/ and */o/. Thus, the hypothesis predicts that Mayak /ɪ/ and /ʊ/ each exhibit regular correspondences with two different vowels in the other Western Nilotic languages, provided that the latter have not been exposed to the same merger.

In the following, this prediction will be tested by a comparison of Mayak with the closest of its relatives of which I have a sufficient knowledge, namely Mabaan. In Köhler's [1955] subgrouping of the Nilotic languages, Mabaan belongs to the Southern Burun branch of Burun and is thus assumed to be more closely related to Mayak than the Luo and the Nuer-Dinka languages are. As we shall see, a comparison of Mayak with Mabaan does indeed shed light on the vowel systems of both of these languages.

As mentioned in Andersen [1992:187f] and as documented in Andersen [in press a], Mabaan has 11 contrastive vowel qualities, including 7 monophthongs, /i, e, ɛ, a, ʌ, ɔ, u/, and 4 diphthongs, /ie, iɛ, uʌ, ua/, and length is contrastive in all 11 vowel qualities. Unlike Mayak, Mabaan does not exhibit any vowel harmony, and the feature [ATR] is largely irrelevant to the description of its vowel system.

As demonstrated below, there are regular correspondences between the root vowels in Mayak and Mabaan. These correspondences are independent of vowel length, and a given root generally has the same vowel length in both languages.

Each vowel correspondence will be documented by means of six pairs of cognates. The examples have been selected in such a way that, as far as the attestation goes, half of the cited cognate pairs have a short root vowel and half of them a long root vowel. Note that I have chosen to write the long diphthongs in Mabaan with a double first component, so that for instance /ua/ is a short vowel and /uua/ a long vowel.

The cognate pairs cited below include nouns, verbs, and an adverb. Nouns are given in their citation form, and their morpheme boundaries are indicated. Plural noun forms are marked by "(pl.)" after their gloss. For verbs the form given is the root, and if the root does not occur on its own or has not been attested without a suffix, it is followed by a hyphen. That a given root is verbal is indicated by a specification of its transitivity after its gloss: "(tr.)" for transitive and "(intr.)" for intransitive.

Almost all of the cognate pairs also exhibit regular correspondences with respect to both the root-initial consonant and the root-final consonant, and exceptions are explicitly mentioned. Some root-initial consonants are the same in the two languages. The others exhibit the regular correspondences shown in (21), as seen from the point of view of Mayak. The root-final consonant correspondences are more complex, which is due to various phonological processes that are either synchronically operative or reflect earlier suffixes. An account of these correspondences is beyond the scope of the present article, but it should be mentioned that in noun roots a final obstruent in Mayak often corresponds to a homorganic nasal in the singular form of the noun in Mabaan.

(21)	Mayak	ɗ	r	j	k	g
	Mabaan	ɖ	j	ɟ, ɲ	k, c	g, ɟ

The presentation of the vowel correspondences takes the Mayak vowels as its point of departure. The non-high [-ATR] vowels will be examined first, then the [+ATR] vowels, and finally the high [-ATR] vowels. The low [-ATR] vowel /a/ corresponds to /a/ in Mabaan, as in (22). The mid [-ATR] vowels /ɛ/ and /ɔ/ cor-

(22)		Mayak	Mabaan	
	a.	*maʈ*	*mar-*	'suck' (tr.)
	b.	*pak-*	*pak-*	'count' (tr.)
	c.	*bak-*	*bak-*	'break' (intr.)
	d.	*jaat̪*	*ɟâan-ʌ̀*	'tree'
	e.	*laak-ɪɲ*	*láak-k-ʌ́*	'urine' (pl.)
	f.	*ʔaak-an*	*ʔâak-ʈ-ʌ̀*	'chicken'

respond to the diphthongs /iɛ/ and /ua/ in Mabaan, as in (23) and (24), respectively. The low [+ATR] vowel /ʌ/ mostly corresponds to /ʌ/ in Mabaan, as in (25).

		Mayak	Mabaan	
(23)	a.	*gɛp*	*ɟiɛp-*	‘beat’ (tr.)
	b.	*t̪ɛl*	*t̪iɛ́l-ʌ́*	‘lower leg’
	c.	*ʔɛt̪*	*ʔiɛ́t̪-ʌ́*	‘faeces’ (pl.)
	d.	*gɛɛl*	*ɟiiɛ̂l-ʌ̂*	‘lion’
	e.	*bɛɛl-ɛt̪*	*biiɛ̂l-l-ʌ̂*	‘cane’
	f.	*nɛɛt̪*	*niiɛt̪-*	‘suck’ (tr.)
(24)	a.	*ɗɔk*	*ɖúaŋ-ʌ́*	‘neck’
	b.	*ʈɔŋ*	*ʈúaŋ-ʌ́*	‘spear’
	c.	*pɔt̪-*	*puat̪-*	‘be good’ (intr.)
	d.	*gɔɔɲ*	*guuaɲ-*	‘scratch’ (tr.)
	e.	*ɗɔɔc*	*ɖuuac-*	‘put’ (tr.)
	f.	*ʔɔɔl-*	*ʔuual-*	‘sing’ (intr.)
(25)	a.	*ʔʌʈ*	*ʔʌ́n-ʌ́*	‘house’
	b.	*ʔʌm*	*ʔʌ́m-ʌ́*	‘thigh’
	c.	*wʌð-it̪*	*wʌ́n-n-ʌ́*	‘buttock’
	d.	*kʌʌl*	*kʌ́ʌl-ʌ́*	‘hole (in the ground)’
	e.	*jʌʌk*	*ɲʌ̂ʌk-ʌ̂*	‘lice’ (pl.)
	f.	*mʌʌn*	*mʌ̂ʌn-g-ʌ̂*	‘women’ (pl.)

But in a few roots, /ʌ/ corresponds to /e/ in Mabaan, as in (26). This is the case when the root ends in an underlying /j/ in Mabaan, corresponding to /r/ in Mayak. In Mabaan, a root-final /j/ is deleted before a consonant-initial suffix, as in (26a-b), whereby a short root vowel is lengthened, as in (26a).

(26)	a.	*wʌr-it̪*	*wée-n-ʌ́*	‘cow dung’
	b.	*wʌʌr-in*	*wêe-n-ʌ̂*	‘night’
	c.	*bʌʌr-*	*be(e)j-*	‘be long, be tall’ (intr.)[16]

The high [+ATR] vowels /i/ and /u/ correspond to the diphthongs /ie/ and /uʌ/ in Mabaan, as in (27) and (28), respectively.

[16] It is not clear whether the root vowel of Mabaan *be(e)j-* is underlyingly short or long.

		Mayak	Mabaan	
(27)	a.	*ʈiɗ-ʌʈ*	*ʈiên-n-ʌ̀*	‘witch-doctor’
	b.	*win-ic*	*wiêɲ-c-ʌ̀*	‘pot type’
	c.	*t̪in-it̪*	*t̪ién-n-ʌ́*	‘breast’
	d.	*riic*	*jiiê-k-ʌ̀*	‘rats’ (pl.)
	e.	*riiʈ*	*jiién-ʌ́*	‘smoke’
	f.	*pii*	*piiê-g-ʌ̀*	‘water’ (pl.)

(28)	a.	*t̪uj-ic*	*t̪ûʌɲ-ɲ-ʌ̀*	‘granary’
	b.	*run*	*jûʌn-n-ʌ̀*	‘year’
	c.	*ʔuŋ*	*ʔúʌŋ-ʌ́*	‘knee’
	d.	*puk-*	*puʌk-*	‘pour’ (tr.)
	e.	*kul*	*kúʌl-ʌ́*	‘wart-hog’
	f.	*lum-anit̪*	*lûuʌm-ʌ̀*	‘grass’

Finally, we come to the high [-ATR] vowels /ɪ/ and /ʊ/ in Mayak. Both of these regularly correspond to two different vowels in Mabaan. The front vowel /ɪ/ in Mayak corresponds to the high and mid front monophthongs /i/ and /ɛ/ in Mabaan, as in (29) and (30), respectively. Similarly, the back vowel /ʊ/ in Mayak corresponds to the high and mid back monophthongs /u/ and /ɔ/ in Mabaan, as in (31) and (32), respectively.[17]

		Mayak	Mabaan	
(29)	a.	*rɪm-at̪*	*jîm-m-ʌ̀*	‘blood’
	b.	*ʔɪc*	*ʔíɲ-ʌ́*	‘penis’
	c.	*bɪl*	*bíl-ʌ́*	‘iron’
	d.	*wɪɪl*	*wîil-ʌ̀*	‘tail’
	e.	*ɗɪɪn-ɛʈ*	*ɗiin-ʌ́*	‘bird’
	f.	*jɪɪt̪*	*ɟiin-ʌ̀*	‘scorpion’

(30)	a.	*gɪm*	*gɛ̂m-g-ʌ̀*	‘cheeks’ (pl.)
	b.	*wɪl-ɔl*	*wɛ̂l-l-ʌ̀*	‘guest’
	c.	*ʔɪɪk*	*ʔɛ̂ɛŋ-ʌ̀*	‘female’
	d.	*kɪɪt̪*	*kɛ̂ɛn-ʌ̀*	‘guinea-fowl’
	e.	*ʔɪɪr*	*ʔɛ̂ɛ-n-ʌ̀*	‘thief’
	f.	*t̪ɪɪn-ɔk*	*t̪ɛ̂ɛn-ɔ̀*	‘yesterday’ (adv.)

[17] The pairs of cognates for ‘thorn’ in (31d) and ‘my friend’ in (31f) are irregular with respect to the root-final consonant.

(31)	a.	*t̪ʊk*	*t̪úk-ʌ́*	'mouth'
	b.	*ʔʊl-*	*ʔul-*	'be black' (intr.)
	c.	*kʊm-at̪*	*kûm-m-ʌ̀*	'egg'
	d.	*kʊʊk*	*kûu-n-ʌ̀*	'thorn'
	e.	*kʊʊt̪*	*kuut̪-*	'blow at' (tr.)
	f.	*mʊʊʈ-a*	*múu-k-ɔ́*	'my friend'

(32)	a.	*bʊk*	*bɔ́ŋ-ŋ-ʌ́*	'arm'
	b.	*rʊk*	*jɔk-*	'kick' (tr.)
	c.	*pʊr*	*pɔ́j-ʌ́*	'path'
	d.	*gʊʊk*	*gɔ̂ɔŋ-ʌ̀*	'dog'
	e.	*ʈʊʊl-ɛ*	*ʈɔ̀ɔl-ɛ́*	'his/her/its child'
	f.	*rʊʊɗ-a*	*jɔ́ɔr-ɔ́*	'my grandfather'

Table 12 summarises the regular root vowel correspondences between cognates in Mayak and Mabaan as seen from the point of view of Mayak. Each vowel in Mabaan has one and only one counterpart in Mayak, but each of the Mayak vowels /ɪ/, /ʊ/, and /ʌ/ has two counterparts in Mabaan. All correspondences are independent of vowel length.

Table 12. Regular root vowel correspondences between Mayak and Mabaan.

<table>
<tr><td></td><td colspan="7">Mayak [-ATR]</td><td colspan="4">Mayak [+ATR]</td></tr>
<tr><td>Mayak</td><td colspan="2">ɪ</td><td>ɛ</td><td>a</td><td>ɔ</td><td colspan="2">ʊ</td><td>i</td><td colspan="2">ʌ</td><td>u</td></tr>
<tr><td>Mabaan</td><td>i</td><td>ɛ</td><td>iɛ</td><td>a</td><td>ua</td><td>u</td><td>ɔ</td><td>ie</td><td>ʌ</td><td>e</td><td>uʌ</td></tr>
</table>

The two Mabaan counterparts of Mayak /ʌ/ have complementary distribution and thus constitute a split. By contrast, the two Mabaan counterparts of Mayak /ɪ/ have identical distribution, and so do the two Mabaan counterparts of Mayak /ʊ/. Hence, the Mayak vowels /ɪ/ and /ɛ/ must each go back to two different vowels, as also hypothesised on Mayak-internal grounds in section 5 above.

7. Vowel changes in Mabaan and Mayak

Although the vowel system of Mabaan is rather different from that of Mayak and does not use the feature [ATR], there is strong evidence that it goes back to a system in which [ATR] played a crucial role. In Andersen [in press a], the vowel system of Mabaan was compared with those of two other Western Nilotic languages belonging to different main branches of Western Nilotic, namely Päri from the Luo branch and Dinka from the Nuer-Dinka branch. Based on facts of vowel quality alternation, it was argued that all three languages go back to a vowel system with

Table 13. Reconstructed Proto-Western Nilotic vowel system.

[-ATR]		[+ATR]	
short	long	short	long
ɪ	ɪɪ	i	ii
ɛ	ɛɛ	e	ee
a	aa	ʌ	ʌʌ
ɔ	ɔɔ	o	oo
ʊ	ʊʊ	u	uu

five [-ATR] and five [+ATR] monophthongs and two lengths. This vowel system, which by definition belonged to Proto-Western Nilotic (PWN), was completely symmetrical, as shown in Table 13.

The changes that were hypothesised to have occurred in Mabaan, taking it from the Proto-Western Nilotic stage to its present stage, are shown in (33). The chronological order of these four changes can be determined to the following extent: The diphthongization of */i, u/ antedates the raising of */ɪ, ʊ/, and the diphthongization of */ɛ, ɔ/ antedates the lowering of */e, o/. Given this set of changes, the Mayak-Mabaan vowel correspondences summarised in Table 12 above can now be depicted from the point of view of Proto-Western Nilotic as in Table 14.

(33)	a.	*i, *u	>	ie, uʌ	Diphthongization of high [+ATR] vowels
	b.	*ɛ, *ɔ	>	iɛ, ua	Diphthongization of mid [-ATR] vowels
	c.	*e, *o	>	ɛ, ɔ	Lowering of mid [+ATR] vowels
	d.	*ɪ, *ʊ	>	i, u	Raising of high [-ATR] vowels

Table 14. Regular Mayak-Mabaan vowel correspondences seen from the point of view of Proto-Western Nilotic.

	PWN [-ATR]					PWN [+ATR]				
PWN	*ɪ	*ɛ	*a	*ɔ	*ʊ	*i	*e	*ʌ	*o	*u
Mayak	ɪ	ɛ	a	ɔ	ʊ	i	ɪ	ʌ	ʊ	u
Mabaan	i	iɛ	a	ua	u	ie	ɛ	ʌ, e	ɔ	uʌ

On the hypothesis embodied in Table 14, the Proto-Western Nilotic mid [+ATR] vowels */e, o/ have changed to /ɪ, ʊ/ in Mayak, exactly as hypothesised on Mayak-internal grounds in section 5 above, while the other Proto-Western Nilotic vowels have remained unchanged in Mayak. Hence, the two vowels that merged into Mayak /ɪ/ were [-ATR] */ɪ/ and [+ATR] */e/, and the two vowels that merged into Mayak /ʊ/ were [-ATR] */ʊ/ and [+ATR] */o/.

As mentioned in section 2.3 above, the Mayak word *d̪ooc* 'five' is aberrant in having the vowel quality /o/ in spite of its monosyllabicity. It is cognate with its Mabaan counterpart *d̪ɔ̂ɔjɔ́* 'five', and as indicated in (33) and in Table 14, the root vowel /ɔ/ of the latter goes back to */o/. So Mayak *d̪ooc* 'five' escaped the regular sound change *o > ʊ.

A proper demonstration that the Proto-Western Nilotic reconstructions are correct is beyond the scope of this article. But a preliminary demonstration can be made by providing examples of cognate words from all main branches of Western Nilotic. For this purpose, Päri is taken as representative of the Luo languages, and the Agar dialect of Dinka is taken as representative of the Nuer-Dinka languages. Thus, Tables 15-16 show one set of cognate nouns in Mayak, Mabaan, Päri, and Dinka for each of the twenty vowels reconstructed for Proto-Western Nilotic, five short and five long [-ATR] vowels and five short and five long [+ATR] vowels.[18] These sets exhibit regular root vowel correspondences, but a valid demonstration of this regularity would have to take into account special developments in Dinka (cf. Andersen [1993]). Crucially, however, the vowels that have been reconstructed as [-ATR] vowels in Proto-Western Nilotic are [-ATR] in Päri and [-breathy] in Dinka, and conversely, vowels that have been reconstructed as [+ATR] vowels in Proto-Western Nilotic are [+ATR] in Päri and [+breathy] in Dinka. Päri and Dinka words in brackets are irregular with respect to vowel height (Päri *t̪ɔ́ŋ*) or vowel length (Dinka *ɟọ̤́*), but not with respect to the features [ATR] or [breathy].

8. Conclusion

Phonetically, Mayak has the same vowel inventory as that reconstructed for Proto-Western Nilotic, namely a 5 x 2 x 2 system, i.e., a system with five vowel positions, the binary feature [ATR], and two lengths. However, the [+ATR] qualities [e] and [o] in Mayak are conditional variants of the [-ATR] qualities /ɛ/ and /ɔ/, respectively; so phonemically, Mayak has only three [+ATR] qualities. Original, that is, Proto-Western Nilotic, */e/ and */o/ have merged with the high [-ATR] vowels /ɪ/ and /ʊ/, respectively.[19]

The change */e, o/ > /ɪ, ʊ/ appears to be an unusual one in languages with a vowel system with the feature [ATR]. In his overview of the Kwa languages, many of which also have vowel harmony based on [ATR], Stewart [1971: 198ff] found that when vowels are eliminated by merger, the first to be eliminated are

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[18] In the transcription of Päri, [ ] is an extra low tone, [^̏] is a tone falling from high to extra low, and [` ̏] is a tone falling from low to extra low.

[19] It is also noteworthy that Mayak has retained the purely monophthongal system of Proto-Western Nilotic, while in the Luo languages and in Mabaan some original monophthongs have become diphthongs [cf. Andersen 1989 and in press a].

Table 15. Cognate sets exemplifying regular root vowel correspondences among four Western Nilotic languages and reflecting the ten [-ATR] vowels in Proto-Western Nilotic.

PWN	Mayak	Mabaan	Päri	Dinka	
*ɪ	rɪm-at̪	ɟîm-m-ʌ̀	rɪ̀mɔ́	rjɛ̰́ɛm	'blood'
*ɪɪ	mɪɪŋ	mɪ̂iŋ-ʌ̀	mɪ̀ɪŋ	mɪ̰̀iŋ	'deaf'
*ɛ	ʔɛt̪	ʔiɛ́t̪-ʌ́	cɛ̀ɛ̏t̪	cɛ̰̀t̪	'faeces' (pl.)
*ɛɛ	lɛɛc	liiɛ̂ɲ-ʌ̀	lɪɛ̀c	—	'elephant'
*a	kac	káɲ-ʌ́	kwàc	kwá̰c	'leopard'
*aa	maac	mâaɲ-ʌ̀	màac	mà̰ac	'fire'
*ɔ	ʈɔŋ	ʈúaŋ-ʌ́	(ʈɔ́ŋ)	ʈɔ̰̀ŋ	'spear'
*ɔɔ	ŋɔɔl	ŋûual-ʌ̀	ŋʊ̀ɔl	ŋɔ̰̀ɔl	'limping'
*ʊ	t̪ʊk	t̪úk-ʌ́	d̪ɔ́k	t̪ɔ̰̀k	'mouth'
*ʊʊ	kʊʊk	kûu-n-ʌ̀	kʊ́ʊd̪-ɔ̀	koò̰w	'thorn'

Table 16. Cognate sets exemplifying regular root vowel correspondences among four Western Nilotic languages and reflecting the ten [+ATR] vowels in Proto-Western Nilotic.

PWN	Mayak	Mabaan	Päri	Dinka	
*i	kic	cíeɲ-ʌ́	kíc	cjé̤ec	'honey, bee'
*ii	pii	piiê-g-ʌ̀	pìi	pî̤iw	'water' (pl.)
*e	wɪl-ɔl	wɛ̂l-l-ʌ̀	wéel-ó	—	'guest'
*ee	lɪɪj-ɪn	lɛ̂ɛg-g-ʌ̀	liéc	—	'elephants' (pl.)
*ʌ	ŋʌc	ŋʌ́j-ʌ́	ŋʌ̀c	—	'back'
*ʌʌ	mʌʌn	mʌ̂ʌn-g-ʌ̀	mʌ́ʌn	—	'women' (pl.)
*o	—	jɔ́l-ʌ́	—	ró̤l	'gullet'
*oo	gʊʊk	gɔ̂ɔŋ-ʌ̀	guòk	(ɟo)	'dog'
*u	ʔum	ʔûʌm-m-ʌ̀	ʔúm	wṳ̀m	'nose'; 'nostril' (Mab.)
*uu	ʔuuɗ-u	—	ʔùuɖ-ò	wṳ́uʈ	'ostrich'

normally the low [+ATR] vowel, which he symbolised [ɜ], and the high [-ATR] vowels [ɪ] and [ʊ]. For the latter, Stewart suggested that there are three common ways of elimination: [ɪ] and [ʊ] merge with either (i) the corresponding [+ATR] vowels [i] and [u], (ii) the mid [-ATR] vowels [ɛ] and [ɔ], or (iii) the mid [+ATR] vowels [e] and [o].[20] The change */e, o/ > /ɪ, ʊ/ in Mayak does not conform to these tendencies, since it is the reverse of the third possibility mentioned by Stewart. But Stewart [1971: 205] also mentioned an example of this change in a Kwa language, namely in the Asante dialect of Akan. Moreover, a merger of */e/ with /ɪ/ has also taken place in the Central Sudanic language Lendu, as demonstrated by Kutsch Lojenga [1989]. So the change */e, o/ > /ɪ, ʊ/ in Mayak is not unparalleled in other language families.

The elimination of /e, o/ rather than /ɪ, ʊ/ is also found in the Moru-Madi subfamily of Central Sudanic. The Moru-Madi languages must originally have had a system similar to that of Proto-Western Nilotic, except that there was no length contrast (cf. Andersen [1986c]). [e] and [o] still have full phonemic status in Madi (cf. Andersen [1986b]) and in Lulubo (cf. Andersen [1987]), but in Moru their phonemic status is marginal (cf. Andersen [1986a]), and in Lugbara they are totally non-phonemic, being allophones of /ɛ/ and /ɔ/, just like in Mayak. But in Lugbara, as demonstrated in Andersen [1986c], */e, o/ merged with /ɛ, ɔ/, so here */e, o/ took a different path than in Mayak.

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[20] Cf. also Hall and Creider's [1998] overview of changes in the Nilotic family.

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