



ILLUSTRATIONS OF THE IPA

Tima

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Tima (ISO 639-3: tms) is a Niger-Congo language spoken by roughly 7,000 people in the Nuba mountains of Sudan, in north-eastern Africa, as well as in smaller communities in the bigger towns of Sudan such as Khartoum and Port Sudan. It is part of the Katla language group which includes the languages Katla and Julut as well as Tima, with Tima being the most distinct of the three. All three languages are regarded as endangered, mainly due to the spreading influence of Arabic in recent decades, but also due to greater speaker mobility. Broadly speaking, there is a decline in speaker fluency from older to younger speakers of Tima. The Tima people are not only exposed to Arabic as the lingua franca and official language of Sudan, but also to English and Kiswahili. These latter languages were introduced into the school system during the extremely difficult circumstances of the second civil war (1983–2005), when teachers from Kenya came to the Tima region (in addition, many Tima people went to Kenya for further education).¹

Tima has a relatively small number of lexical roots, a fact which is compensated for by making use of metaphors, metonymy and synecdoche (see Schneider-Blum 2012; Schneider-Blum & Dimmendaal, to appear) as well as by altering the roots' basic meanings through derivation. However, a good number of words from Arabic (or via Arabic) have entered the lexicon, with the new words mostly being morphophonologically adapted to the Tima system (see Hashim et al. 2020).

Figure 1 shows the area where Tima is spoken in the Nuba mountains of Sudan.

Tima has twenty-one consonants; a two-way tonal contrast High, Low (plus down-stepped High); and twelve vowels, made up of six pairs contrasting in ATR (Advanced Tongue Root) (Bashir 2010; Dimmendaal 2009; Schneider-Blum 2013). The Tima twelve-vowel ATR system is typologically unusual, and includes a low central vowel pair, as well as a high central vowel pair; both of these (but especially the high central pair) are a rare contrast in an ATR system (see Casali 2008 and Rose 2018 for discussion of ATR harmony in

¹ For a social anthropological study on Tima, see Meerpohl (2012). With regard to language policy in Sudan, the interested reader is referred to Mohamed Salih (1995), Mugadam & Abdelhay (2014) and Abdelhay et al. (2015).

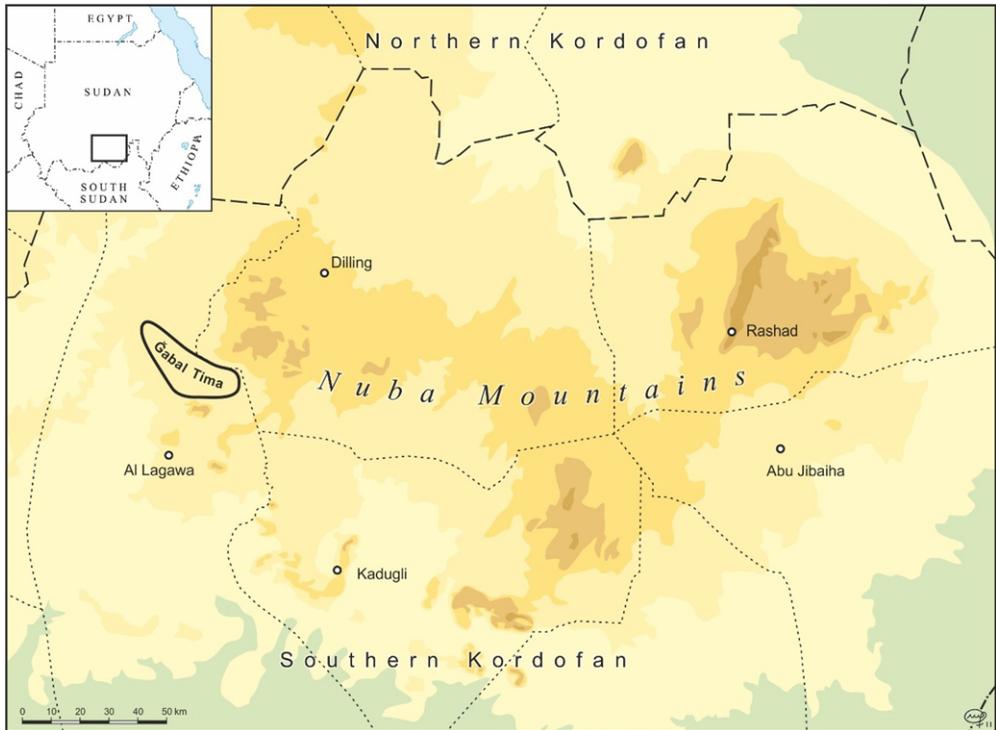


Figure 1. (Colour online) Map of the Nuba Mountains with the Tima-speaking area in Sudan.

the Niger-Congo and Nilo-Saharan language families of sub-Saharan Africa, and Rolle et al. 2020 for a broader view of ATR systems in the region).

The main speaker of this illustration is Mr Hamid Kafi Daldum, a community language worker and security guard, born in 1968. Additional recordings by Mr Nasraldeen Abdallah Korsha (born 1943, died 2018) and Mr Kano Morto (born c. 1960) were also used for the quantitative data presented below. Additional recordings by Mr Darjawad Ismail Tutu (born 1972), Mr Durban Maki (born 1941), Mr Babo Tima (born 1965), Mr Alhaj Tuutu Jubaara (DOB unknown), and Mr Zacharia Said (born c. 1940) were also used for this illustration. The story was narrated by Mr Adlaan Misiriya (DOB unknown). The recordings for this illustration were collected between 2007 and 2010, as part of a language documentation and dictionary project.²

² Recordings were made using an Edirol R-09 recorder and Beyerdynamic M 58 microphone. Files were saved in WAV format at a 48 kHz sampling rate and 16-bits per channel (the original stereo files were subsequently converted to mono for the purposes of phonetic labelling and analysis). Transcriptions of the words (in Tima and English) were imported from a spreadsheet and used for preliminary phonetic segmentation with the Munich Automatic Segmentation system (MAUS – Kislér et al. 2017) pipeline function G2P- > MAUS- > PHO2SYL. Manual correction of the phonetic MAUS labelling was conducted using the EMU Speech Database Management System (Winkelmann et al. 2017; Winkelmann et al. 2019), interfaced with the R statistical software package (R Core Team 2020). The Snack signal processor (Sjölander 2014) was used for calculating formants. The VoiceSauce software was used to extract voicing measures such as Strength of Excitation (Vicenik et al. 2020). Plots were generated using the *ggplot2* package in R (Wickham 2009).

Consonants

	Bilabial	Denti-alveolar	Retroflex	Palatal	Velar	Glottal
Plosive	p b	t <ṭ> d	ʈ <ṭ>	c ɟ <ɟ>	k ɡ	ʔ
Implosive	ɓ					
Nasal	m	n		ɲ	ŋ	
Tap/Flap		r	ɽ			
Fricative						h
Lateral		l				
Glide	(w)			j <y>	w	

The consonants of Tima include ten plosives, with voiced and voiceless pairs at the bilabial, alveolar, palatal and velar places of articulation. However, the voiced velar /g/ is a marginal phoneme, and comparatively rare. The voiced palatal /ɟ/ is also relatively uncommon. The retroflex plosive /ʈ/ does not have a voiced counterpart (nor does the glottal stop, by definition). Note that the orthography uses an IPA dental symbol <ṭ> for the voiceless denti-alveolar /t/, while the regular printed <t> represents the retroflex plosive /ʈ/. However, while the phonemic /ʈ/ is indeed retroflex for many speakers, it is not universally so, and in actual fact speaker HKD in this illustration does not make a clear contrast between denti-alveolar /t/ and ‘retroflex’ /ʈ/. In our transcriptions of these sounds, we will use the IPA symbols, and add the orthographic presentation in brackets when orthography deviates from the IPA.

It should also be noted that /c/ is affricated, and could be characterized as more alveolo-palatal. In addition, the recordings show that intervocalic /d/ may be realized as [r], and final /l/ may have a fricative release. Please note that we do not provide a narrow phonetic transcription with each item.

Tima also has a bilabial implosive (which is not lexically frequent); four nasal consonants (bilabial, alveolar, palatal and velar); a contrast between an alveolar and a retroflex tap/flap; a single lateral; the glides /j w/; and the glottal /h/ (which is quite frequent). Note that Tima has no oral fricatives. In particular, the absence of the fricative /s/ may be noted – it has been suggested by Dimmendaal (2009: 334) that /h/ in Tima is the result of a historical shift *s > h.

The following give examples of the plosives and of the implosive in initial, intervocalic, and final position. Note that word-final /ʈ/ and /c/ are extremely rare. Note also that although an example is not given of an initial glottal stop, this sound is in fact often heard at the start of a vowel-initial word, and also word-final after a vowel.

	initial	intervocalic	final
p	pɛ̃ɛr <i>sharpen (imp sg)</i>	kəpàrtól <kəpàrtól> <i>third weeding</i>	-
b	bóórùk <i>throw it away (imp sg)</i>	kəbàràáj <i>bird sp.</i>	-

ʙ	ḅḅ <i>put (imp sg)</i>	kəḅá <i>hole</i>	-
t <ṭ>	táà <ṭáà > <i>tell (imp sg)</i>	kəṭààjíl <kəṭààyíl > <i>distribution</i>	-
d	dáà <i>run (imp sg)</i>	kùḍùwáh <i>digging tool</i>	-
ʈ <ṭ>	ṭàr <tàr > <i>small place without vegetation</i>	kəṭjàál <kəṭàál > <i>passing</i>	kúkúrét <kúkúrét > <i>mantis</i>
c	cəṭṭṛ <i>Adam's apple</i>	kìcirmá <i>cloud (rain)</i>	bààc <i>loess</i>
ʝ <j>	járâl <járâl > <i>secretary bird</i>	ìjìkíjík <ìjìkíjík > <i>sieves</i>	-
k	kàlùwàṭèk <kàlùwàṭèk > <i>nightjar</i>	kəṭààkèrík <i>widowbird</i>	kèrìṅṅèṭùk <kèrìṅṅèṭùk > <i>simsim cutter</i>
g	gíṅ <i>all</i>	kàgáágák <i>rufuous crowned roller</i>	-
ʔ	-	bùḍúʔàl <i>heat</i>	-

Plosives are rarely attested in word-final position – moreover, voiced plosives and the bilabial implosive are not attested in this position. Of the voiceless plosives in word-final position, /k/ is by far the most common (154 out of the 160 word-final voiceless plosive tokens in our database are /k/). However, author GS-B has noticed a ‘loss in progress’, where final /k/ is often unreleased or inaudible (see for example the word /kàlùwàṭèk/ *nightjar* in the list above, or /kìmλnúk/ *liver* given below for the vowel examples). When questioned, speakers claim that the sound is present; and when a noun is encliticised by demonstratives, for example, the /k/ is audible.

Figure 2 shows boxplots for burst/aspiration duration (i.e. positive Voice Onset Time, or VOT) for the voiced and voiceless plosives of Tima, as well as for the bilabial implosive /ʙ/ (the voiced velar /g/ is not included due to very small token numbers). As can be seen on the figure, voiced plosives tend to have a VOT of about 10–20 ms, whereas the voiceless plosives tend to have a VOT of about 20–30 ms for the bilabial, alveolar and retroflex, and about 30–55 ms for the palatal and velar. These differences in VOT for place of articulation are cross-linguistically typical (cf. Cho & Ladefoged 1999; Cho et al. 2019), and in general it can be said that the voiceless stops are not heavily aspirated. It is notable that both the voiced bilabial /b/ and the implosive /ʙ/ have similar very short VOT values of around 10 ms.

Figure 3 shows boxplots for mean Strength of Excitation (SoE) across the stop closure for word-medial tokens only. SoE is measured at the instant of significant excitation of the vocal-tract system during production of speech, and therefore represents the relative amplitude of impulse-like excitation.

It can be seen that the voiced plosives routinely have a much higher mean SoE than the voiceless plosives. Indeed, the very low value of about 0.01 for the voiceless plosives of Tima

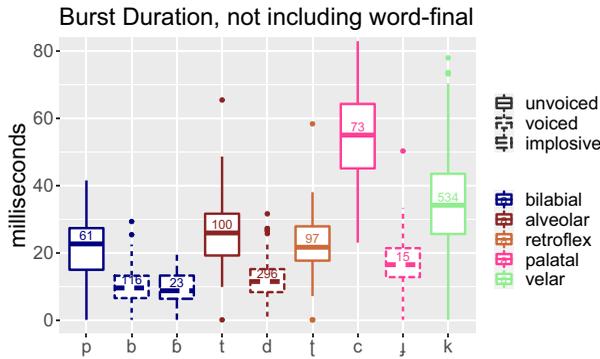


Figure 2. (Colour online) Burst/aspiration duration for 1315 tokens of the voiced and voiceless plosives and the bilabial implosive of Tima. Data are from word-initial and word-medial position. Numbers in the boxes indicate numbers of tokens.

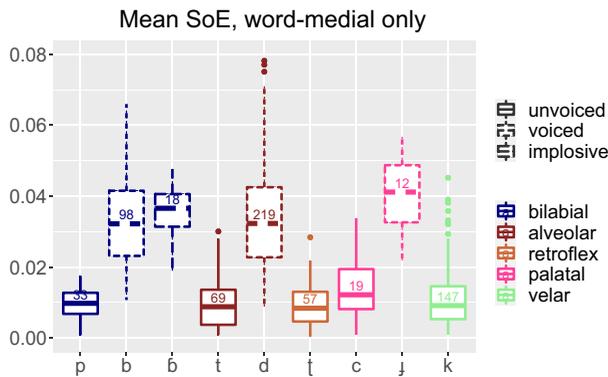


Figure 3. (Colour online) Mean Strength of Excitation for 672 tokens of the voiced and voiceless plosives and the bilabial implosive of Tima. Data are from word-medial position only. Note that there are only eighteen tokens of /b̥/ and twelve of /j/. Numbers in the boxes indicate numbers of tokens.

suggests a voiceless sound. This suggests that there is a ‘true voicing’ contrast in Tima (as noted above, the voiceless stops are not heavily aspirated). Finally, one may note that there appears to be evidence for a greater SoE for the bilabial implosive /b̥/ as compared to the regular voiced plosive /b/.

Figure 4 shows the boxplots of closure duration for the same consonant sounds. It can be seen that the voiced plosive closures are noticeably shorter than the voiceless closures (cf. Lisker 1957), and that there is a cross-linguistically common place effect whereby the more posterior places of articulation have a shorter closure than the more anterior places of articulation (Maddieson 1997). However, the most interesting point to note on this plot is that the bilabial implosive /b̥/ has a noticeably longer closure duration than the regular bilabial /b/ (a mean value of 79 ms for /b̥/ versus 55 ms for /b/). This is the main acoustic difference we have found between the bilabial plosive and the bilabial implosive. Whilst the SoE data above suggest slightly stronger voicing for the implosive, it is not clear how this (i.e. longer closure duration combined with stronger voicing) is achieved in terms of articulatory strategies – this is a topic for further instrumental investigation. It should also be noted that the bilabial implosive is much less common than the regular bilabial in our data – there are only eighteen word-medial tokens of /b̥/ compared to ninety-eight tokens

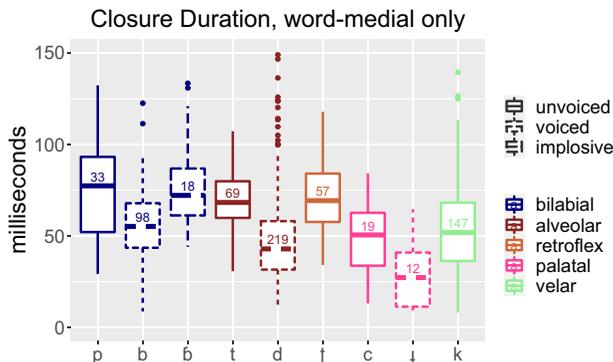


Figure 4. (Colour online) Closure duration for 672 tokens of the voiced and voiceless plosives and the bilabial implosive of Tima. Data are from word-medial position only. Numbers in the boxes indicate numbers of tokens.

of /b/, but even this ratio is likely to be exaggerated, since we made an effort to include as many implosives as possible in our database.

The sonorants (and also /h/ – see below) are attested in syllable-initial and syllable-final position. The following gives examples of nasals:

	initial	intervocalic	final
/m/	m̀l̀r̀í̀m̀l̀r̀á̀t̀á̀ŋ < m̀l̀r̀í̀m̀l̀r̀á̀t̀á̀ŋ > kwèéŋ <i>decorate the bowl (imp sg)</i>	k̀d̀r̀ù̀m̀á̀l ³	ìh́áám <i>honey</i>
/ɲ/	ŋéèŋ <i>lick (imp sg)</i>	k̀ó̀j̀d̀ < k̀ó̀ỳd̀ > ɲ̀ù̀r̀á̀ŋ <i>do (imp sg) work</i>	b̀ù̀r̀á̀ŋ <i>handle of knife</i>
/n/	ǹl̀r̀ú̀b̀ú̀j̀ú̀k < ǹl̀r̀ú̀b̀ú̀ỳú̀k > <i>meet (imp pl)</i>	ǹà̀ŋ̀ó̀ǹá̀á̀k <i>make (imp pl) love</i>	k̀è̀m̀à̀à̀n <i>dried mush of pound tamarind fruits</i>
/ŋ/	ŋ̀ó̀h̀d̀ <i>limp (imp sg)</i>	k̀ù̀ŋ̀à̀r̀s̀l̀ <i>snoring</i>	k̀ù̀r̀ú̀k̀ù̀r̀ú̀m̀á̀à̀ŋ <i>sorghum sp.</i>

Note that there are two (near-)minimal pairs involving the nasals /m/ and /n/ in word-final position.

céɛm	céɛn	káàm	kààn
<i>Grewia sp.</i>	<i>face</i>	<i>hair</i>	<i>huge flat stone</i>

Nasals may serve as the nucleus of a syllable and carry tone, for example:

ímbéèh	ńt́f̀b̀èŋ <ńt́f̀b̀èŋ >	ɲ̀c̀éèŋ	ìŋ̀k̀ó
<i>extremely</i>	<i>continuously</i>	<i>immediately</i>	<i>is/was</i>

There are many examples of homorganic nasals plus stops (note that aN- is the third person perfective marker):

³ Due to the faster speech rate, the difference between the first two vowels separated by /r/ is difficult to perceive.

	with aN-	within nouns
Nb	(àbîr,) ámbòò (kùtúk; ñjλwù? <kùtúk; íyλ wù?>) (Abeer)-she-has-put-(the-bread-away; for who?)	kəhámɓà peel of sugarcane
Nb	àmbòòl something has been lost	kλmbálì bateleur
Np	àmpóòrùk (s)he has/they have left angrily	pámpâŋ drum
Nc	àncáák (àhàróm) sth. has become (brittle)	kúncàl father of all Julut
Nd	ándəŋààtán <ándəŋààtán> sth. has gone sour	təndòò <təndòò> road
Nt <Nt>	àntáánàk <àntáánàk> they have beaten each other	párintáŋ <párintáŋ> gap
Nt <Nt>	àntáák↓úrá↓átán <àntáák↓úrá↓átán> ⁴ sth. has gone mouldy	kúntún <kúntún> tailbone
Nk	àŋkúmùn (s)he has/they have found	tùlùŋkúmé <tùlùŋkúmé> flying mouse

However, there is also the exceptional cluster /md/:

tλmdúlúŋ <tλmdúlúŋ>
spotted hyena
támdókék <támdókék>
whip (leather)

The liquids also occur in both syllable-initial and syllable-final positions. Note that we use the symbol for an alveolar trill /r/, rather than a tap /r/, for typographic convenience, even though most of the productions of this sound tend to be a tap rather than a full trill.

	initial	intervocalic		final
l	lálà follow (imp sg)	kìlìh fat	céélè trading	kùmúùl bull
t	tíítk shelter	cìtìŋkìŋ less than half filling	céér brother-in-law	kóréét robin chat
r	ránkàl crawl (imp sg)	kìirìk Ipomea cordofana	céról cane	kùmúùr ground (salty)

⁴ Note that the symbol ↓ is a downstep – this will be discussed below in the section on tone.

There is a minimal set for the liquids:

pùlí	pùrí (ítàn <ítàn>)	pùrí (itɪŋkɪk)
blow out (<i>imp sg</i>)	warm up (<i>the sauce</i>) (<i>imp sg</i>)	spit (<i>mariisa</i>) (<i>imp sg</i>)

Figure 5 shows a near-minimal pair for the contrast between the two rhotics /r/ and /ɾ/ in the words (a) /kùrùh/ *push* and (b) /kùɾùr/ *side arm of the big river*. It can be seen that the retroflex /ɾ/ (labelled as ‘R’) has a clearly falling F3 in the preceding vowel when compared with the alveolar /r/, in intervocalic position. In addition, the /r/ in word-final position in the word /kùɾùr/ shows some (perhaps fricated) trilling, with two clear pulses evident in the time-waveform.

The following gives examples of the glides /j/ and /w/ and the glottal /h/ in different positions. Note that the word /kúj/ <kúy> is pronounced by older speakers as [kúð] - example pairs of that kind show that younger speakers seem to have reanalysed a previous dental fricative as a palatal glide.

	initial	intervocalic	final
j <y>	jéɛn <yéɛn> <i>faces</i>	jòrkóǰò <yòrkóyò> <i>Indigofera oblongifolia</i> (pl)	kúj <kúy> <i>locust</i>
w	wèníǰà <wèníyà> <i>sorghum kind (sweet)</i>	kùdùwáh <i>digging tool</i>	-
h	hêŋ <i>honey badger</i>	kùròhònúl <i>changing</i>	kútàh <kútàh> <i>Sudan teak</i>

Apart from sequences of nasal plus stop, the only consonant clusters found in Tima are stops plus the glide /w/. Stop-plus-glide clusters are limited to syllable-initial position.

	initial	intervocalic
kw	kwàlèél <i>burying</i>	kúkván <i>opening</i>
gw	gwálè <i>Gwale clan</i>	-
tw <tw>	twâr <twâr> <i>different</i>	bùtwâr <bùtwâr> <i>difference</i>
dw	-	ídwà ⁵ <i>vultures</i>

⁵ The sequence /dw/ may have arisen through a process of metathesis, e.g. /ídwl/ *vultures* has the singular /kúdwl/ *vulture*. To form the regular plural, initial /k/, which indicates singular, is replaced by /i/. In a number of nouns where the first sound of the root is the high back vowel /u/ (as is the case here), this sound is moved to the position after the first consonant of the root and then labialized: iudɔ → iduɔ → idwɔ.

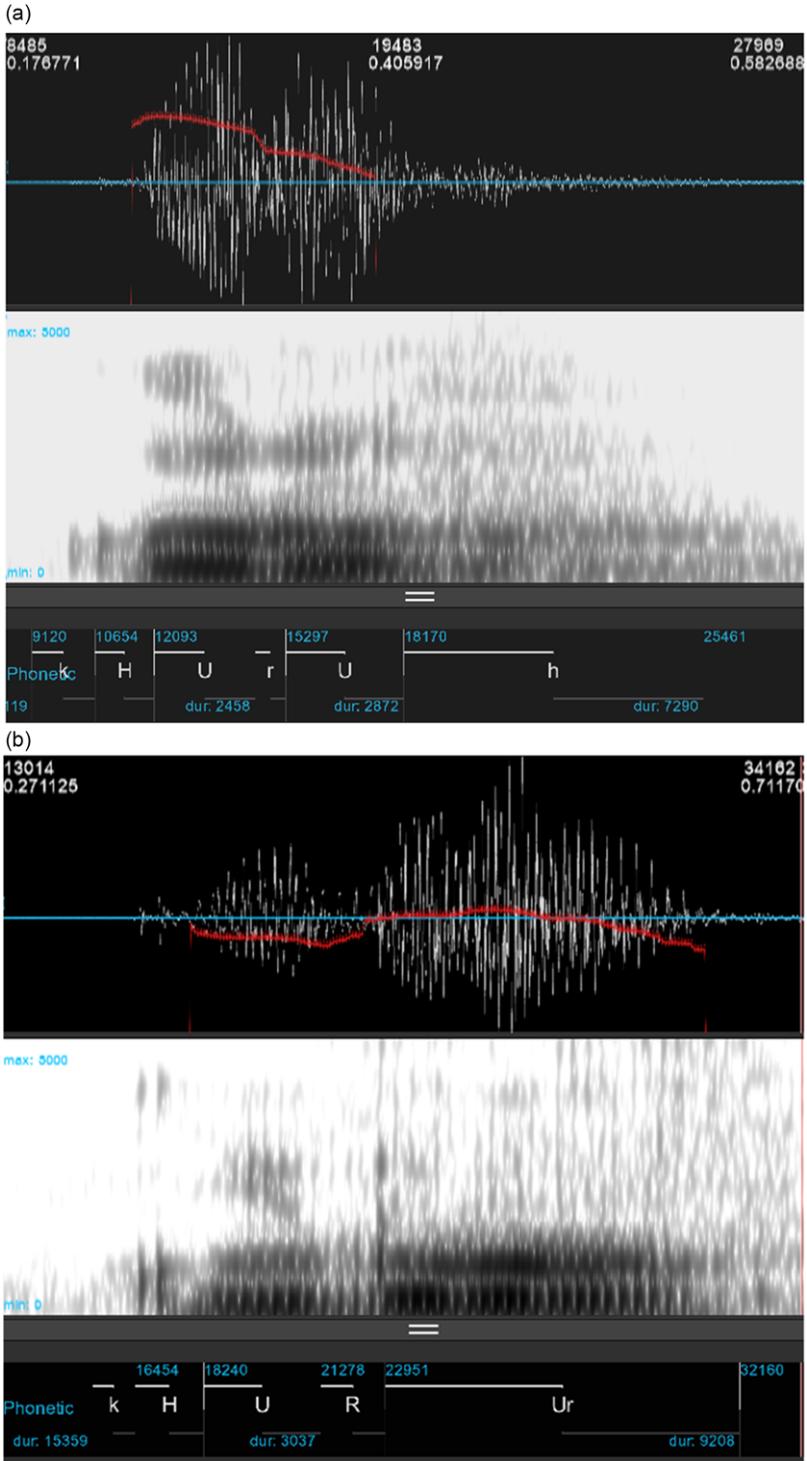


Figure 5. (Colour online) Time waveforms and spectrograms for the words (a) /kúrùh/ *push* and (b) /kùrûr/ *side arm of the big river* as produced by speaker HKD. The red line on the time-waveform shows f_0 (range 50–250Hz). The spectrogram shows the range 0–5 kHz. Note that in the phonetic labelling, ‘R’ denotes /r/ and ‘H’ marks aspiration.

hw hwéèl `hwáà
 whistle (*imp sg*) people

The fricatives [f s z] are only attested in loanwords, e.g.

/ifúndùk/
mortars from Arabic <funduk> (*i* is a Tima plural prefix)

/mùftáàh/ <mùftáàh>
key from Arabic <muftāḥ>

/kùmóòs/
banana from Arabic <mōz> (*ku* is a Tima singular prefix)

Mostly, sounds from Arabic that are unfamiliar to the Tima speakers, are adapted to the sound system of Tima. For instance, Arabic [ʃ] and [s] are most often realized as [ç], as in:

/càáná/
because from Arabic <‘ashān>

/pácàl/
onion from Arabic <baṣal>

The postalveolar [ʃ] is regularly used for the Arabic word <shāy> *tea* that people in Tima would prefix with their plural marker and yield [iʃá:hì] (here [iʃá:i]) <ishááhì> ‘tea’ that alternates with [icá:hì] <icááhì>.

Vowels

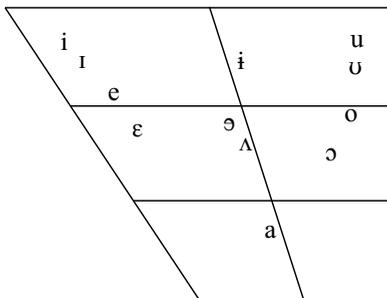


Table 1. Different representations of Tima vowels.

Orthography		IPA	
+ATR	-ATR	+ATR	-ATR
i	ɪ	ɪ̣	ɪ̥
e	ɛ	ẹ	e̥
ʌ	a	ʌ̣	ʌ̥
o	ɔ	ọ	o̥
u	ʊ	ụ	u̥
ɨ	ə	ɨ̣	ɨ̥

Table 1 shows the vowels of Tima as they are represented in the orthography of the language, and also as they would be represented formally in the International Phonetic Alphabet – namely, with diacritics for ATR. It can be seen that the language orthography makes use of the International Phonetic Alphabet; however, as can be seen from the vowel chart at the beginning of this section, these vowels do not occupy their traditional positions in the quadrilateral of cardinal vowels. Since diacritics are difficult to read, we will continue with using the vowel orthography in this Illustration. However, the reader is alerted that /a/ represents a low central –ATR vowel like [ɐ], and that /ʌ/ represents a mid central schwa-like +ATR vowel (rather than a back vowel).

The following examples illustrate the Tima vowels in different positions (see below for discussion of the long/short vowel contrast):

	initial	between Cs	final
a	árɪŋ <i>decant (imp sg)</i>	járâł <járâł > <i>secretary bird</i>	kùdùwá <i>standing up repeatedly</i>
a:	áápɔ̀lâwààŋáŋ <i>if you want</i>	kə̀bààrsɪ <i>peeling sth.</i>	ìùwáà <i>tamarind (soaked)</i>
ʌ	łłʌ <łłʌ > <i>namesake</i>	kíbłŋ <i>pour (repeatedly) (imp sg)</i>	kùdùwł <i>forked pole</i>
ʌ:	-	kíbłłłŋ <i>friend</i>	kùwùłłł [ku::lɪ:] <i>orphan</i>
ə ⁶	ódàhî <i>(s)he / they said to somebody</i>	kə̀pə̀rɛ́éł <i>smearing, painting</i>	
ɨ ⁷	ìkálwúl (kwɔ̀ɔ̀ kùłł) <i>(s)he / they refused (to go yesterday)</i>	kìmínł <i>snake</i>	

⁶ The –ATR high central vowel [ɨ] is attested neither word-finally nor as a long vowel.

⁷ The +ATR high central vowel [ɨ̣] is not attested word-finally.

i:	fih <i>peel</i>	ṛíík <i>shelter</i>	
ε	éndúkùk <i>it is dripping</i>	kijèmpèrè <kìyèmpèrè> <i>serval</i>	kàtè <kàtè> <i>cigarette</i>
ε:	-	ìwèélâṅ <i>windows</i>	línḗ <i>east</i>
e	-	kìrélṁṅ <i>hippo</i>	kúrété <kúrété> <i>Boraginaceae sp.</i>
e:	éèni <i>grind (imp sg)</i>	κλήυ κúrèén <i>locust sp.</i>	kinèè <i>sun</i>
ɪ	ìbàbáj <ìbàbáy> <i>Sodom's apples</i>	kád↓ínkád↓ín <i>parietal bone</i>	hùhúwì <i>point at sb. when quarreling</i>
ɪ:	íídí <i>thorns</i>	kìtìjíl <kìtìyíl> <i>shiver (n)</i>	cîrkî <i>maternal clan sp.</i>
i	ìbóónìn <i>girls</i>	mímíṅ <i>grass for potmaking</i>	hùwí <i>kindle (imp sg)</i>
i:	íídì <i>water</i>	kìpìtìjíl <kìpìtìyíl> <i>freeing</i>	kwârkkî <i>seed of Balanites aegyptiaca</i>
ɔ	ùʔóóṅ <i>no</i>	ìlóbà <i>seed grain</i>	kàntórábú <kàntórábú> <i>plant sp.</i>
ɔ:	-	kùdùùlá <i>creek</i>	cflùù <i>half-digested food</i>
u	úlù <i>polish (imp sg)</i>	kùdùkwâṅ <i>tail feather</i>	káhád↓ú <i>seed dish</i>
u:	-	kùhùndúúl <i>hopping</i>	nllùú <i>push down (imp pl)</i>
ɔ	óhà <i>clean (imp sg)</i>	kòdòjón <kòdòyón> <i>heart</i>	pónò <i>be quiet (imp sg)</i>
ɔ:	-	nàdóójáy <nàdóoyáy> <i>stand (imp pl) up with him</i>	kwòó <i>family father's side</i>
o	-	kùbòròtúl <i>promotion</i>	kóló <i>shame</i>
o:	-	kúlóólíṅ <i>snail</i>	pùrmòò <i>rescue</i>

The following are some (near-)minimal pairs involving the ATR contrast:

-ATR	+ATR
íhì	íhì
<i>milk (imp sg)</i>	<i>soil, earth</i>
(kə̀ɾəkà) kóló	kóló
[place name]	<i>shame</i>
kəmàɲók	kəm̀ɲók
<i>ant</i>	<i>liver</i>
číɲí	číɲì
<i>fire</i>	<i>excrement</i>
kìdî	kìdî
<i>shelter</i>	<i>back</i>
kàwóh	káwùh
<i>white hair</i>	<i>stone</i>
áwùl	áwùl
<i>escape (imp sg)</i>	<i>refuse (imp sg)</i>
kùrì	kùrì
<i>ritual house of the kujuur</i>	<i>force</i>
kwáà	kwàà
<i>tamarind</i>	<i>rope</i>

As already mentioned, particularly unusual in the Tima system is the presence of a low central vowel pair +ATR /ʌ/ versus -ATR /a/, as well as a high central vowel pair +ATR /i/ versus -ATR /ɨ/. Figure 6 shows the vowel formant results for our three speakers' data. It can be seen in Figure 6a that the -ATR vowels (in navy) occupy a much larger space than do the +ATR vowels (in brown). The 'floor' of the vowel space is raised for the +ATR vowels. In fact, the phonemically low +ATR central vowel /ʌ/ is quite high in the vowel space, at the same level as the mid +ATR vowels /e/ and /o/. In the absence of an ATR system, the vowel /ʌ/ might more accurately be described as a schwa-like vowel. Indeed, it has been observed that for languages having an ATR contrast in the low vowels, the [+ATR] low vowel is often not actually phonetically low (Casali 2008).

Figure 6b shows the +ATR and -ATR vowels combined. Here, it can be seen that the low central +ATR /ʌ/ occupies a very similar space to high central -ATR /ɨ/. Impressionistically, both sound quite schwa-like, and different from the +ATR high central vowel /i/, which sounds more like its cardinal vowel value (as already noted, the low central -ATR vowel sounds like IPA [ɐ]). Thus, the low central ATR vowel pair /ʌ/ and /a/ do not occupy the same portion of the vowel space, and /ʌ/ in fact overlaps with high central /ɨ/.

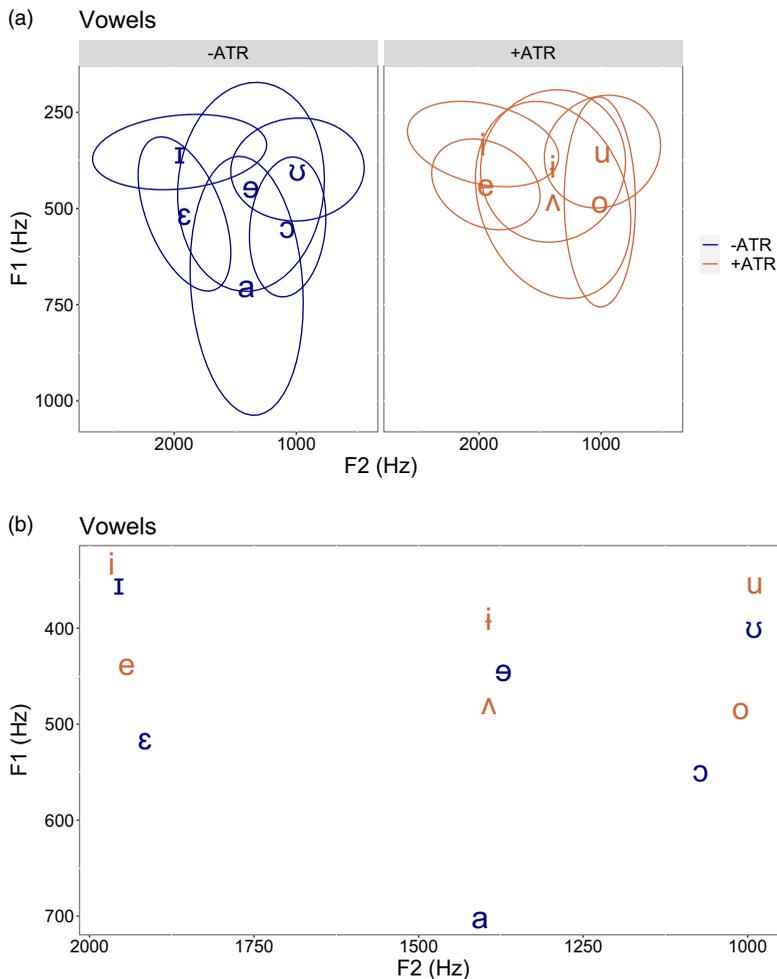


Figure 6. (Colour online) Vowel plots showing mean formant values for 2213 tokens (note that 279 tokens with measured F2 higher than 2200Hz, and/or F1 higher than 1000Hz, were removed from the database before plotting). Short and long vowel data are combined. (a) Vowels presented separately for +/-ATR, with 95% confidence ellipses. (b) Vowels combined on the one plot without ellipses.

An additional, important, difference between +ATR and -ATR vowels is in voice quality. Tabain et al. (in press) show that, as measured by spectral tilt in the 0.1 to 1.0 kHz range and by $H1^* - H2^*$ (the difference between the first and second harmonics), the +ATR vowels have a more open glottis. The +ATR vowels also have a greater strength of glottal excitation (as presented above for plosives), which may be due to the larger oro-pharyngeal cavity facilitating voicing when the tongue root is advanced (measures of harmonic-to-noise ratio, such as Cepstral Peak Prominence, do not appear to separate out -ATR from +ATR in Tima). However, the various ATR differences in voice quality are moderated by an interaction with vowel height (for instance, high vowels have a greater magnitude of spectral tilt than low vowels, suggesting greater vocal fold spread for the high vowels – see Figure 7). The reader is referred to Tabain et al. (in press) for further discussion of the importance of the multiple acoustic features for the ATR contrast in Tima, and for a comparison between the ATR systems of Africa with the register systems of South-East Asia.

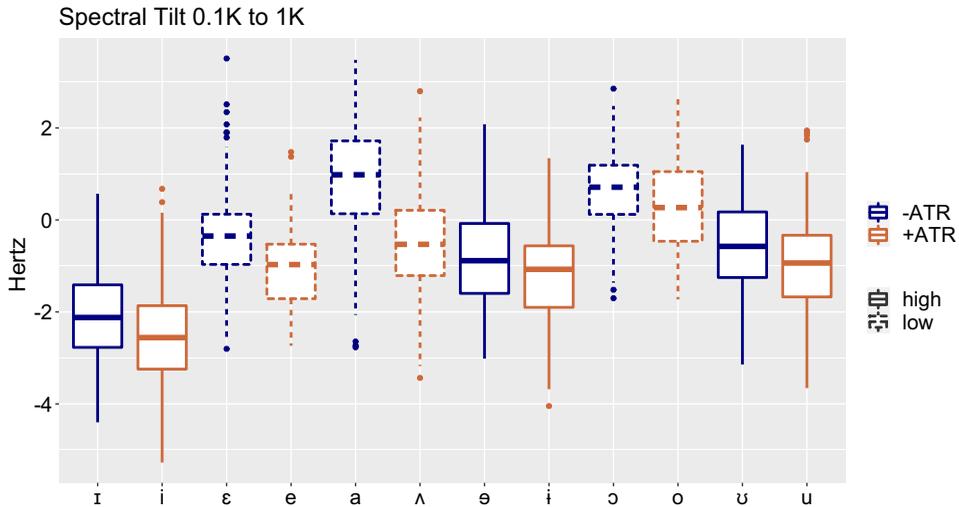


Figure 7. (Colour online) Boxplots showing spectral tilt in the frequency range 0.1kHz to 1.0kHz according to +/-ATR (in colour) and according to vowel height (in linetype). 2492 long and short vowel tokens are combined in this plot.

Vowel length

Tima vowels can be long and short. However, long vowels are much less common than short vowels, making up about 20 per cent of the database (410 out of a total of 2492 vowel tokens) – and this is even after special effort to include more long vowels.⁸ Table 2 shows duration in milliseconds for the long and short vowels of Tima, including the ratio of long vowel to short vowel (mean) duration. It can be seen in this table that the mid vowels are in general less common than the high or low vowels, although this is more true for the +ATR mid vowels than the -ATR mid vowels (the pattern is less obvious for the long vowels, since as noted, we made an effort to include more long vowels in the database). It can also be seen that while the short vowels range from about 40 ms to about 110 ms, the long vowels range from about 140 to 210 ms. The ratio of long to short vowel duration ranges from 1.33 for /ε/ to 3.13 for /i/, but is typically around 2.00. (Note that the long vowel /ɪ/ has a particularly long duration, longer than the long low vowels – it is possible that this may be an idiosyncrasy of the words in our database).

The high central -ATR vowel /ə/ only occurs as a short vowel: it has a mean duration of 41 ms. By contrast, the +ATR /ʌ/ has a mean duration of 79 ms. The -ATR vowel /ə/ is therefore a very short vowel.⁹ It may be noted that this broadly fits in with the cross-linguistic pattern that high vowels are shorter than low vowels (cf. Solé & Ohala 2010) – and in Tima, /ʌ/ is phonologically a low vowel. Tabain et al. (in press) show that the high -ATR /ə/ also has less energy than the 'low' +ATR vowel /ʌ/.

⁸ It should be noted that most of the vowel tokens are produced by one speaker (1786 tokens for HKD, compared to 531 tokens for NAK and 175 tokens for KAM). This is indicative of the number of words recorded by each speaker.

⁹ Preliminary investigation suggests that prefix as well as certain suffix vowels are shorter than root vowels. Since /ə/ occurs in the prefix more often than in the root, the mean duration may be skewed towards shorter values. Note that /i/ also occurs as a prefix in our data base, while /ʌ/ and /a/ do not. Also, in certain other environments (e.g. identical vowels in adjacent syllables separated by a sonorant/glide), a vowel can be very short.

Table 2. Mean, standard deviation and number of tokens for long and short vowel durations in Tima (in milliseconds). The final column gives the ratio of long/short vowel duration.

Short	Mean	S.D.	N.	Long	Mean	S.D.	N.	RatioLong/Short
-ATR								
ɪ	87	59.9	183	ɪ:	214	80.2	30	2.45
e	113	49.5	80	e:	151	35.4	35	1.33
a	87	42.9	362	a:	155	42.3	110	1.78
ə	41	19.6	118	ə:	–	–	–	–
ɔ	94	37.4	126	ɔ:	176	64.1	60	1.87
ʊ	66	37.4	166	ʊ:	170	43.5	19	2.57
+ATR								
i	80	46.2	314	i:	162	63.0	59	2.02
e	107	60.5	19	e:	174	47.7	31	1.62
ʌ	79	38.0	258	ʌ:	184	60.9	22	2.32
ɪ	45	20.9	135	ɪ:	141	23.9	10	3.13
o	100	55.1	36	o:	140	25.8	11	1.40
u	71	39.2	285	u:	149	48.9	23	2.09

The following are some (near-)minimal pairs involving vowel length:

cimí	címì
<i>collect (imp sg)</i>	<i>goat</i>
ìdìf	ídí
<i>legs</i>	<i>thorns</i>
kədàtúɪ <kədàtúɪ>	kədàtúúɪ <kədàtúúɪ>
<i>winnowing sth.</i>	<i>winnowing</i>

As just mentioned, long vowels are relatively rare in Tima. It is assumed that a number of them originate from a loss of intervocalic consonants which can be seen by comparing data from Katla (data provided courtesy of Birgit Hellwig – however there is no audio included in the present illustration). Consider the following three examples (see also Dimmendaal 2018: appendix).

Katla	Tima	Gloss
gágâm	káàm	<i>hair</i>
ògíl	éèl	<i>buy</i>
gágá	káá	<i>porcupine</i>

Synchronically, the long vowels may be treated as long monophthongs that are able to license contour tones by virtue of being bimoraic.

ATR harmony, back harmony, fronting harmony

As many of the examples presented in this paper show, the ATR value of the root determines the ATR value of the prefix, here the singular prefix *kV-/cV-*. Consider the following examples (presented in the table on ATR distinctions above), with the morpheme boundaries indicated.

-ATR	+ATR
kə-màrúk	kì-màrúk
<i>ant</i>	<i>liver</i>
cì-ŋí	cí-ŋì
<i>fire</i>	<i>excrement</i>
kì-dî	kì-dî
<i>shelter</i>	<i>back</i>

Furthermore, these prefixes indicating singular (as well as plural) number (and a number of verbal suffixes, such as middle voice and causative) exhibit front/back harmony. The height of affix vowels is invariable, i.e. they are always high. Consider the following examples, some of them again being repeated.

prefix vowel

front	central	back
cí-ŋì	kí-d̥r̥ŋá	kù-hùndúúl
<i>excrement</i>	<i>early afternoon</i>	<i>hopping</i>
cì-ŋí	kə-mərtáà < kəmər̥táà >	kù-búlà
<i>fire</i>	<i>horse</i>	<i>loss</i>
kì-ŋélm̥ŋ	kì-màrúk	kú-lóólìŋ
<i>hippo</i>	<i>liver</i>	<i>snail</i>
kì-bèéy	kə-mààn	kù-mój̥ðh < kùmóy̥ðh >
<i>person</i>	<i>dried mush of pound tamarind fruits</i>	<i>necklace with pearls</i>

For more examples of front/back harmony (and a change in the system), including the harmonic behaviour of both affixes and clitics, see Bashir (2010: 121 ff., and Chapters 5 and 6), and Dimmendaal & Schneider-Blum (in preparation).

Tones

Though a thorough tonal analysis of Tima is still pending, we can say with some confidence that Tima has a two-tone system, H and L (High and Low), with an additional downstepped high tone ↓H (the conditions for which are described below). The tone-bearing unit is usually a vowel but may be a syllabic nasal at the beginning of the word or a sonorant coda. In addition, the H and L tones can combine on the syllable rhyme (i.e. on a long vowel nucleus; or on a short vowel nucleus plus sonorant coda) to produce rising LH and falling HL tones. Note also that phonetically the second element of a contour tone may be realized on the adjacent sonorant. One word, /kàgáágâk/ *rufuous crowned roller*, is attested which has the falling tone on a short vowel preceding the plosive /k/. At our present status of knowledge, we do not know how this fits in with the general analysis.

Tone can be used to produce minimal pairs at the lexical level (e.g. within the noun class) or at the grammatical level (e.g. noun versus verb; single action versus pluractionality; telic/atelic distinction). Minimal or near-minimal pairs in tone are quite common in Tima.

The following are some minimal pairs involving tone:

kólò	(kə̀rəkà) kóló	
<i>Boscia angustifolia</i>	[place name]	
kùdà	kúdá	kùdá
<i>shoe</i>	<i>python</i>	<i>jelly plum</i>
céén	cêên	
<i>mistletoe</i>	<i>face</i>	
kìdî	kìdí	
<i>shelter</i>	<i>leg</i>	
kálòh	kàlòh	
<i>Derby's eland</i>	<i>second weeding</i>	
ìhì	íhì	
<i>milk (n)</i>	<i>milk (imp sg)</i>	
dǝjá <dǝyá>	dǝjà <dǝyà>	
<i>steal it (imp sg)</i>	<i>keep stealing (imp sg)</i>	

The downstepped tone ↓H only occurs following a H tone, usually within the same word, but, as can be seen in the transcribed passage below, also across syntactic boundaries (consider e.g. ɲǝɲáɲǝn↓á pínλǝ̀ *its use*). The following illustrate the process of downstep:

póɾ↓óm̩póɾ↓ón̩	dúɾúm̩p↓ón̩	àlbééb↓ék	kááh̩p↓ós
<i>wasp sp.</i>	<i>zorilla</i>	<i>it is softish</i>	<i>fontanel</i>

The last item /kááh̩p↓ós/ *fontanel* is a transparent construction, originating from /káàh̩ àpós/ *the head is soft*. This and similar examples allow us to assume that the downstep in a number of cases came into being by loss of a low tone-bearing unit, or by high tone spreading to a low tone-bearing unit, causing the low tone to become un-associated, and thereby

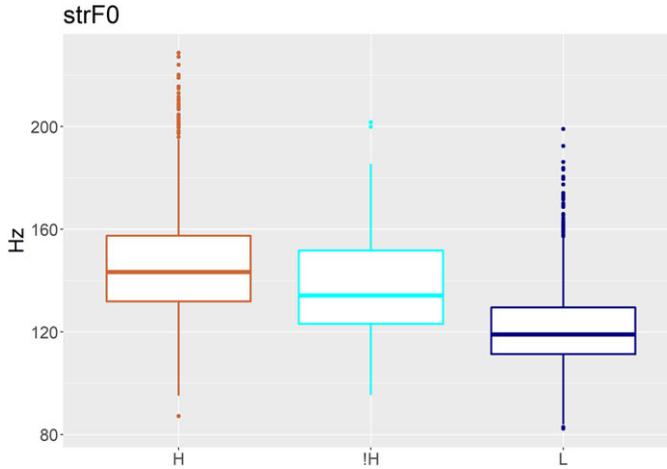


Figure 8. (Colour online) Boxplots showing f_0 (2326 tokens), sampled at the temporal midpoint of the vowel. Long and short vowels are combined, but contour tones are excluded. Data are from three male speakers. F_0 values of less than 80Hz and more than 230Hz were removed as outliers. Note that !H denotes \downarrow H.

triggering downstep. For more information see Dimmendaal & Schneider-Blum (in preparation). With some words, such as /pór \downarrow ómpór \downarrow ónɛ/ *wasp sp.* and /dúrómp \downarrow óɛ/ *zorilla*, the existence of the low tone cannot be proved any more, i.e. the words are lexicalized containing the down-stepped high tone. Since examples of that kind are so rare, we do not consider this tone as a toneme, but by analogy to /káàh àpó/ *the head is soft* as downstepped high.

In summary, the tonal system is characterized by a rather complex system of tonal processes conditioned by morphology and syntax. However, further detailed study of this system is required.

Figure 8 shows boxplots for f_0 for the H, \downarrow H (labelled !H) and L tones. It can be seen that the \downarrow H tone indeed patterns phonetically as a mid tone, intermediate between the H tone and the L tone.

Figure 9 shows GAM-smoothed f_0 plots for the simple tones of Tima on both long and short vowels, and for the contour tones of Tima (on long vowels only). Data are time-normalized over the duration of the vowel. It can be seen that the H tone has a later peak on long vowels than on short vowels (brown line in the panels labelled ‘short’ and ‘long’). It can also be seen that the downstepped tone (labelled ‘!High’ on this plot) begins high, and drops off quite rapidly over the course of the vowel, be it short or long (cyan line). It can also be seen that the low tone becomes lower over the course of the vowel (navy line in the panels labelled ‘short’ and ‘long’) – and that the alignment of the low tone and of the downstepped tone are similar. It should be noted that there are many more short tokens in this plot than long tokens (2057 short, 268 long and 194 contour), so the grey bands show much greater overlap for the long vowel tokens than for the short vowel tokens. Note also that the wide grey bands for the downstepped High tone may indicate typical behaviour of an allotone, or else may be due to the relatively small numbers of tokens of the downstepped High.

Finally, it is clear that for the contour tones (where light green denotes a falling tone HL, and pink denotes a rising tone LH) there is a clear early peak for the falling tone, and a late rise for the rising tone. The early peak for the falling tone HL is relatively earlier than the peak for the simple H tone in both the short and long vowel contexts.

It may be worth noting that in our database, most monosyllables have a falling tone HL (fifty-nine out of eighty-six monosyllabic words). Moreover, most monosyllables have long

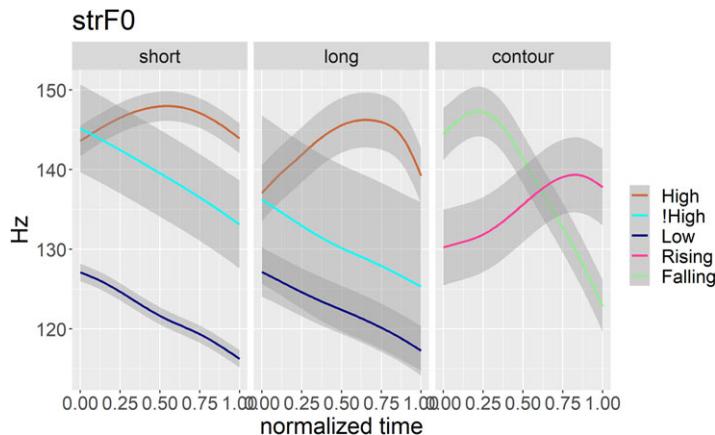


Figure 9. (Colour online) GAM-smoothed timeplots showing f_0 (2519 tokens). Data are shown separately for short vowels (simple tone); for long vowels (simple tone); and for long vowels with a contour tone. Data are from three male speakers. F_0 values of less than 80Hz and more than 230Hz were treated as NA values for the purposes of plotting. Grey bands surrounding the smoothed lines denote confidence intervals. Note that 'High' denotes the downstepped \downarrow High tone. Note also that in the panel labelled 'contour', the light green line denotes a falling contour HL, and the pink line denotes a rising contour LH.

vowels or sonorant codas. In polysyllabic words, contour tones are more likely to occur on the last syllable of a word. Polysyllabic words are also more likely to begin with a Low tone. However, this last point may reflect the fact that our database is dominated by nouns, and initial H tones may be more frequent if we included more verbs in our database.

Syllable structure

The syllable may be open or closed, i.e. the coda position may be filled or empty. The syllable onset is also optional. A monosyllabic independent word, however, must be bimoraic, i.e. it must consist of a heavy syllable CVS (where coda 'S' is specifically a sonorant) or (C)VVC). There are no monosyllabic independent words with the structure CV or VC – these are only found in clitics. Examples of permissible structures in independent lexical items include /gíŋ/ *all*, /dáà/ *run*, /éèl/ *buy*, and /c'éèn/ *face* from the tables above. The monosyllable /íi/ *eyes* with its VV structure is rather exceptional.

Tima has mainly mono- and disyllabic roots, with trisyllabic roots being quite rare. Whenever the root contains three or more syllables, reduplicated roots or lexicalized frozen compounds are involved (with the parts no longer being fully transparent). With regard to reduplication, consider for example the above-mentioned lexeme /kád↓íŋkád↓íŋ/ *parietal bone*. With regard to semi-transparent compounds, consider /kááhp↓s/ *fontanel* mentioned above, as well as /kéŋéd↓í/ *waterplace*, which can be traced back to /kíŋè/ *mouth* and /íidi/ *water*.

Grammatically complex words in Tima tend to be polysyllabic as a result of inflectional and derivational affixation. An example is /àntáánàk/ *they have beaten each other*, with the person/TAM (Tense-Aspect-Mood) marker an- preceding the root taan, in turn suffixed by the antipassive marker -ak. Cliticization results in the formation of even more complex phonological words. Consider, for example the above-mentioned /mlɛ́ɛ́mɛ́ɛ́ɛ́táŋ (kwééŋ)/ < mlɛ́ɛ́mɛ́ɛ́ɛ́táŋ (kwééŋ) > *decorate (the bowl)*, which consists of a reduplicated root cliticized by the source marker =a and the locative marker =tɛŋ.

Transcription of recorded passage

The transcription is broadly phonemic. An orthographic version including morpheme breaks is also given, followed by interlinear glosses and a translation into English. Pause units are marked by | in the first line, and in some cases ||, with the latter corresponding to a final (usually falling) intonation.

Phonemic transcription

Practical orthography (with morpheme breaks)

English gloss, making use of the following grammatical abbreviations:

CAUS=causative; COND=conditional; COP=copula; DEM=demonstrative; DIR=directional; EP=epenthetic element; ERG=ergative; FOC=focus; IDEO=ideophone; INCL=inclusive; INS=instrument; LOC=locative; NEG=negation; P=person; PL=plural; PRO=pronoun; PROX=proximal; REM=remote; REP=reported; SEL=selective; SG=singular; SRC=source; TR=transitive; VENT=ventive.

Free translation

kwɔ̀ɔ̀ɔ̀wú | ɲòɲáɲón ↓ á pínɔ̀ɔ̀ | àààà |

kw-ɔ̀ɔ̀wú, ɲɔ̀ɲáɲ = ɲ = na pínɔ̀ = yi, àààà

SG-sausage.tree SG.work=EP=DEM.PROX PRO3SG=SEL àààà

the *Kigelia africana* (sausage tree), its use (lit.: this work of it), àààà [hesitation],

ùkùɲkwáɲ ímìɲàwàwààjàɲ ícíd ↓ á kóó jùídá |

u = kuɲkwáɲ í-mɲáwá-wáá = yáɲ i = c-idá k-óó yùídá,

COND=something P-swell-INS=LOC3P DIR=SG-body SG-family LOC:body

if there is some swelling (e.g. caused by the sting of a bee) at the body of a person,

àwò kùrùh |

awò ku-ruh,

or SG-hard.swelling

or a hard swelling (= swelling of the lymph node),

kùɲkwáɲ kw ↓ ájáɲ ↓ ɲkwíjɔ̀ tána ɲihwáá ɲkùrùh | díɲàjèèj àkíɲè twàk iídá ↓ |

kuɲkwáɲ k-wayáɲ ɲkwíyɔ̀ tána ɲ = ihwáá ɲ = ku-ruh,

something SG-sickness COP call ERG=people INS=SG-hard.swelling

díɲá = yéey a = kí-ɲé twak iídá,

climb=LOC1PL.INCL SRC=SG-mouth [IDEO] DIR:body

people call something sick in our body which appears without reason 'kuruh',

wùdΛjìkát|áη cíbλ kòmèèné ùkwλjówú |

wudΛ-yik = a =ɬaη c-ibΛ kə-mɛɛnɛ u = kw-ΛyΛwu,
 burn-CAUS=SRC=LOC3P SG-child SG-small.thing DIR=SG-sausage.tree
 you burn the fruit's seeds of *Kigelia africana*,

ókótíη | ílókíjàà pínλjì |

o-kotíη, i-lək = i = yaa pínλ = yi,
 P-take:VENT PL-ash=EP=DEM.REM PRO3SG=SEL
 one takes it, that ash of it,

ídíjΛη móráj↓ítáη ||

i-diyaη mura-yi=ɬaη;
 P-walk:VENT apply-TR = LOC3P
 one comes and puts (it) on it;

íjλlújé kútáη | útóóh↓íηátáη ||

i=iyaΛu=ye kuɬaη, u-tooh-iη=a=ɬaη;
 COND=pus=FOC.PL COP.SG;LOC3P P-burst-VENT=SRC=LOC3P
 if it contains pus, it will burst open;

íjλlújé ílmΛηληtáη | pínλ wárikàtáη ||

i=iyaΛu=ye ílmΛηλη=ɬaη, pínλ wár-ik=a=ɬaη;
 COND=pus=FOC.PL PL:COP.NEG=LOC3P PRO3SG disappear-CAUS=SRC=LOC3P
 if it does not contain pus, it disappears;

ómá ódówájík↓átáη ||

əma u-duwa-yik=a=ɬaη;
 or P-go.down-CAUS=SRC=LOC3P
 or it goes down;

àààà táání | kwλjówú |

aaaa taani, kw-ΛyΛwu,
 aaaa again SG-sausage.tree
 aaaa [hesitation], besides, *Kigelia africana*,

flókíjàà píná jàànóŋ | ópóríŋ ɲlɛhúnén |

ɪ-lɔk=ɪ=yaa píná yaanɔŋ, ɔ-pɔr-ɪŋ ɲlɛhunɛn,
 PL-ash=EP=DEM.REM PRO3SG there P-take-VENT ERG:women
 that ash of it, (the) women take

ídíjɛŋ dúkúk ɲihíná | ìwáɔ́ájéjé ítàn ||

ɪ-diyɛŋ duk-uk ɲ=ihíná, ɪ-wáɔ́=ye=ye ítàn;
 P-walk:VENT drip-CAUS ERG =PRO 3PL PL-ashwater=FOC.PL=REP PL:sauce
 they come and drip it, the filtered ashwater is like sauce;

[i...ii...] ihíná | ícíŋ | íhéɪ [ɛɛɛ..ii...] ìlɛ̀lɛ̀lɛ̀lɛ̀ | ñkááh íjálbɛ̀ɪ ||

[i...ii...] ihíná, ɪ-ciŋ, ɪ-hɛɪ [ɛɛɛ..ii...] ɪ-lɛ̀lɛ̀lɛ̀lɛ̀, ɲ=k-aah ɪyalbɛ̀ɪ;
 [nc] PRO 3PL PL-thing PL-tasteless [nc] PL-[IDEO] INS=SG-head PL:salt
 [false start] they, the things, [false start] are calciuntasty, like salt;

áááá | tà máán | á ùkwáɔ́jɛ̀wúwí | ñkɔ́ nɛ̀ŋ ||

aaaa, ɪ-amaa=na u=k-wáɔ́wúwí, ɲkɔ́ nɛ̀ŋ;
 aaaa SG-talk=DEM.PROX DIR=SG-sausage.tree=SEL COP.SG here
 well, the story of *Kigelia africana*, that's it;

kùŋkwáŋ híj | ááná kwáɔ́jɛ̀wú kɛ̀táárá | àɪmɛ̀ŋŋ ||

kùŋkwáŋ híj-ɪ-amaa=na k-wáɔ́wú kɛ̀táara, àɪmɛ̀ŋŋ.
 something know-INS=ERG1SG SG-sausage.tree SG-different SG:COP.NEG
 there is nothing else that I know about *Kigelia africana*.

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References

- Abdelhay, Ashraf, Al-Amin Abu-Manga & Catherine Miller. 2015. Language policy and planning in Sudan: From local vernaculars to national languages. In Barbara Casciarri, Munzoul A.M. Assal & François Ireton (eds.), *Multidimensional change in Sudan (1989-2011) - Reshaping livelihoods, conflicts and identities*, 263–280. New York, NY, and Oxford: Berghahn.
- Bashir, Abeer. 2010. *Phonetic and phonological study of the Tima language*. Unpublished PhD dissertation, University of Khartoum.
- Casali, Roderic F. 2008. ATR harmony in African languages. *Language and Linguistic Compass* 2/3, 496–549.
- Cho, Taehong & Peter Ladefoged. 1999. Variation and universals in VOT: Evidence from 18 languages. *Journal of Phonetics* 27(2), 207–229.
- Cho, Taehong, Douglas H. Whalen & Gerard Docherty. 2019. Voice onset time and beyond: Exploring laryngeal contrast in 19 languages. *Journal of Phonetics* 72, 52–65.
- Dimmendaal, Gerrit J. 2009. Tima. In Gerrit J. Dimmendaal (ed.), *Coding participant marking: Construction types in twelve African languages*, 338–355. Amsterdam: John Benjamins.
- Dimmendaal, Gerrit J. 2018. Reconstruction Katloid and deconstructing Kordofanian. In Gertrud Schneider-Blum, Birgit Hellwig & Gerrit J. Dimmendaal (eds.), *Nuba mountain language studies – New insights*, 383–415. Cologne: Rüdiger Köppe.
- Dimmendaal, Gerrit & Gertrud Schneider-Blum. In preparation. *A grammar of Tima*.
- Hashim, Mona, Suzan Alamin & Gertrud Schneider-Blum. 2020. Arabic borrowings in Tima. *Faits de Langues/Journal of Language Diversity* 51(1), 175–196.
- Kisler, Thomas, Uwe Reichel & Florian Schiel. 2017. Multilingual processing of speech via web services. *Computer Speech and Language* 45, 326–347.
- Lisker, Leigh. 1957. Closure duration and the intervocalic voiced–voiceless distinction in English. *Language* 33, 42–49.
- Maddieson, Ian. 1997. Phonetic universals. In William Hardcastle & John Laver (eds.), *Handbook of the phonetic sciences*, 619–639. Oxford: Blackwell.
- Meerpohl, Meike. 2012. *The Tima of the Nuba mountains, Sudan – A social anthropological study*. Cologne: Rüdiger Köppe.
- Mohamed Salih, M. A. 1995. Resistance and response: Ethnocide and genocide in the Nuba mountains, Sudan. *Geojournal* 36, 71–78.
- Mugadam, Abdel Rahim & Ashraf Abdelhay. 2014. The politics of literacy in the Sudan. In Kasper Juffermanns, Yonas Mesfun Asfaha & Ashraf Abdelhay (eds.) *African literacies: Ideologies, scripts, education*, 173–199. Cambridge: Cambridge Scholars.
- R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: www.R-project.org/ [last accessed 22 September 2023].
- Rolle, Nicholas, Florian Lionnet & Matthew Faytak. 2020. Areal patterns in the vowel systems of the Macro-Sudan Belt. *Linguistic Typology* 24 (1), 113–179.
- Rose, Sharon. 2018. The typology of vowel harmony in Nuba mountain languages. In Gertrud Schneider-Blum, Birgit Hellwig & Gerrit J. Dimmendaal (eds.), *Nuba mountain language studies – New insights*, 447–473. Cologne: Rüdiger Köppe.
- Schneider-Blum, Gertrud. 2012. Don't waste words – perspectives on the Tima lexicon. In Mathias Brenzinger & Anne-Maria Fehn (eds.), *Proceedings of the 6th World Congress of African Linguistics Cologne, 17–21 August 2009*, 515–522. Cologne: Rüdiger Köppe.
- Schneider-Blum, Gertrud. 2013. *A Tima-English dictionary*, Cologne: Köppe. For the online version see <http://tima-dictionary.mine.nu/> [last accessed 22 September 2023].
- Schneider-Blum, Gertrud & Gerrit J. Dimmendaal. To appear. Lexicography of endangered languages in Africa. In Patrick Hanks & Gilles-Maurice de Schryer (eds.), *International handbook of modern lexis and lexicography*. New York, NY: Springer.
- Sjölander, Kåre. 2014. *Snack Sound Toolkit*. Stockholm: KTH Royal Institute of Technology. Available at: www.speech.kth.se/snack [last accessed 22 September 2023].
- Solé, Maria-Josep & John J. Ohala. 2010. What is and what is not under the control of the speaker: Intrinsic vowel duration. In Cécile Fougerson, Barbara Kühnert, Mariapaola D'Imperio & Nathalie Vallée (eds.), *Laboratory phonology* 10, 607–656. Berlin and New York, NY: De Gruyter Mouton.
- Tabain, Marija, Jaye Padgett, Gertrud Schneider-Blum, Adele Gregory & Richard Beare. in press. An acoustic study of ATR in Tima vowels: Vowel quality, voice quality and duration. *Phonology*.
- Vicenik, Chad, Spencer Lin, Patricia Keating & Yen-Liang Shue. 2020. Online documentation for VoiceSauce. Available at: www.phonetics.ucla.edu/voicesauce/documentation/index.html [last accessed 22 September 2023].
- Wickham, H. 2009. *ggplot2: Elegant graphics for data analysis*. New York, NY: Springer-Verlag.

- Winkelmann, Raphael, Jonathan Harrington & Klaus Jänsch. 2017. EMU-SDMS: Advanced speech database management and analysis in R. *Computer Speech and Language* 45, 392–410.
- Winkelmann, Raphael, Klaus Jänsch, Steve Cassidy & Jonathan Harrington. 2019. emuR: Main Package of the EMU Speech Database Management System. R package version 2.0.4.