

Linear Featurality in Roman Script African Orthographies

David Roberts

Abstract. This paper uses the term “linear featurality” to describe the orthographic representation on the segmental (CV) tier of a unit lower on the phonological hierarchy than the phoneme. It is present, regularly or irregularly, in many of the world’s writing systems, and the Roman script orthographies of Africa are no exception. The paper surveys linear featurality in 180 languages from 30 countries, with language data extracted from published and unpublished literature, responses to an online forum, and a perusal of Omniglot, the online database of writing systems and languages. Cases identified include nasal vowels, prenasalization, labialization, palatalization, glottalized sounds, laterals, dentals, retroflexes, aspiration, rhoticization, fricativization, velarization, ATR, pharyngealization, back unroundedness, and clicks. The survey also illustrates some cases of simultaneous and irregular linear featurality, before a discussion comparing and contrasting linear and multilinear featurality in Africa.

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David Roberts  0009-0004-2282-9159
s/c BP57, Kara, Togo
E-mail: rbrdvd@gmail.com

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1. Introduction

Ever since Sampson (1985), it has been recognized that many writing systems contain featural elements, representing units lower on the phonological hierarchy than the phoneme. While most researchers agree that featurality does not warrant a separate typological class because no writing system is entirely and exclusively featural, it is increasingly acknowledged that featurality is widespread.

The newly emerging orthographies of African minority languages are no exception, yet featurality has received very little attention in the Africanist literature and is not generally taught in training programs for those engaged in orthography development. A twin article (Roberts in press) surveys *multilinear* featurality in Africa, i.e., the use of superscript and subscript diacritics to represent phonological features. The present article is a parallel survey focusing on *linear* featurality, that is, the weaving of featural elements into the tissue of the segmental tier. This tier is largely reserved for consonants and vowels, but the survey will also include the apostrophe <'> and saltillo <'> on the grounds that these symbols, unlike diacritics, occupy the same position as the vertical extensions in the letters <b d h k l>. Moreover, featurality researchers often dissect character stroke patterns, which would lead them to regard, for example, the upper hooks on the implosive letters <b d f g> as featural. This survey, in contrast, is limited to discrete whole characters, finding plenty to report on the featural use of these without adjusting the lens more finely.

The methodology involved a detailed perusal of published and unpublished sources in 180 languages, which inevitably means that some countries are better represented than others. Field workers in Cameroon and South Sudan have been particularly diligent in leaving an online paper trail. To help correct any geographical imbalance, I also accessed overviews such as *Omniglot*, the online encyclopedia of writing systems (Ager 1998–2024) and UNESCO's *Alphabets of Africa* (Hartell 1993). These, like many other individual sources, do not always clearly distinguish between existing practice and proposals, so the present survey makes no attempt to do so either. The survey also avoids reference to historical orthographies, although occasional mention will be made of recent reforms. Neither is there any attempt to assess the effectiveness in terms of literacy outcomes of the different featural strategies identified. The aim is more fundamental than this: to identify which phonological features are represented linearly, the degree of systematicity, and any areal tendencies.

This paper assumes that its intended readership is more likely to recognize phonetic labels (e.g., dental) than their more opaque counterparts (e.g., +CORONAL +ANTERIOR -DISTRIBUTED) as employed in Feature Geometry (Broe 1992; Clements 1985). This more flexible approach

also permits the survey to embrace phenomena such as rhotics, whose featural status is contested (Wiese 2011).

Orthographic data is presented between <chevrons> and phonemic data between /slashes/. The latter largely follow IPA, except that the palatal approximant is transcribed /y/ following the Africanist tradition. Transcription conventions in the sources have occasionally been slightly regularized for ease of comparison.

2. The Survey

2.1. Geographically Widespread Featurality

The survey begins by identifying five of the most frequent and widespread cases of linear featurality in Roman script African orthographies: nasal vowels (Section 2.1.1), prenasalized consonants (Section 2.1.2), labialized and palatalized consonants (Section 2.1.3), glottal consonants (Section 2.1.4), and lateral consonants (Section 2.1.5).

2.1.1. *Nasal Vowels*

The marking of nasal vowels with a postposed letter <n> is probably the most common and widespread case of linear featurality in African languages (Table 1, and see also Table 39). Much less frequently, postposed <ŋ> (Table 2) and <h> (Table 3) are also attested.

2.1.2. *Prenasalized Consonants*

The widespread strategy of representing prenasalized consonants with <m> preceding bilabial consonants and <n> elsewhere (Schroeder 2008, 30–31) is not strictly featural because -bilabial is not a natural class of sounds. However, many languages do represent prenasalization featurally, using <m> for labial consonants (Table 4), <n> for coronal consonants (Table 5), and <ŋ> for dorsal consonants (Table 6, and see also Tables 36, 38, and 42). Depending on the language, labio-velars participate in either the labial or dorsal graphic series, and labio-dentals in either the labial or coronal graphic series, either choice being justifiable from a featural point of view. Sources do not always clearly distinguish between prenasalized consonants /^mC/ and preconsonantal syllabic nasals /ŋC/; Tables 4–6 present them as units for the sake of regularity. Either way, the orthographic representations are featural.

Another featural strategy is to represent all prenasalized consonants, irrespective of their place of articulation, with a preposed <n>. In such cases, only the manner, not the place of articulation, is specified featurally (Table 7).

TABLE 1. Representation of nasal vowels with postposed <n>

Speech	Writing	Language	Family	Country	Citation
/Ṽ/	<Vn>	Aja	Kwa	Benin	(CISOLA 2010, 8-9)
		Glui	Kx'a	Botswana	(Omniglot)
		Cerma	Gur	Burkina Faso	(Hartell 1993, 42)
		Tikar	Bantoid	Cameroon	(Hartell 1993, 93)
		Nzakara	Ubangi	Central African Republic	(ACATBA 2005, 48)
		Niaboua	Kru	Côte d'Ivoire	(Hartell 1993, 140, 165, 194)
		Nafaanra	Gur	Ghana	(Drame & Hagg 2020, 11)
		Grebo	Kru	Liberia	
		Soninke	Mande	Mali	(Legbeti 2016, 89)
		Ososo	Edoid	Nigeria	(Hartell 1993, 282)
		Anufɔ	Kwa	Togo	

TABLE 2. Representation of nasal vowels with postposed <ŋ>

/Ṽ/	<Vŋ>	Gwama	Nilo-Saharan	Ethiopia	(Hellenthal & Kutsch Lojenga 2011, 8)
		Lama	Gur	Togo	(Hartell 1993, 289)

TABLE 3. Representation of nasal vowels with postposed <h>

/Ṽ/	<Vh>	Mo Vagala	Gur	Ghana	(Hartell 1993, 164, 167)
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2.1.3. Labialized and palatalized consonants

Labialization and palatalization are extremely common in African languages, and are especially prolific in Cameroon and Nigeria. These features are usually represented with the rather obvious strategy of postposed <w y> respectively (Table 8). See also Section 2.3, Tables 36–38. Many other African languages have only labialization, but I am unaware of any that only have palatalization.

Alternative featural strategies, which to my knowledge are confined to Cameroon and South Sudan, represent labialization and palataliza-

TABLE 4. Representation of prenasalized labial consonants with preposed <m>

/ ^m b ^{m̃} g̃b/	<mb mgb	Isu	Grassfields	Cameroon	(Anderson 2014, 5)
^{m̃} f ^{m̃} pf	mf mpf				
^{m̃} bv ^{m̃} m/	mbv mm>				
/ ^{m̃} b ^{m̃} v/	<mb mv>	Budu	Bantu	DR Congo	(Bamata 1997, 2)
/ ^{m̃} b ^{m̃} f	<mb mf	Yilumbu		Gabon	(Hubert & Mavoungou 2010, 183)
^{m̃} v/	mv>				
/ ^{m̃} p ^{m̃} b	<mp mb	Mbembe	Cross River	Nigeria	(Barnwell ms, 5)
^{m̃} k̃p	mkp				
^{m̃} g̃b ^{m̃} φ	mgb mph				
^{m̃} β ^{m̃} f ^{m̃} v	mbh mf mv				
^{m̃} m/	mm>				
/ ^{m̃} p ^{m̃} b/	<mp mb>	Ngando	Bantu	Central African Republic	(Murrell 2020, 4-5)
/ ^{m̃} b ^{m̃} g̃b	<mb mgb	Ma'di	C Sudanic	S Sudan	(Kilpatrick 2004, 89-90)
^{m̃} v/	mv>				
/ ^{m̃} p ^{m̃} b/	<mp mb>	Gusilay	Atlantic	Senegal	(Diatla 2013, 3, 7)
/ ^{m̃} b ^{m̃} g̃b	<mb mgb	Lugbariti	C Sudanic	Uganda	(Anonymous ms, 5)
^{m̃} v/	mv>				

TABLE 5. Representation of prenasalized coronal consonants with preposed <n>

/ ^{ñ} d ^{ñ} s ^{ñ} z	<nd ns nz	Bakoko	Bantu	Cameroon	(Njeck & Anderson 2010, 4)
^{ñ} d̃ʒ ^{ñ} l̃ ^{ñ} y/	nj nl ny>				(Prinz ms, 3)
/ ^{ñ} d ^{ñ} d̃ʒ/	<nd nj>	Massalit	Nilo-Saharan Maban	Chad	(Hubert & Mavoungou 2010, 183)
/ ^{ñ} d ^{ñ} z	<nd nz	Yilumbu	Bantu	Gabon	(Hall & Hall 2004, 81-82)
^{ñ} ʃs ^{ñ} d̃ʒ/	nts ndz>				
/ ^{ñ} d ^{ñ} z ^{ñ} ʃ/	<nd nz nj>	Jur Modo	C Sudanic	S Sudan	

TABLE 6. Representation of prenasalized dorsal consonants with preposed <ŋ>

/ ^{ŋ̃} k ^{ŋ̃} g	<ŋk ŋg	Mungong	Beboid	Cameroon	(Mkounga 2022, 5)
^{ŋ̃} g̃b ^{ŋ̃} y/	ŋgb ŋgh>				
/ ^{ŋ̃} g ^{ŋ̃} m̃g̃b/	<ŋg ŋb>	Jur Modo	C Sudanic	S Sudan	(Hall & Hall 2004, 81)

TABLE 7. Representation of all prenasalized consonants with preposed <n>

/ ^{m̃} b ^{ñ} d ^{ŋ̃} g/	<nb nd ng>	Kisie	Atlantic	Guinea	(Hartell 1993, 174)
/ ^{ñ} t ^{ñ} c ^{ŋ̃} k	<nt nc nk	Karon		Senegal	(SIL 2011, 18)
^{m̃} f ^{ñ} s ^{ŋ̃} h/	nf ns nh>				

tion with postposed vowels <Cu Ci> respectively (Table 9) or, in several Beboïd languages of Cameroon, asymmetrically as <Cw Ci> (Table 10).

Finally, some Grassfields languages of Cameroon represent a third series of labio-palatalized consonants featurally (Table 11), and at least one Plateau language of Nigeria does so for fortis labialization and palatalization (Table 12).

2.1.4. *Glottal Sounds*

Implosive consonants are common in many parts of Africa, although the palatal /ɟ/ and velar /g/ positions are much less frequently attested than the labial /ɓ/ and alveolar /ɗ/ positions (Sande & Oakley 2023, 2). Phonemic transcriptions in the literature tend to vary between the palatal implosive /ɟ/ and the glottalized palatal approximant /ʔy/. Implosives form a natural class with other glottal sounds, and tend to be represented featurally either with a preposed apostrophe (Table 13), or a postposed letter <h> (Table 14, and see also Tables 32 and 42).

Ejective consonants are abundant in Ethiopia and also occur sporadically elsewhere. Like implosives, they form a natural class with other glottal sounds, and are usually represented featurally with a postposed apostrophe <'> (Table 15). The use of postposed <h> in Blin (Table 43) is exceptional. At least one Ethiopian language uses separate featural strategies for representing implosives and ejectives (Table 16). However, since implosives and ejectives both involve glottal release and never co-occur (the former being voiced and the latter voiceless), it is completely defensible, from a featural point of view, to represent them with a single orthographic strategy such as a postposed apostrophe <'> (Table 17) or a preposed apostrophe <'> (Table 18).

2.1.5. *Lateral Consonants*

In a wide geographical spread of languages, with a concentration in Chadic, lateral consonants are marked featurally with the letter <l> (Table 19).

2.2. Geographically Restricted Featurality

The remaining cases of linear featurality in African Roman Script orthographies are much less frequently attested and geographically more restricted. Beginning with consonants, the survey will cover six kinds: dental consonants (Section 2.2.1), retroflex consonants (Section 2.2.2), aspiration (Section 2.2.3), rhoticization (Section 2.2.4), and fricativization (Section 2.2.5). Then, turning to vowels, three cases will be enumerated: ATR (Section 2.2.6), pharyngealization (Section 2.2.7), and back unroundedness (Section 2.2.8).

TABLE 8. Representation of labialization and palatalization with postposed <w y> respectively

/C ^w Cy/ <Cw Cy>	Tɔfɛn S Toussian Akoose	Kwa Gur Bantu	Benin Burkina Faso Cameroon	(Hartell 1993, 34) (SIL 2001, 5) (Hedinger 2011, 9-10)
	Moghamo Ipulo Luumbu Senara	Grassfields Tivoid Bantu Senoufo		(Njeck 2008, 4-5) (Tuinstra 2018, 9-12) (Mfouhou 2022, 8) (Hartell 1993, 141, 300)
	Fuliru Latege Tharaka Bwaatye	Bantu Chadic	DR Congo Gabon Kenya Nigeria	(Linton 2016, 4) (Schroeder 2008, 31) (Pweddson n.d., 122-125)
	Bekwarra Tiv	Cross River Tivoid		(Hartell 1993, 221) (Iornumbe 2020, 51-55)
	Venda	Bantu	S Africa	(PanSALB 2019, 10-14)
	Zinza Ruuli-Nyala		Tanzania Uganda	(Odom 2015, 7) (Nzogi 2011, 5-6)

TABLE 9. Representation of labialization and palatalization with postposed <u i> respectively

/C ^w Cy/ <Cu Ci>	Nulibie Numala Nuasue Otuho Dinka Nuer	Bantu Nilotic	Cameroon S Sudan	(Boyd 2015a, 6-8) (Boyd 2015b, 4-7) (Boyd 2016, 4-6) (Duerksen 2004b, 40, 71)
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TABLE 10. Representation of labialization and palatalization with postposed <w i> respectively

/C ^w Cy/ <Cw Ci>	Kemezong Nooni Mungong Naami	Beboid	Cameroon	(Cox 2005, 4-5) (Lux 2018, 7-9) (Mkouna 2022, 6-8) (Mkouna 2023, 12-14)
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TABLE 11. Representation of labio-palatalization with postposed <wy>

/C ^w C ^y C ^q /	<Cw Cy Cwy>	Mfumte	Grassfields	Cameroon	(Eyoh & Hedinger 2008, 5)
		Koffa			(McLean 2020a, 5-7)
		Ndɔ Wuli			(McLean 2020d, 6-7)
		Kwaja			(McLean 2020b, 5-6)

TABLE 12. Representation of fortis labialization and palatalization with postposed <ww yy>

/C ^w C ^{ww} C ^y C ^{yy} /	<Cw Cww Gworok Cy Cyy>	Plateau	Nigeria	(Anonymous 2015, 13-18)
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2.2.1. Dental Consonants

A concentration of languages in Sudan and South Sudan contrasts dental and alveolar plosives, with the dental series usually being represented featurally with a postposed letter <h> (Table 20, and see also Table 35). However, at least two languages use the same strategy to mark the non-dental series (Table 21).

2.2.2. Retroflex Consonants

At least one Ethiopian language marks a series of retroflex consonants with a postposed apostrophe <'> (Table 22).

2.2.3. Aspirated Consonants

Aspirated consonants sometimes contrast with their non-aspirated counterparts, and the aspirated series is sometimes represented featurally with a postposed <h> (Table 23, and see also Tables 32 and 33).

2.2.4. Rhoticized Consonants

The inventories of some languages in Cameroon and South Sudan include a series of rhoticized consonants that are invariably represented with a postposed <r> (Table 24, and see also Tables 38 and 42). Sources do not always make it clear whether /Cr/ is analyzed as a sequence or a unit, but Table 24 presents them as units for the sake of regularity. Either way, the orthographic representations are featural.

TABLE 13. Representation of implosives and other glottal sounds with preposed apostrophe <'>

/b d/	<'b 'd>	Lele Mono	Chadic Ubangi	Chad DR Congo Ghana	(Hartell 1993, 113) (Omniglot)
/b ʔ ʔw ʔy/	<'b 'l 'w 'y>	S Birifor	Gur		
/b d ʔw ʔy/	<'b 'd 'w 'y>	Aringa	C Sudanic	S Sudan	(Kilpatrick 2004, 90)
/b d f/	<'b 'd 'j>	Ma'diti Beli			(SIL ms-b, 44) (Stirtz 2014, 26)
	<'b 'd 'y>	Baka Bari	Nilotic		(Persson 2004, 81) (SIL ms-b, 13)
/b d/	<'b 'd>	Mundu Kadugli	Ubangi Kadu	Sudan	(Bilal 2004, 182) (Hall & Hall 2004, 59)
/ʔp ʔ ʔw ʔy/	<'p 'l 'w 'y>	Teen	Gur	Côte d'Ivoire	(Hartell 1993, 142)

TABLE 14. Representation of implosives and other glottal sounds with postposed <h>

/b d f/	<bh dh vh>	Mangbetu	C Sudanic	DR Congo	(Hartell 1993, 303)
/b d/	<bh dh>	E Dan (2014)	Mande	Côte d'Ivoire	(Vydrin et al. 2019, 9)
		Ngando	Bantu	Central African Republic	(Murrell 2020, 3)
		Lubwisi	Bantu	Uganda	(Tabb et al. 2011, 10, 14)
/aʔ eʔ oʔ/	<ah eh oh>	S Toussian	Gur	Burkina Faso	(SIL 2001, 6-7)

TABLE 15. Representation of ejectives with postposed apostrophe <'>

/k ʔs' ʔj'/	<k' s' c'>	Mpadi	Chadic	Cameroon	(Allison 2006, 2-4) (Omniglot)
/t' k'/	<t' k'>	Gawwada	Cushitic	Ethiopia	
/p' t' k' ts'/	<p' t' k' c'>	Bambassi	Omotic		
/p' t' ts' tʂ' ʔj'/	<p' t' x' c' ch'>	Bench			
/p' k' ʔj'/	<p' k' c'>	Kafa			
/p' t' k' ʔj'/	<p' t' k' c'>	Waata	Cushitic	Kenya	

TABLE 16. Separate representation of implosives with postposed <h> and ejectives with postposed apostrophe <'>

Implosives	/b̥ d̥ g̥/	<bh dh gh>	Hamar	Omoti	Ethiopia	(Yigezu & Mendisu 2015, 12-14)
Ejectives	/s' q' tʃ'/	<s' q' c'>				

TABLE 17. Unified representation of ejectives and implosives with postposed apostrophe <'>

/p' t' k' f̥ tʃ' d̥/	<p' t' k' s' c' d'>	Borna	Omoti	Ethiopia	(Joswig et al. 2010, 2-3)
/p' t' c' k' f̥ tʃ' b̥ d̥/	<p' t' c' k' s' ç' b' d'>	Gumuz	Nilo-Saharan satellite		(Omniglot)

TABLE 18. Unified representation of ejectives and implosives with a preposed apostrophe <'>

/p' t' t̥ c' k' b̥ d̥/	<p' t' t̥ c' k' b' d'>	Uduk	Nilo-Saharan satellite	S Sudan	(Omniglot)
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TABLE 19. Representation of lateral consonants with <l>

/l tɬ/	<l tl>	Tswana	Bantu	Botswana	(Omniglot)
/l ɬ ɬ̥/	<l sl zl>	Buwal	Chadic	Cameroon	(Viljoen et al. 2009, 3-5)
		Guemzek			(Scherrer 2014, 8)
		Muyang			(Smith 2001, 5-6)
		Vame			(Kinnaid 2005, 5-6)
	<l tl dl>	Musey		Chad	(Omniglot)
		Ngizim		Nigeria	
/l ɬ ɬ̥ kɬ/	<l hl dl kl>	Swati	Bantu	Eswatini	
/l ɬ ɬ̥ tɬ/	<l hl dl tl>	Tswa		Mozambique	
/l p̥ b̥ t̥ k̥ p̥/	<l pl bl tl kpl>	Idoma	Idomoid	Nigeria	(Armstrong ms, 8-9)
f̥ m̥ n̥ w̥/	fl ml nl wl>				(Omniglot)
/l ɬ ɬ̥ kɬ tɬ/	<l hl dl kl tl>	S Ndebele	Bantu	S Africa	
/ɬ tɬ/	<sl tl>	Iraqw	Cushitic	Tanzania	

2.2.5. Fricativized Consonants

At least one Bantu language of Mozambique marks fricativized consonants featurally with a postposed <v> (Table 25), and at least one Cameroonian language has a series of consonants with velar fricative

TABLE 20. Representation of dental plosives with postposed <h>

/t̥ d̥ n̥/	<th dh ndh>	Olu'bo	C Sudanic	S Sudan	(Kilpatrick 2004, 89)
/t̥ d̥ n̥/	<th dh nh>	Anywa	Nilotic		(Gilley 2004, 173)
		Shilluk			
		Dinka			(Duerksen 2004a, 74)
		Nuer			
/d̥ n̥/	<dh nh>	Belanda Boor			(Gilley 2004, 173)

TABLE 21. Representation of non-dental plosives with postposed <h>

/t d/	<th dh>	Jumjum	Nilotic	S Sudan	(Gilley 2004, 173)
		Burun			

TABLE 22. Representation of retroflex consonants with postposed apostrophe <'>

/tʂ ʂ ʒ tʂ' /	<c' s' z' x'>	Sheko	Omoti	Ethiopia	(Omniglot)
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TABLE 23. Representation of aspiration with postposed <h>

/p ^h t ^h k ^h /	<ph th kh>	Kaansa	Gur	Burkina Faso	(SIL ms-a, 16, 20)
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TABLE 24. Representation of rhotics with postposed <r>

/tʳ fʳ lʳ/	<tr fr dr>	Baba 1	Grassfields	Cameroon	(Njeck & Hedinger 2006, 5)
/pʳ tʳ kʳ fʳ	<pr tr kr fr>	Bambalang			(Grove & Wright 2012, 11)
ʃʳ ɣʳ ʈʳ lʳ	shr ghr chr lr				
yʳ wʳ/	yr wr>				
/tʳ dʳ ndʳ /	<tr dr ndr>	Avokaya	C Sudanic	S Sudan	(Kilpatrick 2004, 89-90)
/tʳ kʲpʳ dʳ	<tr kpr dr>	Baka			(Persson 2004, 82)
ɡbʳ ndʳ/	gbr ndr>				
/pʳ tʳ bʳ dʳ/	<pr tr br dr>	Morokodo			

TABLE 25. Representation of fricativized consonants with postposed <v>

/bʷ sʷ zʷ/	<bv sv zv>	Nyungwe	Bantu	Mozambique	(Omniglot)
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TABLE 26. Representation of velar fricative articulation with postposed <gh>

/ɣ ɳɣ bɣ fɣ/	<gh ngh bgh fgh>	Weh	Grassfields	Cameroon	(Davison 2009, 8)
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primary or secondary articulation. These are marked featurally with the digraph <gh> (Table 26).

2.2.6. *ATR Vowels*

Certain Sudanese languages mark ATR with a postposed <x> (Table 27, and see also Table 46). However, some have recently rejected this linear strategy in favor of multilinear superscript umlauts (Alaki & Norton 2015, 228). A postposed <h> is also attested in one Nigerian language (Table 28, and see also Table 34). A few sources advocate marking the orthographic word with only one symbol, for languages in which all the vowels in a phonological word agree in ATR quality (Table 29).

TABLE 27. Representation of +ATR vowels with postposed <x>

/i e ə o u/	<ix ex ax ox ux>	Kamda	Kadu	Sudan	(Hall & Hall 2004, 62)
		These	E Sudanic		(Yip 2004, 116)

TABLE 28. Representation of +ATR vowels with postposed <h>

/e o/	<eh oh>	Dhuo	Mambiloid	Nigeria	(Hartell 1993, 235)
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TABLE 29. Representation of +ATR vowels with word final <h>

+ATR vowels	word final <h>	Ogba Igede	Igboid Idomoid	Nigeria	(Williamson 1984, 24-25)
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Hartell (1993, 109) reports a highly unusual application of the ATR word-marking principle in Zande (Ubangi, Central African Republic), where the letter <j> is placed “after the first simple (double) vowel of the word” to indicate that the whole word is +ATR.

2.2.7. *Pharyngealized Vowels*

Several Kx’a languages of southern Africa have pharyngealized vowels, which are represented featurally with a postposed <q> (Table 30, and see also Table 39).

TABLE 30. Representation of pharyngealized vowels with postposed <q>

/ɑ̣ ɛ̣ ɪ̣ ɔ̣/ ʊ̣/	<aq eq iq oq uq>	ǀ'Amkoe	Kx'a	Botswana	(Omniglot)
/ɑ̣ ɔ̣ ʊ̣/	<aq oq uq>	Ekoka !Kung		Namibia	
/ɑ̣ ɔ̣/	<aq oq>	Ju 'hoan			

2.2.8. Back Unrounded Vowels

One Togolese language uses the postposed letter <ɣ> featurally to unify a series of five long back unrounded vowels (Table 31).

TABLE 31. Representation of long back unround vowels with postposed <ɣ>

/ɯɯ ɯɯ ɤɤ ʌʌ ɑɑ/	<iɣ ɪɣ eɣ ɛɣ aɣ>	Kabiye	Gur	Togo	(Roberts 2008, 54-55)
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2.3. Simultaneous featurality

This section illustrates some cases of simultaneous featurality, drawing attention to two possible scenarios. First, a single orthographic convention may represent more than one feature, and within each series, do so regularly and completely. In Ekoka !Kung, the postposed <h> simultaneously represents aspiration, glottalization, and breathiness (Table 32).

TABLE 32. Simultaneous representation of aspiration, glottalization, and breathiness with postposed <h>

Aspiration	/p ^h t ^h k ^h tʃ ^h /	<ph th kh tch>	Ekoka !Kung	Kx'a	Namibia (Omniglot)
Glottalization	/b ^h d ^h g ^h m ^h n ^h /	<bh dh gh mh nh>			
Breathiness	/ə̤ e̤ i̤ ʊ̤ ṳ/	<ah eh ih oh uh>			

Nyungwe uses the same strategy to simultaneously represent voiceless aspirated (as opposed to non-aspirated) consonants, and voiced plosive (as opposed to implosive) consonants (Table 33).

Luwo uses the same strategy to simultaneously represent both dental consonants and +ATR vowels (Table 34).

TABLE 33. Simultaneous representation of aspiration and voiced plosives with postposed <h>

Aspiration	/p ^h t ^h k ^h /	<ph th kh>	Nyungwe Bantu Mozambique (Omniglot)
Voiced plosives	<b d>	<bh dh>	

TABLE 34. Simultaneous representation of dental consonants and +ATR vowels with postposed <h>

Dentals	/t̪ d̪ n̪/	<th dh nh>	Luwo	Nilotic	S Sudan	(Gilley 2004, 173)
+ATR	/ə e i o u/	<ah eh ih oh uh>				

Finally, Goemai uses the postposed apostrophe <'> to simultaneously represent both voiceless non-aspirated (as opposed to aspirated) consonants, and implosive (as opposed to voiced plosive) consonants (Table 35).

TABLE 35. Simultaneous representation of non-aspiration and implosives with postposed apostrophe <'>

Non-aspiration	/t k f s ʃ/	<t' k' f' s' sh'>	Goemai	Chadic	Nigeria	(Omniglot)
Implosives	/ɓ ɗ/	<b' d'>				

The second scenario is equally widespread. A single series of graphemes may systematically manifest more than one featural characteristic. Labialization is probably the articulation most likely to participate in this. Numerous Cameroonian languages combine it with labial, coronal, and/or dorsal prenasalization (<NCw>, Table 36a, b, c respectively), while elsewhere labialization co-occurs with laterals <Clw> and rhotics <Crw> (Table 37a, b respectively).

Convergences also frequently occur between prenasalization and another feature, such as palatalization <NCy> or rhotics <NCr> (Table 38a and b respectively).

Similarly, in some Kx'a languages, nasalization co-occurs with pharyngealization <Vqn> or breathiness <Vhn> (Table 39a and b respectively).

Finally, these Kx'a languages, as well as Khoe-Kwadi and some of Bantu stock, are characterized by an elaborate series of clicks with multiple secondary and tertiary articulations, which are represented orthographically with extensive and often highly regular simultane-

TABLE 36. Simultaneous representation of labialization with (a) labial, (b) coronal, and (c) dorsal prenasalization

a	$/\text{m}^{\text{pw}} \text{mb}^{\text{w}} \text{nf}^{\text{w}}/$	<mpw mbw mfw>	Sari	Beboid	Cameroon	(Langhout 2022, 9-10)
b	$/\text{nt}^{\text{w}} \text{nd}^{\text{z}} \text{nd}^{\text{w}} \text{nf}^{\text{w}}/$	<ntw nzw ndw nchw>	Bafanji	Grassfields		(Hamm & Hamm 2016, 8)
c	$/\text{ng}^{\text{w}} \text{nm}^{\text{g}} \text{nv}^{\text{w}}/$	<ngw ngvw nvw>	Kwanja	Mambiloid		(Weber & Weber 2008, 5)

TABLE 37. Simultaneous representation of labialization with (a) laterals and (b) rhotics

a	$/\text{tl}^{\text{lw}} \text{tl}^{\text{wh}} \text{dl}^{\text{w}}/$	<tlw tlhw dlw>	Tsonga	Bantu	S Africa	(Omniglot)
b	$/\text{tr}^{\text{rw}} \text{dr}^{\text{w}} \text{nd}^{\text{rw}}/$	<trw drw ndrww>	Moru	C Sudanic	S Sudan	(Kilpatrick 2004, 90)

TABLE 38. Simultaneous representation of prenasalization with (a) palatalization and (b) rhotics

a	$/\text{nt}^{\text{y}} \text{nt}^{\text{f}} \text{nd}^{\text{z}} \text{nd}^{\text{y}} \text{mp}^{\text{y}} \text{mb}^{\text{y}} \text{mf}^{\text{y}}/$	<nty nchy nzy ndy> <mpi mbi mfi>	Bafanji	Grassfields	Cameroon	(Hamm & Hamm 2016, 6)
b	$/\text{nt}^{\text{r}} \text{nd}^{\text{r}} \text{ns}^{\text{r}} \text{nz}^{\text{r}} \text{nf}^{\text{r}}/$	<ntr ndr nsr nZR nchr>	Mbembe	Jukunoid		(Eyoh & Sandamu 2009, 8)

TABLE 39. Simultaneous representation of nasalization with (a) pharyngealization and (b) breathiness

a	$/\tilde{\text{a}}^{\text{f}} \tilde{\text{o}}^{\text{f}}/$ $/\tilde{\text{a}}^{\text{f}} \tilde{\text{ɔ}}^{\text{f}} \tilde{\text{ɔ}}^{\text{f}}/$	<aqn oqn> <aqn oqn uqn>	Ju 'hoan	Kx'a	Namibia	(Omniglot)
b	$/\tilde{\text{a}} \tilde{\text{o}}/$	<ahn ohn>	Ekoka !Kung			

ous featureality. The five ǀAmkoe clicks—labial, dental, lateral, alveolar, palatal—are represented featurally with the IPA symbols <ǀ | ǁ ! ǃ> respectively, while a host of secondary articulations are also represented, such as uvulars with the postposed letter <q> (Table 40).

Table 41 summarizes how the clicks themselves are represented orthographically in other southern African languages, while Table 42 summarizes how a representative sample of secondary articulations is represented.

TABLE 40. Simultaneous representation of clicks and uvular secondary articulations in ǀ'Amkoe (Botswana)

	Bilabial	Dental	Lateral	Alveolar	Palatal
Simple uvular	<Ōq>	< q>	< q>	<!q>	<ǀq>
Ejective uvular	<Ōq'>	< q'>	< q'>	<!q'>	<ǀq'>
Aspirated uvular	<Ōqh>	< qh>	< qh>	<!qh>	<ǀqh>
Voiced ejective uvular		<g q'>	<g q'>		
Ejective affricate uvular	<Ōqx>	< qx>	< qx>	<!qx>	<ǀqx>
Voiced ejective affricate uvular	<gŌqx>		<g qx>		<gǀqx>

TABLE 41. Symbolization of clicks in other southern African languages

Dental	/ /	< >	G ui Ekoka !Kung Ju 'hoan Khoekhoe	Kx'a Khoekhoe	Botswana Namibia	(Omniglot)
		<c>	Naro Swati N Ndebele S Ndebele Zulu	Bantu	Botswana Eswatini S Africa	
		<q>	Tsonga			
Lateral	/ /	< >	G ui Ekoka !Kung Ju 'hoan Khoekhoe	Kx'a Khoekhoe	Botswana Namibia	
		<x>	Naro S Ndebele N Ndebele S Ndebele Zulu	Bantu	Botswana S Africa	
Alveolar	/!/	<!>	G ui Ekoka !Kung Ju 'hoan Khoekhoe	Kx'a Khoekhoe	Botswana Namibia	
		<q>	Naro N Ndebele S Ndebele Zulu	Bantu	Botswana S Africa	
Palatal	ǀ	<ǀ>	G ui Khoekhoe Ekoka !Kung Ju 'hoan Zulu	Kx'a Khoekhoe Kx'a	Botswana Namibia	
		<x>	Zulu	Bantu	S Africa	

TABLE 42. Representative sample of secondary articulation symbolization in southern African click languages

Aspirated	/C ^h / <Ch>	G ui Naro ǀ'Amkoe Khoekhoe Ekoka !Kung Ju 'hoan	Khoe-Kwadi Kx'a Khoe-Kwadi Kx'a	Botswana (Omniglot) Namibia
Glottalized	/Cʔ/ <C'>	Naro ǀ'Amkoe Ju 'hoan	Khoe-Kwadi Kx'a	Botswana Namibia
Nasalized	/ᵑC/ <nC>	G ui Naro ǀ'Amkoe Ekoka !Kung Ju 'hoan S Ndebele N Ndebele	Khoe-Kwadi Kx'a	Botswana Namibia
Voiced	/gC/ <gC>	G ui ǀ'Amkoe Ekoka !Kung Ju 'hoan S Ndebele Zulu	Khoe-Kwadi Kx'a Bantu	Botswana Namibia S Africa

2.4. Irregular featurality

The survey so far may have given the impression of a high degree of systematic featurality in African orthographies, whereas in fact irregularity is just as widespread. Highlighting the following cases carries no implication that the strategies are necessarily defective, since decision-makers may be influenced by linguistic or sociolinguistic issues that go unexplained in the sources consulted. Again, it will be helpful to highlight two possible strategies. In all the following examples, the regular featurality is highlighted in bold.

The most common scenario is when a single orthographic strategy is applied regularly within a particular featural series, but is also employed irregularly for a mixed bag of other unrelated purposes. Table 43 illustrates this for implosives, ejectives, dentals, retroflexes, aspiration, and velarization in various languages.

The second scenario, when featurality is applied partially but does not extend to an entire series, is also widespread. In languages that mark fricatives and affricates with a postposed <h>, the phoneme /d͡ʒ/, if present, is usually excluded, being represented non-featurally as <j> (Table 44). To a lesser extent, the same is true of /t͡ʃ/, which is sometimes represented non-featurally as <c> (Table 45). I am unaware of any

African language that marks the fricative/affricate series with entirely regular featurality.

Similarly, three languages of South Sudan mark all but one of the series of +ATR vowels with a postposed <x> (Table 46).

Finally, in Tswana, the irregularity operates in both directions. On the one hand, the postposed <h> falls one short of marking all the aspirated consonants and, on the other hand, it marks one unaspirated consonant (Table 47).

3. Discussion

Featurality bequeaths visual similarity to an orthography, binding together a natural class of sounds. As the foregoing survey has amply demonstrated, linear featurality, which weaves featural elements into the tissue of the segmental tier, is widespread in Roman script African orthographies.

Table 48 summarizes symbol choice and position for the linear featural representations of vowels. In all cases, they involve digraphs the second element of which is a letter, most commonly <Vh>, which may represent nasality, ATR, or breathiness. Of the three options for nasal vowels, the digraph <Vn> is by far the most frequently attested and geographically widespread.

Click consonants tend to be represented with their corresponding IPA characters, but the letters <c q x> are also attested (Table 49). Obviously, none of these orthographic strategies is geographically widespread because the clicks themselves are not.

The picture that emerges for consonants other than clicks is more complex because they are represented with an additional symbol which may be (a) preposed or postposed, (b) a consonant, a vowel, or an apostrophe, and these form (c) digraphs or, in one case, a trigraph (Table 50).

With these summary charts in mind, it will be instructive, by way of conclusion, to compare the two basic approaches to featurality—linear and multilinear—identifying which characteristics they share and to what extent they differ.

Linear and multilinear strategies encode a similar number of phonological features. Nasal vowels, which are ubiquitous, attract linear and multilinear featurality in more or less equal measure (<Vn> vs <Ṽ>; Roberts in press, 90), and the same is true of implosives (<bh dh...> vs <b̥ d̥...>; Roberts in press, 97). Tongue-root position is another matter. In areas of Africa that are resistant to representing the -ATR set with special characters, multilinear featurality is clearly the preferred option, albeit with a startling lack of uniformity (Roberts in press, 87–89). The linear strategies reported in this paper, on the other hand, are much less

TABLE 43. Extending a featural strategy irregularly for other unrelated purposes

Implosives	/b d f ɸ ɹ kʷ/ ɸ x/ θ ð nð c/ t d f ɹ/ pʰ kʰ tʰ ɸ γ/ kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<bh dh sh ch zh wh> <th qh ch sh kh> <th dh ndh ch> <th dh sh zh> <ph kh ch sh gh> <kh bh gh bvʰ sh gh ch>	Ekpeye	Igboide	Nigeria	(Ngulube 2011a, 56)
Ejectives	/t' k' tʃ' ɸ x/ θ ð nð c/ t d f ɹ/ pʰ kʰ tʰ ɸ γ/ kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<th qh ch sh kh> <th dh ndh ch> <th dh sh zh> <ph kh ch sh gh> <kh bh gh bvʰ sh gh ch>	Blin	Cushitic	Eritrea	(Fallon 2006, 96)
Dentals	/θ ð nð c/ t d f ɹ/ pʰ kʰ tʰ ɸ γ/ kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<th dh ndh ch> <th dh sh zh> <ph kh ch sh gh> <kh bh gh bvʰ sh gh ch>	Dholuo	Nilotic	Kenya	(Hartell 1993, 183)
Retroflexes	/t d f ɹ/ pʰ kʰ tʰ ɸ γ/ kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<th dh sh zh> <ph kh ch sh gh> <kh bh gh bvʰ sh gh ch>	Kanga	Kadu	Sudan	(Hall & Hall 2004, 59)
Aspiration	/pʰ kʰ tʰ ɸ γ/ kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<ph kh ch sh gh> <kh bh gh bvʰ sh gh ch>	Tumbuka	Bantu	Malawi	(Omniglot)
Velarization	/kʷ bʷ gʷ bvʷ ɸ γ ɸ/	<kh bh gh bvʰ sh gh ch>	Isu	Grassfields	Cameroon	(Anderson 2014, 4, 8)

TABLE 44. Omitting /dʒ/ in a series of fricatives and affricates

/ʃ ʒ ʧ tʃ dʒ/	<sh zh gh ch j>	Lidzonka	Grassfields	Cameroon	(McLean 2020c, 4-5)
		Ndā Wuli			(McLean 2020d, 3-4)
/ʃ ʧ tʃ dʒ/	<sh gh ch j>	Awing			(Alomofor & Anderson 2005, 2)
/ʃ tʃ dʒ/	<sh ch zh j>	Mbembe	Jukunoid		(Eyoh & Sandamu 2009, 5-6)
/ʃ ʒ x ʧ tʃ dʒ/	<sh zh kh gh ch j>	Tera	Chadic	Nigeria	(Tench n.d., 19)
/ʃ ʒ tʃ dʒ/	<sh zh ch j>	Lunda	Bantu	Zambia	(Omniglot)

TABLE 45. Omitting /tʃ dʒ/ in a series of fricatives and affricates

/ʃ ʒ tʃ dʒ/	<sh zh c j>	Mekaa	Bantu	Cameroon	(Hartell 1993, 73, 84)
/ʃ ʒ ʧ tʃ dʒ/	<sh zh gh c j>	Fe'efe'e	Grassfields		
/ʃ ʒ tʃ dʒ/	<sh zh c j>	Nupe	Nupoid	Nigeria	(Madugu n.d., 32, 35-36)
/ʃ ʒ ʧ tʃ dz/	<sh zh gh c j>	Tarok	Plateau		(Hartell 1993, 239)

TABLE 46. Omitting /ə/ in a series of +ATR vowels

/i e o u ə/	<ix ex ox ux a>	Kadugli Kanga Kufa	Kadu	Sudan	(Hall & Hall 2004, 62-63)
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TABLE 47. Irregular representation of aspiration with postposed <h>

Aspirated (regular)	/k ^h p ^h t ^h tʰ/	<k ^h p ^h t ^h tʰ>	Tswana	Bantu	Botswana	(Omniglot)
Aspirated (irregular)	tʰʰ tʰʰ/	tʰʰ tʰʰ>				
Unaspirated (irregular)	/kˀ/	<kg>				
	/f/	<sh>				

TABLE 48. Symbol choice and position of linear featurality of vowels

	Vh	Vn	Vŋ	Vx	Vq	Vɣ
Nasal vowels	✓	✓	✓			
ATR vowels	✓			✓		
Pharyngealized vowels					✓	
Back unrounded vowels						✓
Breathy vowels	✓					

TABLE 49. Symbol choice for linear featurality of click consonants

	ʘ	ǀ	ǁ	ǃ	ǂ	c	q	x
Labial clicks	✓							
Dental clicks		✓				✓	✓	
Lateral clicks			✓					✓
Aveolar clicks				✓			✓	
Palatal clicks					✓			✓

widely attested and, in some cases, are on the wane (Alaki & Norton 2015, 228).

Linear featurality is frequently applied to consonants and less often to vowels, whereas the reverse is true of multilinear featurality (Roberts in press, 102–103). Table 50 may give the impression of a wide range of linear strategies available for consonants other than clicks. But in fact, beyond the rather obvious strategies of spelling out secondary articulations as they sound (e.g., laterals as <Cl>, rhotics as <Cr>), and putting aside those that are infrequent and geographically limited, the choice whittles down to just two symbols: postposed <h>, and preposed or postposed apostrophe <'>. This contrasts vividly with about ten commonly used symbol-and-position choices for multilinear representations (Roberts in press, 102–103).

This survey has intentionally ignored one ubiquitous scenario. Linear featurality occurs whenever a primary articulation is constant across an entire series. For example, all the phonemes in the series /p^{mp} p^w p^y p^h p' k^p/ are labial and, in a given orthography, they might plausibly be represented featurally as <p mp pw py ph p' kp>, respectively. Such

TABLE 50. Symbol choice and position of linear featurality of consonants other than clicks

	Preposed				Postposed									
	'C	mC	nC	ŋC	C'	Ch	Cr	Cw	Cu	Cy	Ci	Cl	Cv	Cgh
Prenasalization		✓	✓	✓										
Labialization								✓	✓					
Palatalization										✓	✓			
Glottalization	✓				✓	✓								
Lateralization												✓		
Dentals						✓								
Retroflexes					✓									
Aspiration						✓								
Rhoticization							✓							
Fricativization													✓	✓
Voiced plosives						✓								
Non-aspiration					✓									

cases were judged to be simply too numerous and widespread to include in the survey.

Similarly, the survey has deliberately avoided any mention of tone. Most sub-Saharan African languages are tonal, and if tone is marked at all, it is usually with a multilinear strategy involving superscript diacritics (Roberts in press, 91–92). Linear strategies for marking tone, on the other hand, have been proposed much more often than they have been implemented (e.g., Mann & Dalby 1987: 210; Mann 1969: 98–106; Nakuma 2002: 16; Tucker 1949: 222–223; 1964: 606). A notable exception is Côte d'Ivoire, where word-initial and -final punctuation symbols were officially endorsed for an entire generation for various Mande, Kru, and Kwa languages (ILA 1979, 20), and this is a clear case of linear featurality because the system encodes tone fully and systematically. However, more recently, this strategy has been abandoned in numerous languages in favor of multi-linear marking by means of superscript diacritics (see Roberts et al. 2019, 320 for the case of Eastern Dan). As for semiographic representations of grammatical tone (Cahill 2021: 109–111; Kutsch Lojenga 2014: 65–67; Snider 1992: 25–30), they cannot be considered featural because they encode grammar, not phonology. For these reasons, including tone in the present survey was considered unwarranted.

Finally, areal tendencies are less clear for linear than for multilinear featurality. For example, marking nasal vowels multilinearly with a subscript cedilla <Ṽ> is a distinctively Cameroonian strategy unattested elsewhere (Roberts in press, 97). However, although Cameroon has a dense concentration of languages attesting labialization, the linear strategy of representing this feature with postposed <w> is by no means restricted to that country. Granted, the linear use of postposed <x> to

mark +ATR vowels is unique to Sudan, as far as I am aware, but it is not widespread even within that country and has already been abandoned in some languages. Similarly, postposed <q> marking pharyngealized vowels linearly is a distinctively southern Africa tradition, but within that area, the languages that have this phonological feature and that use this orthographic strategy are far from numerous.

In conclusion, Table 51 summarizes the differences between linear and multilinear approaches in African Roman script orthographies.

TABLE 51. Linear and multilinear featurality in Roman script African orthographies

Linear featurality (this paper)	Multilinear featurality (Roberts in press)
• Narrow range of frequently used symbols • Frequently applied to consonants • Less frequently applied to vowels • Rarely applied to tone • Less clear areal tendencies	• Wide range of frequently used symbols • Less frequently applied to consonants • Frequently applied to vowels • Frequently applied to tone • Clearer areal tendencies

The highest priority, surely, is to empirically test the various featural strategies against one another in classroom interventions, beginning with this fundamental distinction between linear and multilinear representations. Armed with data, we will be better placed to train the next generation of orthography developers to avoid any featural strategies that do not contribute, or contribute negatively, to reading outcomes.

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