Grammar Drives Writing System Evolution

Lessons From the Birth of Vowels

Daniel Harbour

Abstract. Vowel omission is a common trait of Afroasiatic writing systems. The current article places this observation on empirically firm footing by showing that, across a large range of cases, the transmission of alphabetic writing within Afroasiatic shows only minimal increases in vowel writing, in contrast to transmission beyond Afroasiatic, where vowel writing markedly increases. This correlation is analysed as a reflex of grammatical differences between Afroasiatic and non-Afroasiatic languages, connected to the predictability of vowels from grammatical and pragmatic context. Where they are not contextually recoverable, omitted vowels amount, owing to Afroasiatic grammar, to omitted morphemes, a feature of other writing systems, including early Chinese and Sumerian. As a result, both the underrepresentation of vowels within Afroasiatic writing systems and the increase in vowel representation beyond Afroasiatic represent adaptations of writing systems to grammatical niches. Philographic theory must therefore recognise grammar as a driving force in writing system evolution.

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> Instead of the vowels being unrepresented, or only represented by points, as in all Semitic writing that was first applied to a Semitic language, we have in the cuneatic inscriptions every vowel definitely expressed. The Semitic language appears in a disguise similar to what the Maltese does in Roman letters, or the Punic in the well-known passage of Plautus.
>
> (Hincks, 1852, p. 295, cited in Cathcart, 2011, p. 7)

> [T]he Assyrian mode of writing laboured under a great disadvantage, as compared with that used for other Semitic languages, so far as respected the imperfective roots.
>
> (Hincks, 1863, p. 27)

1. Introduction

It has been appreciated since at least the mid 1800s that the orthographic underrepresentation of vowels is a characteristic of Afroasiatic writing systems. Perhaps because it is so widely accepted, the observation has not, to my knowledge, been put on sound empirical footing. However, the claim is an important one. If, as Hincks Hincks (1852) suggests, orthographic vowel omission is facilitated by Afroasiatic grammar, then it constitutes a case of grammar (morphosyntax/morphophonology) driving writing system evolution and, therefore, speaks strongly to the question of why and how writing systems have changed at various points in their history.

I set out to prove this as follows. Section 2 sharpens the question beyond the false dichotomy sometimes encountered, with Afroasiatic scripts being vowelless and others being vowel-complete. Section 3 then shows that vowel underrepresentation is maintained when the writing system of one Afroasiatic language is adopted or transferred to write another. Section 4, by contrast, shows that vowel writing generally markedly increases when such systems are used for non-Afroasiatic languages.

This naturally raises the question of what aspect of Afroasiatic grammar facilitates reading with minimal vowel marking. I argue that there are three factors at play here (Section 5). The first, obviously, is the famous consonantal nature of Afroasiatic roots. However, this, by itself, is not an explanation, as, under this grammatical set up, vowel-reduced writing fuels ambiguity (Crellin, 2018). There are, I propose,

two additional factors involved: one is another peculiarity of Afroasiatic, namely, that affixal consonants predict not merely affixal vowels, but root vowels too. The other is that any grammatical information that remains ambiguous constitutes a morphological impoverishment at the level of the language written, a finding that I interpret in light of recent research into artificial language learning (e.g., Martin et al., 2019). Vowel omission in Afroasiatic is therefore akin to morphological impoverishment and makes written Afroasiatic languages ambiguous in dimensions (such as category and voice) that many languages do not mark morphologically and that were unwritten in other early writing systems.

2. Sharpening the Question

I begin by dispelling the myth (e.g., Sacks, 2014) that Afroasiatic writing was uniformly vowelless and by sharpening the hypothesis to be tested below.

An example of genuinely vowelless writing is the (ca. 500 BCE) golden Pyrgi tablets, a bilingual Etruscan-Phoenician text (Schmitz, 1995, O'Connor, 1996a).

(1) Phoenician: 𐤋𐤀 𐤌𐤁𐤊𐤊𐤇 𐤌𐤊 𐤕𐤍𐤔 𐤔𐤕𐤓 𐤌𐤋𐤀 𐤔𐤀𐤌𐤋 𐤕𐤍𐤔𐤅
Right-to-left transcription: l ʔ mbkkh mk tnš ytbr ml ʔ šʔml tnšw
/wašanat limuʔiš ʔilim rabbotay šanat kima hakokabīm ʔelle/
'And may the years of the god's statue be as many as these stars'

The transliteration (line 3) shows five different vowels (/a e i o u/). But none appear in the Phoenician, irrespective of length or position in the word. Likewise, the glides <w> and <y> occur only as consonants, as onset /wašanat/ or coda /rabbotay/. The Phoenician indicates all and only consonants.

Not all Afroasiatic writing was strictly vowelless. When 'the stars' appears several times in the Old Testament (e.g., Judges 5:20, Ecclesiastes 12:2), it is written הכוכבים <hk**w**kb**y**m> /hakk**o**ḵāḇ**ī**m/.[1] As per the boldfacing, two of the four vowels are written: /o/ and /ī/ by the corresponding glides <w> and <y>. Consonants used in this way (termed *matres lectionis* 'mothers of reading') underdetermine the vowel for which they stand. For instance, <y> stands for /ē/ (and /o/ is unwritten) in ככבי <kkkb**y**> /kəḵōḵəḇ**ē**/ 'as the stars of' (Nehemia 9:23); and <w>, for /ū/ (with unwritten /ī/) in יזהרו <yzhr**w**> /yazhīrū/ 'they will shine' (Daniel 12:3). (Arabic made similar but not identical use of glides; see pp. 210–211.)

1. Transliterations do not distinguish allographs, such as word-final ם /m/ versus nonfinal מ, or the initial, medial, and final forms of Arabic letters.

Below, I refer to Phoenician-style writing as vowelless and to Hebrew/Arabic-style as vowel reduced. Vowel-reduced writing underrepresents vowels in two ways: they may be unwritten (e.g., /h**a**kkoḵ**ā**ḇīm/, /y**a**zhīrū/), or, if written, ambiguously represented (e.g., <w> stands for either a consonant or a vowel, and in Hebrew, the vocalic value too is ambiguous, /o/ or /u/). (Sacks' error is one of reductionism: a writing system is more its glyphs. Phoenician, Hebrew, and Arabic have vowelless alphabets, but a writing system is a set of glyphs together with a set of rules of use and the rules of use can represent vowels even when the glyphs alone do not—just as English represents <θ> without a dedicated letter.)

The Hebrew scribal tradition of 600–1000 CE developed diacritic marking to indicate vowels (as well as consonant gemination and spirantization evident in the previous paragraph; given that these are predictable from vowel length, their omission from the consonantal script is on a par with the underrepresentation of vowels). כְּכֹכְבֵי /kəḵōḵəḇē/ indicates /ə/ by two vertical dots below the letter (כְ), /ē/ by two horizontal dots beneath the letter (בֵ), /ō/ as a dot following above (כֹ). These marks were restricted to particular genres, such as holy books, where accurate reading was important. They do not impinge on whether Hebrew (or other) writing was, in general, vowel reduced. Indeed, their existence proves that it was. However, as we will see, especially for Arabic, such diacritics can play a major role in adaptation of the system beyond Afroasiatic.

The empirical question here is therefore more subtle than a dichotomy between Afroasiatic writing being wholly vowelless and non-Afroasiatic writing being vowel-complete. Rather, the question to be assessed is how vowel writing changes in completeness and obligatoriness when Afroasiatic writing systems that underrepresent vowels, partially or completely, are transferred within versus beyond the family.

3. Transmission Within Afroasiatic

I begin with cases showing that vowel writing remains minimal when writing is transferred within the Afroasiatic family. These cover a range of sociolinguistic situations: the same script in different languages, the same language in different scripts, transfer in the presence versus absence of education systems, transfer in the presence of multiple scripts, and ancient versus modern transfer. In all these intra-Afroasiatic scenarios, vowel writing barely increases.

We begin with two different cases of Berber writing. The first, the ancient Berber script, is believed to derive from Phoenician, the likely source also of the name of its modern descendant, *Tifinigh*, from Latin

Punic (O'Connor, 1996b). Like Phoenician, the script is vowelless, as the following excerpt (ibid., p. 116; Donner and Röllig, 2002, p. 24) shows:

(2) Ancient Berber: 𐤉𐤎=𐤊𐤋 𐤃𐤉𐤋𐤂 𐤔𐤎𐤆𐤎 𐤔𐤃𐤂𐤊
Right-to-left transliteration: nswkm dlg ʔsys tdgś
/sugadenn syusaʔ gəllid mikiwsan/
'after Micipsa became king'

Some modern varieties (written left to right, suggesting European influence) use vowels. Nonetheless, vowelless writing continues (though use of the script in either form is sporadic). An example from a Tuareg letter with minimal vowel writing is given below (O'Connor, 1996b, p. 116):

(3) Tifinigh: ⵙⵡⵢ ⵀⴷ ⵍⴳⵛⴱ
Transliteration: swy hd lǵšbʔ
/siwi hid elɣəšaba/
'send me here a garment'

Souag (2014) presents a study of more recent Arabic-based literacy in Berber and Berber-influenced Kwarandzyey, a Songhay language. Her case studies are independent of other written forms of Berber and differ noticeably from nearby non-Arab orthographies. A range of strategies is attested throughout her sample (there having been little central planning) and, though *matres lectionis* are attested in some writing (including cases where all vowels are written), vowels are only partially written in others.[2] The following words are drawn from a range of dialects, unwritten vowels in bold.[3]

(4) عقرقي <ʕgrgy> /ʕa**a**gg^{w}ə**a**rg^{w}əy/ 'I fought'
تمقنا <tmgnʔ> /t**a**məgna/ 'head'
تمزوغين <tmzwɣyn> /t**i**məẓ̣uɣin/ 'ears'
لقفرتسي <lqfrtsy> /ləqfərdzsi/ 'the key to which'

<y> stands for /i/ in the last two examples (though not in the first). Likewise, <ʔ> stands for /a/ in the second.

Strikingly, even in didactic contexts vowels are frequently omitted. Online fora promoting Berber language and culture feature vocabulary challenges. Though presumably aimed at somewhat advanced speakers,

2. In contrast to Hebrew, dots are integral parts of Arabic consonants (table 1). Interestingly, a consonantal dot is used in the Judeo-Arabic example (6), distinguishing ך /k/ from כ /x/; in unvowelled Hebrew, the latter represents both.

3. Arabic ق <q> is commonly, but not exclusively, used for /g/ and I transcribe it as <g>. Labialisation is often unwritten; it 'carries a significant load only in Kwarandzyey' (Souag, p. 60).

the likely presence of more basic learners apparently does not motivate complete vowel writing:

(5)	تغنجايت	<tγnjyt>	/t**a**γ**ə**njayt/	تمزراين	<tmzrʕyn>	/t**i**m**ə**zraʕin/
	تقسريت	<tqsryt>	/t**a**q**ə**srit/	نلغمان	<nlγmʔn>	/n**i**l**ə**γman/

<CyC> is vocalised either as /CayC/ or as /CiC/, <tC> as /taC/ or /tiC/. So, vocalisation is underdetermined.

Arabic itself has been written by speakers of other Afroasiatic languages using their own writing systems. An example of this is Judeo-Arabic. Written in Aramaic block script, it was initially significantly phonetic, then underwent a stage of imitating Arabic orthographic conventions, before settling on a system distinct from both. In this stage (and earlier), underrepresented vowels are well attested. In the following literary passage (Egypt, circa 1600), only long vowels are indicated (Hary, 1996, pp. 733–734). Boldfaced vowels in the transliteration are unwritten:

(6)	Judeo-Arabic:	מולאנא אל מלך אן נחן לך עביד אן שית
	Right-to-left transliteration:	tyš nʔ dybʕ kl nḥn nʔ klm lʔ ʔnʔlwm

/m**a**wlānā **i**l m**a**l**i**k **i**nn**a** na**ḥ**n**u** l**a**k ʕ**a**bīd **i**n šīt/
'We are truly slaves to you, and if you wish …'

The history of the Arabic script is itself interesting in this regard. Developed by the Nabataeans, who spoke Arabic but wrote Aramaic, it shows significant linguistic insight and sophistication (Daniels, 2014, p. 29, citing Diem, 1979–1983). Aramaic, and hence its script, lacked many sound distinctions that Arabic preserved from Proto-Semitic. Writing Arabic without significant ambiguity therefore required new letters. Several were derived by adding a single dot to existing letters. The choice of which letter to dot, far from being arbitrary or based on

Table 1. Source of Arabic <C>~<Ċ> consonant pairs

Aramaic	PrSem	Arabic	
t	*t	t	ت
	*θ	θ	ث
ḥ	*ḥ	ḥ	ح
	*x	x	خ
d	*d	d	د
	*ð	ð	ذ
tʕ	*t’	tʕ	ط
	*θ’	θʕ	ظ
sʕ	*s’	sʕ	ص
ʕ	*ɬ’	ðʕ	ض
	*ʕ	ʕ	ع
	*ɣ	ɣ	غ

superficial phonological resemblance, reflected pairs of sounds that were cognate in the two languages. In table 1, sounds that have collapsed in Aramaic correspond, for the most part, to letters differentiated by a dot in Arabic. Orthography recapitulates etymology, not in irregular spelling (like the <k> in English <knot>), but in letter design itself. Despite this sophistication, vowels remained underrepresented. In fact, the Nabataean script had several deficiencies, such as pairs of nearly indistinguishable letters. This led to problematic ambiguity, which was tolerated for a surprisingly long time. Nonetheless, its solution did not involve investment in vowel writing.

Ugaritic presents a similar redesign of form while maintaining principles of function. The script is a fascinating Mesopotamian–West Semitic hybrid, cuneiform in appearance, but consonantal in structure. It departs from the West Semitic prototype in incorporating three syllabic signs instead of a single glottal stop: <ʔa>, <ʔi>, and <ʔu>. Otherwise, it adheres to underrepresentation of vowels (Schniedewind and Hunt, 2007).

Turning to a yet older case, possibly, indeed, the oldest, Darnell et al. (2005) show that two inscriptions from Wadi el-Ḥôl (ca. 1,800 BCE) are alphabetic, rather than logo- or syllabographic, given the number of repeated glyphs, and record a language that is not Egyptian but is likely Semitic, given the connection of several signs to later West Semitic letters. Nonetheless, most of the characters are clearly Egyptian in origin. So, this is a very early case of transmission. Of the 28 characters that comprise the two inscriptions, 22 occurrences are of full consonants (b, ḥ, l, m, n, p, r, $š^{ʾ}$, t, $ṯ^{ʾ}$, ʕ) and only 6 ($h^{ʾ}$, w, ʔ) come from the set that later served as *matres lectionis*. The 22 consonants could have spelled as few as 11 closed (CVC) syllables or as many as 22 open (CV) syllables. In consequence, even if, improbably, the inscriptions recorded some vowels via *matres lectionis*, the majority of vowels were unwritten. Even at the earliest transmission, then, a vowel-reduced orthography was maintained.

Thus, ancient or modern, by design or diffusion, when developing a new script or applying an established one, the vowelless or vowel-reduced character of Afroasiatic writing is constant.

4. Transmission Beyond Afroasiatic

This situation contrasts sharply with the adoption of Arabic, Aramaic, Egyptian, Hebrew, and Phoenician scripts for non-Afroasiatic languages. Across a range of families and borrowing scenarios, the rise of vowel marking is both more complete and more obligatory than in inter-Afroasiatic borrowing.

The most famous case of transfer beyond Afroasiatic is the Greek borrowing of Phoenician (Taylor, 1883, Diringer, 1948, Gelb, 1963). Greek repurposed unneeded laryngeals and glides as vowels.

(7)	Phoenician	Greek
	𐤀 /ʔ/	A /a/
	𐤄 /h/	E /ɛ/
	𐤅 /w/	F /w/
		Y /y/
	𐤇 /ḥ/	H /e/
	𐤉 /j/	I /i/
	𐤏 /ʕ/	O /o/

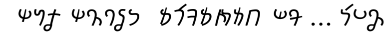
Though Phoenician did not provide the steppingstone of *matres lectionis*, Greek nevertheless converged on many of the same reuses of consonants as are found elsewhere (e.g., Aramaic א ה י <ʔ h j> for /a ɛ i/). This may indicate non-Phoenician influence (see Sass, 2005 for assessment) and has inspired some rather triumphalist rhetoric (see Share, 2014 for critique). Yet a simple explanation for the convergence comes from phonetics and the letter names themselves. If Greeks ignored the laryngeal onsets of Phoenician letter names, then <ʔ ḥ h> for /a ɛ e/ is acrophonic: *(ʔ)alef* for /a/, *(ḥ)ēṯ* for /e/, *(h)ē* for /ɛ/. And phonetically, /i/ from <j> is a small step. Combining phonetic proximity and ignored onsets, *(ʕ)ayin* would have been taken for a retracted /a/, close to /o/. (The correlation between Phoenician pharyngeal C and Greek back V emerges in 𐤒 <q>, too: it served as Greek /k/ before back vowels.)

Vowel writing is far from uniquely Greek. A second example from the westward migration of Phoenician is Iberian. This script, or family of scripts, represents only vowels and continuants (e.g., /m, n/) via standalone signs. Other consonants are written via CV syllabograms (without voicing distinction for C). It is not entirely certain whether Iberian derives from Phoenician directly or whether the transmission proceeded via Greece. However, if the latter, it might constitute the only case of a vowelled alphabet being transformed into a (partial) syllabary, which consideration favours direct transmission from Phoenician (though a second potential case is the Caroline Islands syllabary, Riesenberg and Kaneshiro, 1960).

By contrast, the conversion from consonantal alphabet to CV signs is attested elsewhere. Meroitic, the only other descendant of the Ancient Egyptian writing (besides Proto-Semitic and hence most of the world's current writing systems), adopted the small alphabet-like set of monoconsonantal signs of Egyptian hieroglyphs but transformed them by adding pure vowels and a small number of CV syllabograms. Most of the system comprises consonant signs, C, optionally read as Ca. The result is a mixture of signs for syllables, signs for phonemes, and signs that alternate between the two.

Eastward transmission of consonantal alphabets shows the same trend of increased vowel writing, by the means just mentioned. The Indian scripts Brāhmī (source of most scripts of India and Southeast Asia) and Kharoṣṭhī (no descendants) developed from Aramaic and were ini-

tially used to write Prakrit and Sanskrit. Aramaic used *matres lectionis* (including in its application to Prakrit and Sanskrit, e.g., Dupont-Sommer, 1966, p. 444), but Brāhmī and Kharoṣṭhī greatly expanded vowel writing by innovating diacritics (Salomon, 1996), representing diverse vowels, diphthongs, and liquids. Compare for instance the second and third syllables of *śarīrā* in the sample of Kharoṣṭhī below (Salomon, p. 382).[4]

(8) Kharoṣṭhī: 

Right-to-left transcription: $\overset{i}{m}\underset{u}{b}t^h$ $\overset{i}{m}ka\underset{\bar{u}}{ṇ}t$ $\overset{i}{t}\overset{e}{v}\overset{i}{ṭ}^ht\underset{r}{p}$ $r\overset{i}{r}ś$ $\overset{e}{m}\overset{i}{a}$ … $\overset{e}{r}m\underset{u}{k}$

/kumāre … imē śarīrā pratiṭ^{h}avēti taṇuakami t^{h}ubami/
'The Prince … establishes these bodily relics in his own stupa.'

A further, and highly productive, offshoot of Aramaic is the Sogdian script (Skjærvø, 1996). Used for an Iranian language, it was further adapted for Altaic. The resulting scripts (written vertically, presumably imitating Chinese) include Uyghur, Mongolian, the Clear Script and Manchurian (Kara, 1996), the last two of which were alphabetic. Yet, even before full alphabetism, vowel marking was systematic and substantial, as in Uyghur: <ywkwnwrmn> /yükünürmen/ 'I prostrate myself', <ʔwydwn> /ödün/ 'time.LOC', <qwtynkʔ> /qutïnga/ 'majesty.POSS.DAT', <yyqylqw [l]wq yn> /yïγïlγuluqïn/ 'meeting place'.[5] And earlier, in Sogdian, <βγw xwtʔw> 'lord master' and <nmʔcyw spʔtzʔnwky> 'reverently with bended knee' were read /βaγu xutāw/ and /namācyu spātzānuk/, in which only short /a/ is unrepresented (though written as <ʔ> in the same text).

Like the Aramaic script, the Arabic script spread both eastward and westward. The former (Kaye, 1996) was comparable to the eastward spread of Aramaic, initially finding an Iranian language, Persian, and moving from there to other families (e.g., Indo-European and Malayo-Polynesian). In Persian, as in Sogdian, *matres lectionis* were used, though non-initial short vowels were often unrepresented: compare, for instance, <z> /ze/ 'from' with <kh> /ke/ 'that', or <rxy> /roxī/ 'face' with <xvšbʔš> /xošbāš/ 'be happy'. Word-final vowels in particular are represented more thoroughly in Persian than in Arabic (Gnanadesikan, 2017).

4. Absence of a vowel in the transliteration signals the orthographically "inherent" vowel /a/. <a> is a place holder for vowels, hence, orthographically, a null consonant. /pr/ is written as <p> with <r> appended beneath.

5. These examples show that front/back vowel pairs were undifferentiated. Given that the language is vowel harmonic, this underrepresentation may, again, be tied to grammar: front/back is predictable for most vowels in a given word. In Turkic runes, a separate offshoot of Sogdian, several consonant phonemes corresponded to pairs of letters, one used if the following vowel was front, the other, otherwise (a solution that Ottoman Turkish would later reinvent, utilising otherwise 'dead' letters of the Arabic script, Daniels, 2014; cf. Vydrin, 2014, pp. 221, 224 on Mande languages).

And again as with Sogdian, Persian had offshoots, such as Kashmiri, that became fully alphabetic.

Less known is that the Arabic script supported a wide range of indigenous writing traditions throughout Africa (Mumin, 2014). Apparently all non-Afroasiatic languages with established Arabic-script literacy make vowel writing obligatory. Representative examples include, from West Africa, Old Kanembu and Kanuri (Bondarev, 2014) and Mandinka (Vydrin and Dumestre, 2014), and, from East Africa, Swahili (Luffin, 2014) and Chimi:ni (Banafunzi and Vianello, 2014). Some Afroasiatic languages, including for instance Kabyle Berber, also marked vowels fully (Souag, 2019) (see next section for discussion).

Old Kanembu and Kanuri (spoken around Lake Chad) are attested in manuscripts from the late 18th to early 20th century. Orthography is not standardised across (or within) manuscripts and relies substantially on speaker knowledge. Consonants and vowels are both significantly underrepresented. Some 'dead letters' of Arabic are reassigned to sounds of Kanembu/Kanuri in a one-to-one fashion (e.g., Ar. ث /θ/ to Ka. /ʦ/; Ar. غ /ɣ/ to Ka. /g/), but others are pressed into multiple roles (e.g., Ar. ج /ʒ/ to Ka. /ʤ ʒ nʤ nʒ/), with prenasalisation of stops prone to nonrepresentation, as just illustrated. There is no orthographic /o u/ distinction (comparable to some Arabic varieties), except that /ó/ can be optionally distinguished from /ó ú/. The three-tone system is underrepresented by a two-way graphic distinction, repurposing /ʔ w y/ from vowel length into tone marking (high/falling). Despite these mismatches, these writing systems invested in obligatory vowel marking rather than expansion of the consonant inventory, as is graphically obvious from the numerous diacritics in the examples below (Bondarev, 2014, pp. 121, 131, 133–4).

(9)	ثْلِم	<θ̊l̊m>	/tsələm/	'black'
	جُندُوغُم	<ʒ̬nd̬w̬ɣ̬m̬>	/dzundógoma/	'possessor of knowledge'
	نَاسْكُودُو	<n̥ʔs̊k̬w̬d̬w>	/náskóndó/	'your soul'
	دِيغِبُو	<d̬yɣ̬b̬w>	/dígibú/	'there is not'

Mandinka presents a similar situation. Both /o u/ and /e i/ are undifferentiated. Tone is unmarked. Nonetheless, vowel symbols are obligatory. The following excerpt is from a hunter's incantation (Vydrin and Dumestre, 2014, p. 227):

(10) Mandinka: مِنَّ كَبَ كُتُ تُّبُ بِا عِ كُّتُ

Right-to-left transcription: t̬k̬ ʕ̬ ʔb̬ b̬t̬ t̬k̬ y₂k̥ n̥m̬

/mìnankaña kòto túnbuŋ bé í kùntu/
'Old male antelope, ruins will cut you.'

In East Africa, Swahili (Luffin, 2014) and Chimi:ni (Banafunzi and Vianello, 2014) present similar patterns. Examples from Swahili court transcripts (Luffin, pp. 314f) illustrate:

(11) وُمُلِتِي <$\overset{u}{w}\overset{u}{m}\underset{i}{l}\underset{i}{t}y$> /umulete/ ‘you bring me’
اَمَفَنِيزَ <$\overset{a}{ʔ}\overset{a}{m}\overset{a}{f}ny\overset{a}{z}$> /amefaniza/ ‘he did’
مْزُغُ <$\overset{0}{m}\overset{u}{z}\overset{u}{g}$> /mzungu/ ‘European’
مَهُونغُ <$\overset{a}{m}\overset{u}{h}wn\overset{u}{g}$> /mahongo/ ‘tribute’

The manuscripts surveyed vary with respect both to consonants and vowels, as (11) shows: /ŋg/ is both <g> and <ŋg>. Similarly, /e/ is sometimes encoded like /i/ via the <i> diacritic, sometimes, it is grouped with <a> and /a/. Sometimes <y> stands for /i, e/, without any further diacritic, sometimes it supports a diacritic. Despite these differences (and the absence of orthographic innovation), vowels are obligatory.

Adaptations of Aramaic block script in the Jewish diaspora shows the same pattern. Two European examples are Yiddish (Germanic) and Judeo-Spanish (Romance). The earliest full text in Frakes, 2004, *Abraham the Patriarch* of 1382 (hence Old, not Early, Yiddish), already shows rich vocalisation (text, ibid., p. 11; transcription, cf. Frakes, 2017; translation, Frakes, 2014, p. 4).[6]

(12) Yiddish — וועך די אלטא שטרושא וול גבווט גוט
Left-to-right transliteration — tvg t**v**vbg l**vv** **a**švrtš **a**tl**a** **y**d r**e**vv
/ver di altə štrosə vol g**ə**bóut gut/
‘He who travels the old and well-built streets’

Every vowel except one interconsonantal schwa is indicated (boldfaced in the voweled transliteration), including, interestingly, in some cases, by digraphs absent from Classical Hebrew (<vv>). In contrast to the African adaptations of Arabic script above, vowel diacritics were only occasionally exploited in Yiddish (Frakes, 2017, 22f).

Judeo-Spanish spelling is also striking. Romance vernacular writing from Muslim Spain is largely fragmentary, but Andalusian lyrical poems in Arabic or Hebrew sometimes exploit it for their closing couplets, as a way of supplying a different voice (Pountain, 2000, p. 43). A representative example (from Yehuda Halevi in the 12th century) is reproduced below:

(13) Judeo-Spanish: — שן אלחביב נן בבראיו אדבלארי דמנדארי
Right-to-left transliteration: — yrʔdnmd yrʔlbdʔ wyʔrbb nn bybḥlʔ nš

6. א and ע are transliterated as <a> and <e>, reflecting their Yiddish usage, as the Semitic values /ʔ/ and /ʕ/ did not survive into Ashkenazi Hebrew.

/š**i**n al-ḥ**a**bib n**o**n b**i**b**i**reyu adb**o**larey d**e**m**a**ndare/
'Without my lover I will not live; I will fly away to seek [him].'

As per the boldfacing, several vowels are unrepresented here. Nonetheless, the extent of *matres lectionis* is greater than in Hebrew, both in its variety (<ʔ> is used for both /a/ and /e/) and in its extent (the prepenultimate use of vocalic <ʔ> is un-Hebraic; /kōḵāḇīm/ 'stars' is never written with <ʔ> for /a/).[7] (A later Romance text in Arabic script, from the early 15th century or before, is fully voweled, like the African writing above; Martínez Ruiz, 1974.)

5. The Grammar of Vowelless Writing

The preceding discussion shows clearly that vowel-reduced writing is preserved much more strongly within the Afroasiatic family than when writing systems move beyond it. The correlation is not perfect: Kabyle Berber is Afroasiatic, but is written vowelled; Sogdian and Persian are non-Afroasiatic (Iranian), but leave many vowels unrepresented (though they are vowel reduced, not vowelless). Nonetheless, it is clear that something about Afroasiatic languages facilitates vowel-reduced writing. What is it?[8]

An initially plausible guess is that vowel-reduced writing does not conduce ambiguity in Afroasiatic languages as it would in non-Afroasiatic ones. It is easy to find consonant strings, like p-r-t, that can host more vowels in, say, English than Hebrew:

(14) a. part, pert, port, prat, prate, parrot, pirate, pyrite, pirouette
b. *prat* 'detail', *peret* 'list, to detail', *parat* 'to break', *porat* 'to be detailed'

However, closer reflection on English lexis and Hebrew morphology suggests that such examples are misleading. Counterbalancing (14a), it is relatively easy to find triplets of consonant phonemes that admit of

7. The written vowels are towards the end of the word, where Romance stress is typically located—precisely where Semitic *matres lectionis* had first taken hold more than 1500 years earlier (Cross and Freedman, 1952).

8. Fidel, used for several Eritrean and Ethiopian Afroasiatic languages, systematically indicate vowels, but the motivation seems to be sociocultural (Meyer, 2016): Fidel was influenced by two voweled scripts, Greek and Indic, and by the liturgical needs of nonnative speakers (cf. Arabic and Hebrew). An exception in the other direction is Carian (Adiego, 2007; 2020). Having only recently become aware of it, I have yet to analyse the system. However, the current research concerns trends, not exceptionless generalisations, so the conclusions do not depend on the status of any one writing system.

TABLE 2. Vowel-reduced Greek and Hebrew: Ambiguity in frequent vs. all words, with (left) and without length distinctions (Crellin, 2018)

	Frequent	Total	Frequent	Total
Hebrew (Pentateuch)	91,278	280,180	77,910	248,288
Greek (Pentateuch)	56,916	140,325	48,657	121,853
Hebrew (Judges)	103,177	315,650	85,418	275,729
Greek (Herodotus)	93,035	212,666	93,260	227,089
Greek (Xenophon)	89,148	212,098	96,159	224,733

only one vocalisation in English (/m-ʤ-k/, /r-ð-m/, /θ-k-n/). In Hebrew, however, nearly every three-consonant string is subject to multiple vocalisations. The question is whether, cumulatively, ambiguities in a system like Hebrew outnumber those of languages like English.

Clearly, this question cannot be answered for all of the languages above. However, in a study that is to my knowledge unique (though see also Sampson, 2015), Crellin (2018) compares the levels of ambiguity in two languages that more or less recreate one of the crucial transmissions of writing beyond Afroasiatic, Old/Classical Greek and, as a proxy for Phoenician, Biblical Hebrew. Crellin's method is to rewrite Greek texts as per Hebrew norms (representing initial vowels by glottal stop, using glides for others, and leaving others, along with geminate consonants, unmarked). Ambiguity was measured as the product of types and tokens for each consonant string in the first 80,000 words of each text. A second experiment disregarded vowel length. In both, ambiguity without vowels was higher in Hebrew, the language that managed without writing them.

The results are shown in table 2, with counts given for each text separately. The Pentateuch was used for both languages. To control for genre, historical texts were also analysed (*Judges* for Hebrew, Xenophon's *Anabasis* and *Hellenica*, Herodotus' *Histories* for Greek). Alongside the total ambiguity measure for each text, the eight most frequent C-strings were counted. Only for the frequent items in the second (no length) experiment is Greek more ambiguous than Hebrew (by about 10%). In all other measures, Hebrew is the more ambiguous, at times by a much greater factor (50–100%). Crellin concludes that the Greek coining of vowels cannot have been to escape unacceptably high levels of ambiguity.

Evidently, it is the nature of the ambiguity, and hence of its resolution, that makes vowel-reduced writing tolerable for Afroasiatic languages. Several factors are at play.

It is well known (and appreciated by writing system scholars, e.g., Coulmas, 2003, Sampson, 2015) that much lexical meaning in Semitic

languages is carried by consonants. The difference between, say, 'read' (q-r-ʔ) and 'write' (k-t-b), inheres entirely in consonants. Vowels and further consonants encode whether an occurrence of these roots is nominal, verbal, etc.; if verbal, whether finite; if finite, whether active or passive; and so on.

However, it is an oversimplification to say that consonantal roots carry all lexical meaning. Since Arad, 2005, it has been appreciated that lexical meaning inheres in the combination of consonantal root and a vocalic pattern. For instance, Hebrew s-p-r means 'count' with vowels -a-a-, but 'tell' with vowels -i-e-. All templates derived from -a-a- and -i-e- preserve the meanings of 'count' and 'tell', respectively (e.g., *sfira* 'counting', *sipur* 'story'). The pattern -i-e- no more derives 'tell' from s-f-r than the prefix *er-* derives *erzählen* 'tell' from *zählen* 'count' (or English *recount* from *count*). Thus, vowel underrepresentation is not harmless to lexical meaning in Afroasiatic languages.

To understand why it persists, a grasp of the grammar of the language family is crucial. Because Afroasiatic morphology only ever uses a limited number of vowel templates, the search space to recover vowels is more restricted than in other languages. For instance, -o-u- is a possible vowel pattern in English (*bonus*, *chorus*, *nodule*), but not in Hebrew.[9] Similarly, -i-i- is highly limited in Hebrew (e.g., *ḥiriq*, name of /i/ diacritic), but unremarkable in English (*limit*, *visit*, *vivid*). Thus, Afroasiatic facilitates resolution of the ambiguity by limiting the search space.

Syntax restricts the search space further. The common -e-e- pattern is restricted to nouns (*qešer* 'knot', *peret* 'list', *sefer* 'book', *gefen* 'vine'); -a-u- is confined to adjectival participles (*qašur* 'fastened', *gamur* 'completed', *barux* 'blessed'); -a-i- excludes verbs (*qašir* 'connected', *ragil* 'regular', *nagiš* 'accessible'); and so on. Syntactic cues as to category may come either from word order (for instance, in a verb-initial language, a verbal pattern is likely at the start of a sentence) or from context (a nominal pattern is more likely in the vicinity of determiners or adjectives, or after a clitic preposition).

Further, morphology is particularly important as concerns the facilitating effect of Afroasiatic grammar in reading with minimal vowels. In most of the world's languages, affixal consonants enable a reader to predict affixal vowels. For instance, English <fxng> is, by basic phonotactics, to be read as /f○x○ng/, and speakers recognise that this comprises a root f○x and an affix ○ng. From the affixal consonants, one can determine the affixal vowel: /f○xing/. But that gives no handle on the root vowel, which can be /faxing/, /fixing/, /foxing/.

In Afroasiatic, by contrast, affixal consonants frequently provide unambiguous cues to all unwritten vowels, whether part of the affix or in-

9. I use English as a comparator for Hebrew even though it reduces unstressed vowels. Other languages avoid this issue (e.g., German *Bonus*, *Forum*, *Tonus*).

ternal to the root. For instance, in a nominal context, tCCCt is read as tiCCoCet (with /i/ changing to /a/ for some consonants):

(15)	תזמרת	<tzmrt>	/tizmoret/	'orchestra'	< /tizmer/ 'orchestrate (vb)'
	תכתבת	<tktbt>	/tixtovet/	'correspondence'	< /tiktev/ 'dictate (vb)'
	תרשמת	<tršmt>	/tiršomet/	'details'	< /tiršem/ 'outline (vb)'
	תחבשת	<tqšrt>	/taxbošet/	'bandage'	< /tixbeš/ 'bandage (vb)'

Similarly, hCCCh is read as haCCaCa:

(16)	הסברה	<hsbrh>	/hasbara/	'explanation'	< /hisbir/ 'explain'
	הזהרה	<hzhrh>	/hazhara/	'warning'	< /hizhir/ 'warn'
	הקדמה	<hqdmh>	/haqdama/	'introduction'	< /hiqdim/ 'introduce'

For monoconsonant affixes, there is often residual ambiguity. For instance, nCCC can be either third person masculine singular past "passive," niCCaC, or first person plural future active, nCaCeC (17). Similarly, mCCC can be a nonagentive nominal, miCCaC, or an agent nominal / present participle, mCaCeC, amongst other patterns.

(17)	נקשר	<nqšr>	/niqšar/	'it was tied'
			/nšaqer/	'we will tie'
	נשבר	<nšbr>	/nišbar/	'it was broken'
			/nšaber/	'we will break'
	נלמד	<nlmd>	/nilmad/	'it was learned'
			/nlamed/	'we will teach'
(18)	מחקר	<mxqr>	/mexkar/	'research (n)'
			/mxaker/	'researcher; researching'
	מספר	<mspr>	/mispar/	'number'
			/msaper/	'narrator; narrating'

Obviously, discourse, syntactic, or morphological context are likely to reduce, if not resolved, such ambiguity.

Much of the residual ambiguity concerns functional vocabulary. For instance, the ambiguity between 'research' and 'researcher' amounts to the neutralisation of morphological derivation, making an agentive noun identical to what such agents produce. However, many languages would not make such a difference to begin with. Consider /šiber/ and /šuvar/. These are active and passive of the same verb, 'break'. Yet, without vowels, they are written identically, <šbr>. Although not an exact equivalent, this is similar to the causative/inchoative alternation which, for many English verbs, is unmarked: *I broke it* versus *it broke*.

Thus, Afroasiatic vowel-impoverished writing is akin to morphologically impoverished writing. This is an interesting state of affairs, in light of both recent research involving artificial language learning and of the history of writing itself.

The artificial language learning paradigm exposes experimental subjects to data from a fictitious language and then induces them to extrapolate it beyond what they are been taught. Learners' responses often

converge on typologically common systems even though neither their native tongue nor the data they have been given overtly biases them to (Martin et al., 2019). This looks like what early writers of Afroasiatic languages were doing. Their writing system can be seen as an artificial language akin to a natural language of a more common typological kind—one with less morphology.

The same strategy has arisen elsewhere. Mandarin has words that are related by now defunct derivational processes (Baxter and Sagart, 2014) but that have not come to be orthographically distinguished, despite differing in meaning and pronuncation. For instance, 乘 was both /Cə.ləŋ/ 'drive' and /Cə.ləŋ-s/ 'wagon' (modern *chéng* and *shèng*, respectively). Similarly, in Sumerian, large amounts of morphology were only sporadically written for centuries. Two copies of *The Instructions of Šuruppak* (Alster, 2005, pp. 176, 180), several centuries apart, illustrate. Abstracting away from irrelevant details of the orthography, the "standard Sumerian" of copies from Nippur, Ur, Kiš, and Susa marks ergative, possessive, dative, object agreement, and imperfective (boldfacing; <^{ki}> is an orthographic disambiguator).

(19) šuruppak-^{ki}- **e** dumu-**ni**- **r** na na- mu- **n**- ri- **ri**
šuruppak-CITY-ERG child- his-DAT "instruct" PVB-VENT-3SGO-lay-IMPF$_{RED}$
'The Man from Šuruppak gave instructions to his son.'

All of these are absent from the earlier Abū Ṣalābīkh (Early Dynastic) version even though the sentence recorded is taken to be the same:

(20) šuruppak dumu na na- mu- ri
šuruppak child "instruct" PVB-VENT-lay
'The Man from Šuruppak gave instructions to his son.'

The representation of morphology was largely mnemonic in Sumerian, aiding the fluent speaker/reader, not aiming at high-fidelity recording of the language (rather as punctuation scantly records prosodic groupings in English). Underrepresentation of functional material creates a writing system that is simply a language of a different grammatical type, but a legitimate one.

An obvious parallel to the effect of vowel-reduced writing in non-Afroasiatic languages is consonant-reduced writing in Afroasiatic ones. One such case arose when Akkadians adopted the Sumerian writing system, which routinely omitted coda consonants from its writing. When used phonetically (for rebus writing) <kuř> could stand for /ku/, <gub> for /gu/. With a range of logograms and other devices to clarify meaning, Sumerians clearly felt this to be unproblematic. For Akkadian, which opted initially for a much more phonetic orthography, the convention was problematic: /iprus/ 'separate' (root p-r-s plus template i--u-) would be written <i.ru>. This erases most of the root. The Akkadi-

ans consequently adopted the convention of writing /CVC/ as <CV.VC>, expanding the inventory and use VC already available within Sumerian.

Returning to Kabyle Berber in this light is also interesting. In contrast to the Berber varieties surveyed in Souag, 2014, Kabyle Berber (Souag, 2019) has been written with vowels in a range of orthographies. Some of these may reflect European influence, having been European commissions for missionary ends. However, full vocalisation, via diacritics rather than *matres lectionis*, applies to orthographies that predate European influence. Sociological factors cannot be discounted: diacritics distinguished Berber script from secular Arabic (Souag, p.c.), or Quranic Arabic may have been taken as a model. However, linguistic factors may also be at play that may limit the viability vowel-reduced writing in Kabyle Berber.

Souag (p.c.) suggests two. First, Afroasiatic grammar is not uniform. The extent of intercalating templates, as opposed to crosslinguistically more common concatenating morphology, varies. Berber may be one of the more concatenative cases, making it more like a non-Afroasiatic language in the respects relevant here. Second, several root consonants do not emerge phonetically in Kabyle Berber. For instance, of the root ʔ-r-β 'write', only the middle consonant emerges in *y-aru* in '(that) he write' (< y-ăʔrŭβ) and *y-ura* 'he wrote' (< y-ŭʔrăβ). Full assessment requires study beyond the scope of this article. But it is interesting that *matres lectionis* emerged towards the end of the word in Hebrew, a locus where consonants were prone to loss.

6. Conclusion

The emergence of vowel writing was not a one-off affair. Vowel writing accreted gradually and partially within some Afroasiatic writing systems, and some non-Afroasiatic orthographies continue with partial representation of vowels today. However, as a whole, vowel writing increases most when an Afroasiatic writing system is adapted to a non-Afroasiatic language, and it remains most constant when the system is passed within the family. The 'sudden' innovation of vowels, whether via diacritics, letters, or syllabograms, appears exclusively within non-Afroasiatic systems, like Brāhmī, Greek, Iberian, Kharoṣṭhī, and Meroitic.

The obvious correlate of vowel expansion is, therefore, grammatical. Only Afroasiatic languages structure their lexical and functional vocabulary such that removal of vowels minimally affects lexical vocabulary and amounts, on the whole, only to impoverishment of functional vocabulary. This view of matters is supported by other writing systems that underrepresented functional vocabulary. Grammar is, therefore, a key force that shapes the evolution of writing systems.

I end on a speculative note. The alphabet has been portrayed by some as the logical, even teleological, end of writing system development (as surveyed in Share, 2014). I believe this is a radical misreading of grammatical history. With one exception, when writing systems have invested in phonetic devices (that is, sound- rather than meaning-based writing), the unit of investment has been the syllable. This applies both to pristine writing systems (Sumerian, Egyptian, Mayan) and to their descendants (Akkadian, Meroitic, Japanese) and to adoptions of the idea of writing but invention of a new system (Linear B, Cree, Vai). The exception is Egyptian. However, a syllabary for a language unconcerned with vowel writing is, simply, a consonantal alphabet. Passed onto unrelated languages, in which vowels and consonants have more equal status, the consonantal alphabet acquires vowels. On this picture, the existence of the alphabet is a highly contingent accident of history: at the right time, a language of the right grammatical type, innovated a writing system, that was then simplified by speakers of a related language, before being passed to speakers of others who invested in complete vowel writing. Had different peoples been involved, writing might never have become more finegrained than the syllabary.

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