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Rebus and Acrophony in Invented Writing

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Rebus and acrophony are crucial in the development of ancient invented scripts from Mesopotamia (cuneiform), China, Mesoamerica (Maya), Egypt, and scripts which may have been created through exposure to literate cultures (Anatolian Hieroglyphic and Nahuatl). Yet, these two linguistic mechanisms have been understudied from a terminological, contextual and comparative perspective. This article aims to address issues regarding their definition, development and application in script formation. The scope of our study is all attested writing systems that are largely iconic in their sign repertoire, and whose phonetic values were generated anew based on an underlying language (hence 'invented'). This allows us to chart how writing systems are created *ex novo* and what trajectories of development are put into practice when phonetisation takes place. We show some reliable patterns of universal mechanisms, observable from a comparative perspective, which can be explained. We also demonstrate that these patterns attest to a verifiable degree of phonological awareness that ties the process of phonetisation to the path to script formation. We further highlight that the tendencies discerned from deciphered writing systems provide ways to test hypotheses in the study of iconic writing systems which are undeciphered, such as the Indus Valley script and the Rongorongo of Easter Island.

Keywords: rebus; acrophony; phonetisation; script formation

Funding details:

This work was supported by the European Research Council under the ERC Consolidator Grant Agreement n. 771127 (project INSCRIBE, Inventions of Scripts and their Beginnings). The first author would also like to acknowledge the support of the

Spanish Ministry of Science, Innovation and Universities under the Juan de la Cierva Formación Post-doctoral Fellowship FJCI-2017-31941.

1. Introduction

Invented writing systems are based, in their graphic appearance, on an inherent relationship with images. This applies to inventions that took place without any external influence from literate neighbouring cultures, such as those attested for different periods of antiquity from Mesopotamia, China, Mesoamerica and perhaps also Egypt, and to writing systems which may have been created through exposure to literate cultures, but whose internal development in repertoire of shape and sound was wholly original. While the former instances could be defined as primary inventions, the latter, secondary inventions inspired through cultural stimulus, are based on autonomous triggers of creation, marked by graphically new iconic signs, with original shapes and sounds.[1]

The mechanisms involved in the formative processes of these inventions have never been investigated across the globe and systematically, to gauge the extents whereby the trajectories may be similar or not. This is an important avenue to consider, because all first stages of these processes are shrouded in mystery, standing, as they are, at a crucial interstice, that between iconography and linguistic notation, between art and writing. The overarching question is simple: when does a figurative symbol, one which is representative of something recognisable, cease to be figurative and come to represent

[1] This excludes cases of more recent scripts sometimes defined as "invented", but whose sign shapes or values were certainly or potentially inspired by other writing systems: among others, Pahawh Hmong (Laos), Vai (Liberia) and Cherokee (United States).

the name of the thing represented? In brief, when does a picture become a sign?

Behind the question lies a plethora of problems. This paper aims to shed light on these problems, not so much to capture the very moment sound is first registered, which may be an unattainable feat, but to reconstruct the mechanisms in action when we have direct evidence for writing. The step we intend to explore follows directly *after* the 'pictographic' stage, namely when we can safely say that sound is being recorded. The principal question, and the focus of this paper, is *how* this took place. To shed light on this step, which in technical terms is called phoneticism or phonetisation, we have selected all scripts whose repertoire of signs is new. Our pool of data comprises four cases that occurred in Mesopotamia, Egypt, China and Mesoamerica, which may represent original inventions. To this core group we have elected to add other scripts whose sets of signs are invented from zero and primarily picture-based. These are the Anatolian Hieroglyphic and Nahuatl (Aztec) scripts. The Proto-Sinaitic will be included, even though its path is slightly different, as it is not properly a new invention, but will be used as a test case and foil to the general discussion.

Our core and supplementary case studies (with the exception of Proto-Sinaitic) partake of the following criteria: (1) fundamental iconicity of the sign-shapes (2) originality of sign shapes, and (3) originality of sign values. These criteria, as we shall see, also have important repercussions on how we are to reconstruct the formative stages of undeciphered scripts, such as Cretan Hieroglyphic and the Rongorongo script from Easter Island. The choice of selecting picture-based scripts is less intuitive than it is empirically valid since, as DeFrancis (1989, p. 50) claims 'pictographs used as pictographs lead nowhere, pictographs used as phonetic symbols lead to full writing'. And because the process of primary phonetisation marks the invention of writing, we

need to start from its building blocks, namely speech sounds.

Our intention is to reconstruct the processes involved in the invention of a system of writing in its repertoire of phonetic signs. This is a tangible phenomenon, which has never been addressed globally and comprehensively. Our effort is geared towards addressing the open questions of how writing first emerged, and our goal is to shed light on how any set of symbols becomes phonetised. The two levels of analysis will involve the mechanisms that allow symbols to represent speech sounds as lexical units (logograms) and speech sounds as phonological units, mainly syllables (phonograms).

2. From Picture to Sound: Rebus and Acrophony

Two specific mechanisms are often cited as crucial when phonetisation first takes place. These are rebus and acrophony (Sampson, 1985; Daniels, 1992, 2007; DeFrancis 1989; Robinson, 1995; Mattingly, 1992). Rebus is a principle whereby a symbol is used not specifically to represent the thing depicted by the symbol, but to represent the sound evoked by the name of the thing depicted by the symbol. It pivots on homophony or near-homophony, so that one utterance can have two completely different meanings. An equivalent of this strategy in the English language would be, e.g., the notation of the word *belief* with drawings of a BEE and a LEAF (DeFrancis, 1989, p. 50). It is widely used even today, to make puns, in emojis, etc. Acrophony extracts the name of a symbol rendered pictographically by using its initial sound. Many first writing systems appear to apply these two mechanisms, yet these have never been investigated comparatively. It is also still unknown if all inventions follow the same mechanisms.

Rebus is a strong candidate as the first prompt to expand the repertoire of meanings to include concepts not easily rendered by logographs. It has often been

considered the *primary* springboard to writing. The earliest recorded example is, perhaps, the sign GI 'REED' expanded semantically to include the verb 'to reimburse' in Sumerian (Vaiman, 1974, p. 18; but see Englund, 1988, pp. 131–132, n. 9). Monosyllabic morphemes (words or parts of words) are an affordance for significant homophony, and so it was suggested that all first scripts depended on this 'precondition' (Daniels, 1992; Boltz, 2000). The status of acrophony is, however, less clear. In his influential *A Study of Writing*, Gelb (1963, p. 251) dismissed its role altogether stating that "as a principle [it] seems to play no part in the history of writing". In this article, we contend that both devices were used not *only* in pristine inventions, but also in newly invented scripts, i.e. scripts whose repertoire, also picture-based, is new, but whose origin is conceptually derivative, from a pre-existing literate culture (Anatolian Hieroglyphic, Nahuatl).

First, however, the term 'acrophony' needs to be clarified, as it has been used to mean different things. It originally emerged as a neologism, after Champollion's initial decipherment of Egyptian. He believed the script included a component of phonetic signs that were essentially alphabetical, representing both consonants and vowels. In particular, his contention was that every phonetic hieroglyph corresponded to the picture of an object whose name in the Egyptian language began with the sound the sign was meant to convey. For example, the hieroglyph depicting a 'lion', ⲗⲁⲃⲟⲓ in Coptic, would be used for /r/ or /l/ (Champollion, 1824, p. 381). One of his detractors, Seyffarth (1826, p. 366), coined the term 'acrophonic' (from Greek ἄκρος 'outermost' and φώνη 'speech sound') to describe this principle.[2] Eventually, it became clear that Egyptian

[2] Seyffarth used the Latin adjective *acrophonicum* and the German equivalent *akrophonisch*.

The term appeared around the same time as *acrologique*, a coinage by Klaproth (1827, pp.

was actually a logo-consonantal script, and that the majority of the phonetic hieroglyphs could not be interpreted as acrophonic. In the meantime, 'acrophony' had spread through the literature, especially in descriptions of the Semitic consonantal alphabets (Seyffarth, 1834, p. 2). Scholars of the day were well aware that the Phoenician and Hebrew scripts had letters whose readings matched the first sound of their names. Later, in 1916, Gardiner published the theory, still valid, that the Proto-Sinaitic consonantal alphabet was of Egyptian inspiration, its sign values being derived acrophonically. After that, Proto-Sinaitic and other early Semitic *abjads* became the paradigm of acrophony. By then, the term was largely used to mean the process by which a sign depicting an object of the real world was assigned a sound value corresponding to the first phoneme of that object's name.

In parallel, acrophony has also been used to refer to the invention of the names for letters: e.g. the Runic letters *f* and *b* received the Old Germanic names **fehu* 'cattle' and **berkanan* 'birch twig'.[3] This 'false acrophony' is the actual '*a* as in *apple*' principle, and also lies behind the Glagolitic letter-names or the modern-day NATO phonetic alphabet (*alpha*, *bravo*, *Charlie*, etc.) (Miller, 1994, p. xii). Although some scholars treat both senses as the same (e.g. DeFrancis, 1989, p. 160), it is clear that these are two different processes. Acrophony in its original sense describes the

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33–34, n. 2), another detractor of Champollion. Klaproth used 'acrologic' to describe the views of Goulianov, a scholar who believed the hieroglyphs were logographs that evoked the initial sound of the word they meant to notate (as if e.g. one drew a sign depicting a pig to write 'plant' or 'pain', etc.). 'Acrology' and 'acrologic' were used as synonymous with 'acrophony' and 'acrophonic' throughout the 19th century until the latter eventually became dominant.

[3] First used in this sense by Steinthal (1852, p. 113). Here we provide the reconstructed Old Germanic version of the letter names, after Williams (2004, p. 263).

phonetisation of signs of writing in connection with pictures, but ‘false acrophony’ is sound-based. It merely reflects the attribution of names to (non-iconic) letters of alphabetical writing systems, based on phonetic values that already exist: iconicity plays little or no part. This last practice has more to do with mnemonics than with early script inventions, and therefore it is not within our scope.

Tied, as it was, to consonantal scripts, for a while acrophony was widely understood as the creation of a sign value based on a single phoneme, the first of any given word. In time, though, the label extended to designate also the invention of syllabograms whose value was the first syllable of the name of the object they depicted, namely in Anatolian Hieroglyphic (Gelb, 1931, pp. 71, 83), Maya (Ringle, 1985, pp. 154–155) and Nahuatl (Lacadena, 2008). Progress in the decipherment of these writing systems has shown that, historically, the values of syllabic signs were also derived through a kind of acrophonic procedure. Especially informative as a starting point is the case of Maya Hieroglyphic. In this script, CV sign values were derived from words with a CVC structure where the last consonant is a ‘weak’ sound, often the ‘post-velars’ *ʔ* and *h* or *j* (/x/), or sonorants (Campbell, 1984, p. 12; Ringle, 1985, pp. 154-155). For instance, this is the origin of the Maya glyph T738  *ka* (from Mayan **kay* ‘fish’; see Appendix 3). To be sure, it is still uncertain whether the Maya script is invented or adapted, while Anatolian Hieroglyphic and Nahuatl are secondary inventions (as they developed in societies that knew of the existence of writing). Still, this suggests that, just like rebus, acrophony was implicated in early inventions of writing, and could moreover operate in close connection to near-homophony and monosyllabicity. Thus, one might suggest that acrophony emerged where the language(s) targeted by script invention had less homophony, and after the potential for rebus had been exhausted.

This is the reason that it has been seen as a ‘simple’ (DeFrancis, 1989, p. 160) or ‘defective’ (Vernus, 2016, p. 154) kind of rebus.

3. Trajectories of Phonetisation

In the comparative study that follows, we show data that demonstrates how these two mechanisms of phonetisation are used in all scripts whose sign shapes and sign values are invented from icons. We will also demonstrate that this assumption is valid even if the concept of writing was not invented primarily, but was vaguely borrowed from a pre-existing source. Our goal is to investigate how they operated globally. In the primary cases, rebus and acrophony are applied only in the creation of scripts whose signs have iconic shapes and whose sound values are invented, thus not borrowed nor adapted from a source. Therefore, we need to narrow our investigation to scripts that match this profile. For a significant analysis to be possible, these scripts also need to be deciphered.

[INTRODUCE FIGURE 1 ABOUT HERE]

Seven pre-modern writing systems fit the description: Egyptian, Sumerian cuneiform, Proto-Sinaitic, Anatolian Hieroglyphic, (Old) Chinese, Maya Hieroglyphic and Nahuatl. Four of these are widely accepted by scholars as certain or potential independent inventions of writing. These are Egyptian, Sumerian cuneiform, Chinese and Maya. The remaining three, Proto-Sinaitic, Anatolian and Nahuatl, were created in contexts in which their creators knew certainly or almost certainly that writing existed as a technique. Nevertheless, their signs are iconic and their values were derived independently. These three cases may be called ‘secondary inventions’.

Two caveats are necessary, before we contextualise each of these formations. 1. The inclusion of Nahuatl needs to be explained. Deciphered as a logo-syllabary in the mid-19th century (Aubin, 1849), it was for a long time denied the status of phonetic writing. Even recent and reliable treatises on writing persist on this stance (Trigger, 2004, pp. 47, 63). Yet, there is evidence that Nahuatl, as a notation system, contained signs of syllabic value, which phonetically represented local names that constituted transparent Nahuatl sentences as well as opaque foreign names (Lacadena, 2008; Whittaker, 2009). 2. Proto-Sinatic also deserves a note. Although its signs are iconic and their values invented, this script presents two features that set it apart from the other six cases. On the one hand, iconic as they are, the shapes of Proto-Sinaitic signs are so similar to the shapes of Egyptian hieroglyphs that they must have been borrowed. On the other hand, Proto-Sinaitic is a system that shows no primary logograms, and as such it is fundamentally phonographic. These two traits imply that the creators of the script borrowed the shapes of the signs from Egyptian and then (re)invented their sound values. By contrast, the other six scripts considered here certainly or probably emerged when a pre-existing set of pictorial symbols (what we might call semasiography, although we will not treat this phenomenon here) was phonetised. The inclusion of Proto-Sinaitic, therefore, is justified as a foil, to test if and how newly-applied phonetisation is different when the template is borrowed.

3.1. Iconic scripts and original phonetisation

Each case study is briefly introduced in its historical setting and following a chronological order. Egyptian and Sumerian cuneiform are the earliest writing systems in the world, but Egypt and Mesopotamia compete for the earliest invention to ever take place. In southern Mesopotamia and Susa a form of graphic notation, defined as proto-

cuneiform, appears as early as ca. 3200 BCE, in the Uruk IV period (Englund, 1998). Using mostly iconic signs, proto-cuneiform was mainly used to inscribe inventories on clay tablets that registered the flow of goods. Yet, proto-cuneiform signs strictly represent basic grammatical categories, usually nouns, verbs and adjectives, and apart from a few proposed cases (Englund, 2009, p. 7-10) they do so logographically. It is only ca. 3000-2900 BCE, on archaic clay records from the site of Jemdet Nasr, that we see compelling cases of signs that stand for speech sounds, the underlying language being Sumerian.[4]

In Egypt, the first systematic records using iconic signs have been identified on bone and ivory labels and ceramic jars found in tomb U-j at the royal necropolis of Abydos. They date also to ca. 3200 BCE (Naqada IIIa period) and are roughly contemporary with the Uruk IV period (Baines, 2004, p. 175). However, their decipherment as logo-phonetic writing (Dreyer, Hartung, Pumpenmeier, & Drey, 1998) is contested (Baines, 2004, pp. 162–163), and they may well represent a semasiographic type not too dissimilar from proto-cuneiform. The earliest clear phonetic hieroglyphs are found on inscribed objects associated with the tombs of kings Iry-Hor and Sekhen/Ka (taken to have reigned in the last two centuries of the 4th millennium BCE), and even more certainly Narmer (Kahl, 2004). Thus, evidence for semasiography is more or less coeval in Mesopotamia and in Egypt, even though the oldest examples of phonetic writing come from the Nile. We will see in the next section that the

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[4] We shall not address whether proto-cuneiform was used by speakers of a non-Sumerian language (Englund, 1998). There are clear matches between early cuneiform sign shapes, sign values and Sumerian words which imply phonetisation based on that language. The residual involvement of another remains a possibility, but so far there is no consensual evidence.

phonetisation of Egyptian writing was, in any case, an original process, not the result of borrowing.

The origin of Proto-Sinaitic lies in the 19th century BCE in the Sinai Peninsula with fewer than fifty inscriptions incised on stone from Serabit-el-Khadim (Gardiner, 1919; Albright, 1966; Dalix, 2012) Interpretations vary on the sociolinguistic context and the agency behind this creation. The setting is markedly different from the other case studies considered here, as it seems to have taken place at the margins of a centralised power, in a remote location, at the hands of individuals untied to an institutional and already existing scribal community. Located in the temple of the Egyptian goddess Hathor, patroness of turquoise mining, the inscriptions may have been the product of illiterate miners (Goldwasser, 2012) or military at the service of Egypt speaking a Proto-Canaanite dialect (Darnell, Dobbs-Allsopp, Lundberg, McCarter, & Zuckerman, 2005). The many attempts at deciphering the inscriptions are equally problematic. They have been based on the assumption that the signs were related to Egyptian hieroglyphs and to later Hebrew, redeployed to write a West Semitic language on the principle of acrophony (a schematised 'house' for *b* from **baytu* or **bēt* 'house'; an 'eye', for the pharyngeal fricative ʿ from **ʿayin* 'eye'). Some precise readings, such as *b'lt* or *mhb'lt* ('for, or beloved of the Lady') are possible (Gardiner, 1916), but correspondences, however, are not extensible to the whole repertoire. Altogether, many readings remain highly uncertain (Albright, 1966; but see Wilson Wright, 2013, 2016). Another site in south Egypt, Wadi el-Hôl, recently yielded two inscriptions which resist decipherment (Darnell et al., 2005).

Our next case is Anatolian Hieroglyphic, a logo-syllabic script containing no more than 250 individual signs (Weeden, 2014, p. 82). It was invented in the region after which it is named. By all indication, Anatolia knew writing centuries before its

invention. In the period of the Old Assyrian emporia (ca. 2000-1800 BCE), cuneiform Akkadian writing was introduced in the territory. Later, apparently after the establishment of the Hittite kingdom (ca. 1650 BCE), the cuneiform system was adapted to Hittite, as well as two other local Indo-European languages, Luwian and Palaic (Hawkins, 1986, pp. 363–365). Despite the presence of these adapted writing systems in the region, Anatolian Hieroglyphic was invented. It was used to write mainly Luwian in monumental inscriptions of the Hittite Empire (ca. 1400–1200 BCE) and in epistolary and administrative documents of the later Syro-Anatolian states (ca. 1200–700 BCE) (Hawkins, 1986, 2003; Yakubovich, 2008).

It should be noted that there are two theories on the origins of the script. A recently developed theory argues for a beginning dated as early as the 3rd millennium BCE, whose traces are lost due to the perishable material (such as wood) on which they were recorded (Waal, 2011, 2013). The second, more widely accepted, theory sees the development of Anatolian Hieroglyphic as a later process, culminating towards 1400 BCE (Hawkins, 1986, p. 368; 2003, p. 166; Weeden, 2014, p. 82). The script has its roots in local iconic symbols associated with (mostly) stamp seals although some of these symbols are attested as early as 2000–1800 BCE on cylinder seals from Cappadocia. During ca. 1700–1500 BCE and alongside cuneiform inscriptions, stamp seals feature a few apotropaic signs, probably of logographic value. Thus, the bulla of king Isputahsu of Kizzuwatna was inscribed with signs 199 = TONITRUS (‘THUNDER’) and 17  = REX (‘KING’) as if the monarch was proclaiming himself “King under the authority of the Stom-God”. The first phoneticised signs appear by the early 14th century BCE. It is possible that the script was partly read in Hittite at this stage, but shortly after we find longer inscriptions written only in Luwian.

In China, phonetic writing is first attested in the late Shang period (ca. 1200–1050 BCE) in Anyang, the last Shang capital. The majority of the earliest written records found there was related to divinatory practices at the royal court, and was made on turtle shells and scapulae of cattle, goats and sheep. Albeit in fewer numbers, inscribed bronze vessels, jade halberds and pottery are also attested, particularly at the necropolis of Anyang (Keightley, 1978; Boltz, 1986, 1994; Bagley, 2004; Bóttero, 2004). Specialists agree that the origins of many or most of the signs making up the earliest Chinese writing are iconic, depicting the thing whose name they represent (Boltz, 1986, p. 424; Bóttero 2004, pp. 251–252). The Chinese script can be described as logo-syllabic, but not in the same sense covered by the term with regards to other early writing systems. In Chinese, signs stand for either morphemes or sounds (syllables), but in most cases simultaneously.

Our last case is Mesoamerican writing. Its beginnings have been dated to the first half of the 1st millennium BCE (Houston, 2004, pp. 292–293).[5] Certain iconographic elements of the so-called Olmec culture (ca. 1000–400 BCE) have been considered its forerunners (Justeson, 1986). Specialists envisage two major regional groups of 'scripts' in Mesoamerica, of which not all can be firmly considered writing following the definition used here. They are the Oaxacan group, whose first representative is the Zapotec of Monte Albán (ca. 600–500 BCE), but later yielded the

[5] The two earliest examples of writing are Monument 13 from La Venta (in the Olmec heartland) and the Monument 3 from San José Mogote (Oaxaca, Zapotec Highlands). These would be instances of early Olmec and Zapotec 'scripts', respectively. However, these inscriptions are not deciphered and we cannot tell whether phonetic notation was involved. A possible third case from La Venta, Tabasco (Pohl, Pope, & von Nagy, 2002), dating to ca. 650 BCE and associated as well with the Olmecs by archaeologists, seems inconclusive.

Mixtec graphic symbols, and ultimately, the Nahuatl writing system also; and the South-eastern group, which includes the Isthmian (or Epi-Olmec) and Lowland Maya writing systems, but also a series of local scripts of uncertain affiliation, such as Izapa and Kaminaljuyu (Marcus, 1976; Justeson, 1986; Mora-Marin 1997, 2005, p. 63; but see Houston, 2004, p. 279 against such division).

This is the general picture, but several questions persist: which writing system was the first to emerge in the region? How did it develop? What are the precise relationships between the various Oaxacan and South-eastern scripts? A crucial issue is whether Maya hieroglyphic writing is a primary or secondary invention, or the adaptation of a previously existing script. This is difficult to address, given the undeciphered state of various inscriptions from the 1st millennium BCE. Still in use when the Spaniards arrived in the continent, the Maya script is first attested around ca. 100 BCE (Houston, 2004, p. 302), if not earlier (ca. 300-200 BCE; Saturno, Stuart, & Beltrán, 2006). The poorly attested Isthmian was in use in the Isthmus of Teuantepec (see Figure 1) between ca. 400 BCE and 162 CE (Houston & Coe 2003, p. 151). It shares with the Maya script features consistent with a fully-fledged phonetic writing system.[6] A decipherment of Isthmian was proposed (Justeson & Kaufman, 1993, p. 2001), but it remains problematic (Houston & Coe, 2003).

[6] The relationship between the two scripts remains unclear, as do their alleged ties to the so-called Zapotec 'script' (Macri & Looper 2003, 4-5). It has been suggested that Maya derives from Isthmian (Lacadena, 2010), but it is also possible that it was the other way around (Boot, 2010, p. 157, fn. 34). Curiously, Isthmian sign shapes (as attested) seem more schematised, and in general the script is less iconography-dependent than Maya (Houston, 2004, pp. 297-298).

3.2. Phoneticism in Action, Case by Case

In this section lies the crux of the problem. We will survey the evidence case by case, detailing trajectories of phonetisation following a scheme that considers: (1) Exclusive recourse to rebus: Sumerian and Chinese; (2) Use of both rebus and acrophony: Egyptian, Anatolian Hieroglyphic, and Nahuatl; (3) Exclusive recourse to acrophony: Maya and Proto-Sinaitic. This analysis helps us build a picture in each setting and path to formation.

Sumerian

Sumerian has very high monosyllabicity at the morpheme level. The language is agglutinative, so it has bound morphemes, but their semantic boundaries are clear; also, a substantial number of them are monosyllabic (Mattingly, 1992, pp. 20-21; Edzard, 2003, p. 1). To quote Daniels (1992, p. 83): "The most salient unit of language [morpheme] coincides with the most salient unit of speech [syllable], facilitating the recognition of the rebus principle". This makes the case of early cuneiform phonetisation straightforward and not dissimilar to Chinese in the use of rebus.

Chinese

Especially in its oldest stages, Chinese is often described as an isolating and monosyllabic language (Boltz, 1994, 18; 1999, 91). 'Isolating' refers to a predominance of morphemes that stand alone as words (Aikhenvald, 2008, 3); 'monosyllabic' means that these morphemes are composed, for the most, of a single syllable. The extent to which this applies to Old Chinese, especially the first written stage, is uncertain due to the ambiguity with which sound is represented by the script itself (Boltz, 1999, pp. 91–92; Baxter & Sagart, 2014). In any case, when it comes to word formation, no

human language is ever rigid or uniform in terms of morphology or syllable structure. How did the morphology of Old Chinese, then, affect the choices made to assign phonetic values for the signs? As reconstructed, the Old Chinese language featured numerous one-syllable words, which were at the same time the smallest units of meaning and the smallest units of sound (Boltz, 1994, p. 18). This resulted in a high amount of homophony or near-homophony, which in turn ensured the potential for extensive rebus.

Bóttero (2004, p. 251) states that 80 percent of the Shang iconic signs represented not just the words conveyed by their iconicity, but also other words unrelated in meaning but similar in sound. Two main strategies were deployed. For example,  *kə* 'BASKET'[7] stood also for **gə* 'perhaps, probably' (the reconstructed Old Chinese forms are from Baxter & Sagart, 2014).[8] This mechanism operated with individual graphs, but a rebus sign could also be used as the phonetic indicator next to a semantic sign, namely a logogram (DeFrancis, 1989, pp. 98–99; Bóttero, 2004, p. 254). For instance, **nʕiŋ* 'harvest, year' was written by combining signs **nyin* 'person' (for its sound) and **gáj* 'GRAIN STALK' (for its semantics) (Boltz, 2000, pp. 6–8; reconstructed forms from Baxter and Sagart, 2014). The reader would perceive this as 'word relating to the growing of crops that sounds like *nyin*'. Spellings of this kind

[7] Or similar. 'Basket' is the translation by Bóttero (2004, p. 251), based on the shape of the sign in the oracle bone inscriptions form, whereas Baxter (1992, pp. 28, 472) has 'winnowing basket' Baxter and Sagart (2014, p. 343) have 'base'. The latter corresponds better to shape of the sign on the bronze inscriptions,  (a container on a stand), which is the predecessor of modern 基 *jī*.

[8] Another strategy existed by which a sign became polyvalent. It consisted of representing the word depicted by the sign, and, metonymically, a closely associated concept: e.g. the graph 'mouth' could also denote the verb 'to call, name' (Boltz, 1986, p. 426). Evidently, this procedure is semantic and hence is of no consequence for our purposes.

produced a composite character or block, which in time came to be perceived as a single graphic unit. This process has concealed to modern eyes the phonetic elements of many Chinese graphemes, in this way sustaining the myth of an ‘ideographic’ script (DeFrancis, 1989, p. 108).

Our knowledge of Old Chinese phonology is limited by the very nature of the script signs, which represent syllables equivalent to full words via rebus. Thus, while we know the pronunciation of later stages of Chinese, we can read the Shang graphs only to a narrow extent, through historical linguistics (Keightley, 1978, pp. 65–70; Baxter, 1992, e.g. p. 223; Baxter & Sagart, 2014, pp. 4, 29). Moreover, there seems to be no published list of all Shang graphs with rebus values *vis-à-vis* their readings, as inferred from the reconstruction of Old Chinese forms. This hinders a precise assessment of the degree of homophony involved in the attested cases of rebus. It would seem, for instance, that certain phonological contrasts, such as voicing (cf. above case of **kə* ‘BASKET’ → **gə* ‘perhaps’), were not obstacles for puns. The level of homophony tolerated in rebus, as far as we can see, may ignore phoneme contrasts such as voice.

A parallel to Chinese worth mentioning is the Dongba system of notation of the Naxi group (Yunnan, China), who speak a Tibeto-Burman language. Dongba has been used for centuries by Naxi priests as a ‘mnemonic’ device, alongside a Chinese-derived syllabic script. Its iconic signs cannot register the full range of language, but they are sometimes used phonetically. For example, the ‘eye’ sign, a drawing of two eyes, is also used to write ‘fate’, as both words are pronounced *myə*^{3} (Ramsey, 1987, pp. 266–270). Due to the monosyllabic and isolating nature of the language (not unlike Chinese), acrophony was not used.

Egyptian

The Egyptian writing system is distinct from other invented writing, in that it was a logo-consonantal script. It comprised logograms, semantic determinatives, and phonograms. Phonograms were of three kinds: uniconsonantals (26 signs), biconsonantals (ca. 80 signs) and triconsonantals (ca. 70 signs) (Ritner, 1996, pp. 74–75; Loprieno and Müller 2012: 106). As the names indicate, these signs expressed a single consonant and skeletons of two or three consonants (e.g.  *n*, *nw*, and *nfr*), vowels being omitted. The spellings of certain Egyptian words whose vocalism can be reconstructed from indirect evidence confirm that uniconsonantals were vowel independent, and in general Egyptian notated speech sounds on a *segmental* rather than syllabic basis.[9]

This structure is tied to the morphology of the language (Edgerton, 1940, p. 475; Ray, 1986, p. 313; Trigger, 2004, p. 50). As with other members of the Afroasiatic family, including the Semitic languages, changes of meaning in Egyptian words were effected by two morphological mechanisms: internal vowel shifts (*Ablaut*) and affixation (mostly suffixes but also a small set of prefixes). Thus, several related words within the Egyptian lexicon shared a consonantal skeleton and their semantic nuances were marked by stem-internal vocalic changes, affixes, or both: cf. *n-ṯ-r* ‘god’ > *nāṯar* ‘god’, *naṯūraw* ‘gods’, *nuṯrit* ‘divine (f.)’, and so forth (Loprieno, 1995, p. 53). Both vowels and consonants participated in morphological activity, but only consonants were

[9] For example, *r* was used to write syllables with different vocalisms in words such as *nṯrt* /naṯārat/ ‘goddess’, *nṯrj* /nuṯrij/ ‘divine (m.)’, and *nfr* /nāfir/ ‘good, beautiful’ (Loprieno, 1995, pp. 35, 39, 53). In this way, *r* denoted strictly the consonant /r/.

notated in full. Probably native speakers could guess from the context the internal vowel modifications to the consonantal skeletons (Ritner, 1996 p. 74). In this way, dozens of existing iconic logograms covered a vast portion of the Egyptian lexicon.

Conversely, affixes expressed grammatical information that was difficult to convey via iconic hieroglyphs and thus required phoneticised signs. And since many Egyptian affixes had only one consonant (e.g. *m*- for nouns of instrument, place or agent; -*t* for feminine nouns and adjectives, -*w* for the masculine plural, -*f* for the 3rd masculine pronoun, etc.; Loprieno & Müller, 2012, p. 120), they were transcribed with uniconsonantal signs. Bi- and triconsonantal hieroglyphs were usually accompanied by uniconsonantals that served as phonetic complements (Loprieno, 1995, p. 12; Ritner, 1996, p. 75). This was sometimes done redundantly for reasons of aesthetics or tradition, but the fact that bi- and triconsonantals were complemented by phonograms reflects their origin as logograms standing for Egyptian roots of two or three consonants. When expressing less obvious concepts, they required disambiguation. For example, 𓄤 *nfr* is classed as a triconsonantal phonogram, but it in practice it acts as a logogram noting the root *N-F-R* 'good, beautiful'. With either phonetic or semantic complements, 𓄤 spelled *nfr* /nāfir/ 'good, beautiful' and several related words such as *nfrt* /nāfrat/ 'beauty, goodness', *nfrw* 'recruits', etc., but not unrelated lexemes. Words deriving from the same root tended to be written with the same sign (Ray, 1986, p. 313), especially triconsonantals.[10]

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[10] This is true even for triconsonantals derived from logographs denoting more than one root. For example, as a logogram and determinative, 𓌙 expresses the concept of 'thigh (*ỉwꜥ*) or leg (*swt*) of beef' and, by metaphor, also the idea of 'reward' (*ỉsw*). Thanks to this ambivalence, the sign developed two separate phonetic values, *ỉwꜥ* and *ỉsw*. As a result, it

It is often claimed that Egyptian developed its phonetic signs through rebus (e.g. Edgerton, 1940, pp. 475, 477; Gardiner, 1957, p. 6; Loprieno & Müller, 2012, p. 106; Vernus, 2016, p. 151), and only in later stages were certain sign values innovated by means of acrophony (Loprieno, 1995, p. 12). This claim needs to be reassessed. Most biconsonantals and some triconsonantals were sometimes used as phonetic complements, and their phonetisation was indeed achieved through rebus. An early example is the spelling of *ṯḥnw* 'Lybians (pl.)' as  , attested already in the reign of Narmer (*ca*. 3100-3000 BCE). Accompanied by the determinative for foreign lands, the hieroglyph (sand strip), the logogram (foreign weapon) could stand for *ʿȝm* 'Asiatic', *nḥsy* 'Nubian' or *ṯḥn* 'Lybian'. So here the sign (bowl) is used phonetically with the biconsonantal value *nw* to disambiguate as *ṯḥn-w* 'Lybians' (Kahl, 2004, p. 121; Vernus, 2011, pp. 45-46). Presumably *n-w* was the name of the vessel depicted by , even though we cannot be certain of how close to the *ᵒnw* of *ṯḥnw* (probably vocalised as /ᵒnaw/) it sounded.[11]

Despite the claim that uniconsonantal ('alphabetical') signs were also constructed through rebus, Egyptologists noticed early on the coincidence between the sounds expressed by these hieroglyphs and the initial consonants of the names of the objects they depict (Gardiner, 1916, p. 12; Sethe, 1916, pp. 150–147; Naville, 1926).

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spelled words such as ***ỉwʿ*** 'to inherit' and ***ỉwʿt*** 'inheritance', but also ***ỉsw*** 'reward', ***ỉswt*** 'representative' and ***ỉswj*** 'testicles' (Edgerton 1940: 484; Hoch 1998: 22).

[11] Perhaps their vocalism diverged, as it is accepted that both uniconsonantals and biconsonantals omitted vowels. Conversely, in cases like  *ḥr* /ħar/ 'FACE' → *ḥr* /ħar/ 'on' (Loprieno. 1995, pp. 56, 100; Hoch, 1998, p. 9) the reconstructed vocalisations suggest that the logogram 'FACE' was used phonetically thanks to close homophony. In conclusion, since the vocalism of most ancient Egyptian words is irrecoverable, we cannot be sure of the extent to which rebus could ignore the vowels of biconsonantals.

Even if this was sometimes passed as a simple version of the rebus principle (DeFrancis, 1989, p. 160), it is clearly acrophonic behaviour. The patterns in Appendix 1 confirm that most of the 26 Egyptian uniconsonantals match, through iconicity, words whose first consonant is the sound they represent. However, since in several cases the sources of the signs' values are radicals with more than one consonant, it is clear that some kind of reduction intervened. Acrophony was clearly the derivational mechanism of choice. Most of the source words for Egyptian uniconsonantal hieroglyphs were open CV or closed CV(C)C monosyllables. Some consist of closed syllables in which the omitted final consonant is either a semi-vowel (/j/, /w/) or a uvular trill (*ꜣ* /ʀ/), hence presumably 'weaker' than other consonants in terms of articulation (Vernus, 2016, pp. 154–155).[12]

Yet the omission of semi-vowels and the uvular does not account for all uniconsonantals. Certain sound values of uniconsonantals were derived by ignoring the feminine ending *-t* of the source (Edgerton, 1940, p. 479; Vernus, 2016, p. 154). It is possible that the creators of the Egyptian script perceived *-t* as a separate element from the word-roots, so that, for instance, they would analyse *ḥt* 'belly' () as *ḥ-t*. A third potential type of derivation, suggested so far by only one sign, involves 'discarding' the nasal /n/. Finally, a fourth type of possible source words are simply open syllables, as in the case of  *š* (< */*šV/ 'pool'). In conclusion, the values of Egyptian uniconsonantals were derived by 'reducing' already phonologically short words. Their structure would have made them the most economical choices for transcribing single consonants, as they involved the most straightforward 'reductions'. For example,  'mouth', pronounced

[12] This principle was applied even in later acrophonic reforms of the script, for example when the 'traditional' biconsonantal  *rw* came to be used as *r* in the New Kingdom (Vernus, 2016, pp. 157–158). In fact, *j*, *w* and *ꜣ* were occasionally omitted from spellings altogether.

r(*ɜ*) /raʁ/ was a more obvious choice for /r/ than, for instance,  'man', pronounced *rmṯ* /rāmaṯ/.[13]

The preference for acrophony appears to be due to linguistic reasons, namely the need of segmental phonetic complements for writing affixes in inflected words. As remarked above, phonologically many affixes contained only one consonant. Also, several suffixes corresponded to closed syllables (internal and historical evidence suggests that feminine -*t* was /-at/, not **/tV/ or **/VtV/, while -*w* was probably /-aw/, not **/-wV/ or **/-VwV/, etc.), which could be yet another factor militating against syllabism. One obstacle to the idea that uniconsonantal acrophony was motivated by a necessity to represent more abstract inflectional categories is that the first attested complete sentence in the Egyptian language is dated to ca. 2690 BCE (Regulski, 2016), long after the earliest known phonetic hieroglyphs.[14] Another complication is that we would expect more spellings of the type root (logogram) + affixes (phonograms), but

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[13] Of course, language may not have been the only determining factor. In many cases (but not all and not systematically), the simplicity of the iconic logograms in terms of design may have been key: hieroglyphs with less strokes and complex details like  *r*,  *ḳ*, *t*,  *k*,  *s* , *p*,  *b*, and  *h* are among the easiest to inscribe. Since they would become the phonetic complements to use and repeat in the spelling of several words, economy of effort may have been considered.

[14] Ten of the later 26 standard uniconsonantals had already been created by the time of Narmer: *i̯*, *p*, *f*, *n*, *r*, *ḥ*, *s*, *t*, *ṯ*, and *ḏ* (Kahl, 2004, p. 119. Moreover, the uniconsonantal *n* is attested already in the reign of Sekhen/Ka (ca. 3150 BCE), as a complement to the logogram ('lotus' *nḥbt*) in the spelling of *nḥb* 'gift'.

these were not the norm throughout the life of the script.[15] Yet we need to consider that the available data may not be representative of all that was written in the earliest period.

Anatolian Hieroglyphic

The phonetic values of the Anatolian hieroglyphs were based mainly on one Indo-European Anatolian language, Luwian, with another, Hittite, apparently playing also a role (Morpurgo Davies & Hawkins, 1978, pp. 776–777; Hawkins, 1986, pp. 373–374; Neumann. 1992, p. 39; Yakubovich, 2008; Rieken. 2015; Payne. 2015, p. 42). In both languages few morphemes can stand alone as words and most words are polysyllabic. Thus, in addition to rebus, acrophony was in action. Hawkins (1986, p. 374) attempted to understand the two mechanisms in the formation of the Anatolian Hieroglyphic script. In his view, the syllabic values of the signs were always drawn from 'monosyllabic or reduplicated (…) roots' of Luwian or Hittite words. Yet, beyond these two strategies, a new series of acrophonic patterns has been proposed (Valério 2018) through a reassessment of the evidence.

As for rebus, only a few signs seem to have been phoneticised through it, due to the linguistic constraints that greatly reduced its application: the syllabograms of Anatolian Hieroglyphic were predominantly of the monosyllabic V and CV types, while the majority of Luwian and Hittite morphemes are polysyllabic. Importantly, rebus worked on morphemes taken in isolation, without involving inflectional endings.

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[15] We find redundant orthographies of the type NFR+*f*-*r*-*t* + semantic complements for *nfrt* 'goodness, good things' (Hoch, 1998). Parts of the root, not just the affix -*t*, were phonetically expressed (but cf. NFR+*t* + semantic complements for *nfrt* 'cattle').

Acrophony follows three main patterns: CV sound values are derived from morphemes with the structures CV*y*/*w*V-, CV*y*/*w*V*n*(V)- and $C_1V_1C_1V_{1/2}$. These were stems which, on the one hand, ended with vowels, semivowels or glides, and the nasal /n/; on the other hand, they corresponded to the same duplicated syllable, from which the phonetic value was derived by haplology (e.g. *la* < /lala/i-/) (Appendix 2). There was a possible fourth pattern, so far represented only by two possible cases, and which may have operated only where more optimal alternatives were lacking. It consisted in deriving CV values from *a*CV- morphemes, or, more precisely, C*u* values from *a*C*u*- morphemes (Appendix 2). This is an important exception, because it appears like a form of 'reverse acrophony' that ignores the first rather than the last sound of a morpheme. However, for Anatolian hieroglyph L412  *ru* (probably from Luwian /aru-/ 'high'), this is justified: at least in earlier forms of Luwian, /r/ did not occur at the beginning of words. No sign evoking a morpheme beginning with this sound was available (Valério, 2018).

Few examples of acrophonies that do not follow one of these patterns exist before the reign of Hittite king Hattusili III (mid-13th century BCE). Out of 37 phonetic signs attested for the earlier stage, only 14 have plausible derivations, of which 11 fit the scheme. Therefore, it is suggested that these patterns applied during the initial development of the Anatolian Hieroglyphic script, but signs phonetised at a later stage acquired their values by simply extracting the first syllable of a word of any phonological structure, a procedure we may term 'secondary acrophony' (Appendix 2).

Maya

Maya is essentially deciphered (with some uncertainties) and represents a logo-syllabary. The script changed over time, its Classical phase (250-900 CE) differing from

the earliest one (Grube, 1994), which is more challenging for decipherment (Houston, 2004, pp. 280, 299). Moreover, Mayan is an umbrella definition for a large family of languages still spoken today in Central America (Campbell, 1984; Houston, Robertson, & Stuart, 2000; Bricker 2008). The two language groups that contributed the most to the decipherment were the Yukatekan and Ch'olan, from the Lowland Maya area. Most scholars now agree that the main language represented in the texts of the Classical period (250-900 CE) is Ch'olan (see Houston et al., 2000).

Logograms redeployed as phonetic indicators or complements seem to have played a role in the phonetisation of the Maya script. For example, the reading of the logogram T614 'HOUSE' as Ch'olan **otot* 'house' is suggested by an accompanying sign T59 = 'TORCH' / *ti* ~ *ta* that indicates the final *-t* (Campbell, 1984, p. 12; Macri & Looper, 2003, p. 253). The regular strategy employed to derive phonetic values was acrophony (Mora-Marin, 2003) and we have found no clear-cut examples of rebus.[16] The scarcity of rebus is unsurprising because the Maya script comprises syllabograms of the V and CV type, but monosyllabic CVC morphemes predominate in the underlying language (Bricker, 2008, p. 178). In particular, Maya glyphs attained their syllabic values from CVC morphemes with 'weak' final consonants (Campbell, 1984, p. 15). A significant number of these morphemes seem closer to reconstructed Proto-Ch'olan forms (or an even earlier Proto-Wasteko-Ch'olan stage? cf. Houston et al., 2000, p. 328). Where the sources of sign values are clear, they mostly consist of CVC

[16] According to Justeson (2012), a few CVC syllabograms occur in Maya: e.g. *nah*, spelling both *naah* 'house' and *nah* 'first'. However, it is important (though not always easy) to distinguish between rebus as a mechanism for deriving phonetic values at the formative stages of the script, and rebus as an orthographic device throughout the life of the script.

morphemes in which the last consonant is *ʔ*, *h* or *j* /x/, *w*, and *y* /j/ (Campbell, 1984, p. 12; also Houston et al., 2000, p. 328; Mora-Marin, 2003).

Thus, the Maya trajectory is generally consistent with the patterns observed in other inventions. There is, however, an exceptional group of signs derived from (C)V(*h*)*k*(') roots, in which the last phoneme is either a velar /k/ or a glottalised velar /k'/ (from Proto-Mayan uvular **q* and *q*', respectively) (Appendix 3). Curiously, this special group has its only parallel in the other invented script from Mesoamerica treated here, Nahuatl, in which we find a few CV signs derived from CV*k* roots (Appendix 4). This implies that velars at the end of syllables, crucially in this whole region, are perceived as less salient.

Similarly to 'secondary acrophonies' as we define them, late redeployments of Maya glyphs with new sound values have also been reported. Thus, sign T751a B'AHLAM ('JAGUAR') was apparently used as *b'a* (Zender, 1999, pp. 38-41; Macri & Looper, 2003, p. 80). Mora-Marin (2003, p. 209) mentions other possible cases, but none seems certain. Likewise, we have not included alleged acrophonic developments for Maya signs that are attested at a relatively late stage of the script. This affects, in particular, syllabic signs that begin with the palatalised consonants *ch* and *ch'* (< */k/ and /k'/). These 'seem to have been introduced into the syllabary in the Late Classic period' (i.e. 700–900 CE), with the exception of *chi* (Law, Robertson, Houston, Zender, & Stuart, 2014, pp. 361–362).[17] For example, glyph  T590ab, used as the logogram

[17] Sign T671  *chi*, depicting a hand with the thumb touching the forefinger, stands logographically for day 7 or *manik*, which was a day named 'deer' throughout Mesoamerica. While 'deer' is **chij* in Proto-Ch'olan (< Proto-Mayan **keeh*), the shape of the sign cannot have motivated its phonetic value. Hence Law et al. (2014) argue that the syllabic value *chi* was based on the calendrical value of the sign but emerged secondarily

B'AK ('BONE, CAPTIVE') and the syllabogram *cho***,** depicts a jaw bone and is related to Proto-Ch'olan **choj* 'jawbone; cheek; tooth (molar)' (< Proto-Mayan **kooh* due to historical palatalisation; Mora-Marin, 2003, p. 229, and cf. Kaufman & Norman, 1984, p. 118). However, according to Law et al. (2014, p. 361), its syllabographic value dates to the early 7th century CE and is therefore relatively late. Another example is T578a  CH'OH ('RAT'), *ch'o*, which would fit the CV < CV*ʔh* or CV*h*K pattern, depending on whether it derived its value from a form closer to Proto-Mayan **ch'oʔh* 'mouse' or Proto-Ch'olan **ch'oh(o)k* (Kaufman & Norman, 1984, p. 119; Macri & Looper, 2003, p. 76; Mora-Marin, 2003, p. 209).

The fact that there is yet no ascertained case of rebus in early Maya may be due to the limited data for its earlier stages. This is also the case of Anatolian Hieroglyphic. We cannot exclude that rebus may have played a role in these early phases of formation, but given the state of our knowledge this is only a hypothetical assumption. So far, we can safely conclude that *ca*. 20 out of *ca.* 55 syllabic signs attested by the Early Classic phase (ca. 250-600 CE) have plausible and coherent acrophonic derivations.

Nahuatl

In Central Mexico, a characteristic iconographic style continued the Oaxacan tradition of graphic systems mentioned above. It seems to have influenced the development of a regional tradition of manuscript painting in the Postclassical period (900–1520 CE). Speakers of different languages, including Zapotec, Mixtec, and Nahuatl, adopted this

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only after the palataliation of **keeh* 'deer' had occurred. There is a variant sign T- = AV1, which depicts a deer head, but it is reported by Macri and Looper (2003, p. 84) to be a substitute for *chi* in throne titles (presumably a later addition to the script).

new pictorial style, in which a set of notation symbols complemented iconography to produce visual narratives. From this the Nahuatl writing developed (Justeson, 1986, p. 449; Boone, 2000, p. 32). The earliest Nahuatl documents date to a few decades before the Spanish conquest (1519–1521), but most are from the Early Colonial period. They are painted codices made on deer hide, tree bark or cloth. The script was at first concerned with historical and genealogical narratives, but then the Nahua elites and their neighbours employed it for the Spanish colonial administration (Boone, 2000; Lacadena, 2008, p. 3; Whittaker, 2009, p. 49). It functioned as a labelling device in pictorial narratives, transcribing designations of persons and places. This does not mean that Nahuatl was not true writing. In fact, Nahuatl onomastics are transparent, comprising lexical and grammatical elements: personal names are often sentences that contain nouns, verbs, adjectives or even adverbs, whereas place names are locative constructions (Whittaker, 2009, p. 59).[18]

It is debated when increased phoneticism emerged in the Nahuatl system (Lacadena, 2008; Whittaker, 2009, p. 73), namely whether it was a pre-Colonial development, a consequence of Spanish influence, or an Early Colonial indigenous development. Be that as it may, the script was phoneticised through an internal process tied to the Nahuatl language. To understand this process, we review its principles (laid down, with some differences, by Lacadena, 2008a, 2008b; Lacadena & Wichmann,

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[18] The phonetic component of the system has been deemed underdeveloped, as glyphs for the frequent syllables *ti* and *qui* are unattested (Whittaker, 2009), and in general it still relied heavily on puns. Yet certain glyphs may be missing due to the limitations of the corpus, while Maya and other logo-phonetic scripts made also extensive use of puns. Likewise, partial spellings in Nahuatl (e.g. MATLA for *Matlatzinco*; Lacadena, 2008a, 5, fig. 1-e) are comparable to spellings in the formative stages of other scripts, for instance Anatolian Hieroglyphic.

2008; Whittaker, 2009) and their relation to the language. Nahuatl is a logo-phonetic script whose signs can function in three ways: (1) logograms, which stand for full words, (2) logograms used not just as such, but also, through rebus, for the phonetic form of the word they represent, and (3) phonetic signs standing for syllables. All syllabic signs can in principle be used in the other two roles as well. However, the functions of rebus logogram and syllabogram must not be confused. The difference is illustrated by the uses of sign TLAN(-TLI) 'teeth': as a rebus logogram it transcribed the place-name *te*[2]-TEPE-*tlan* = gloss <tepetitlan> 'Hard stone place (or similar)'; as a true syllabogram, *tla*, it spelled another place name, *tla*-YACA = <tlayacac> (Lacadena, 2008a, 8, fig. 5-k; Lacadena & Wichmann, 2008, p. 137). For Lacadena, all phonograms are monosyllabic and represent open syllables of the types V and CV, but Whittaker provides compelling examples of VC signs (see Appendix 4).

The morphology of the Nahuatl language is essential for understanding how phonetic values were assigned. The majority of logograms stood for nouns (such as 'water', 'pot', etc.), and in their dictionary form (non-possessed singular form) most Nahuatl nouns were inflected with an absolutive suffix. This suffix is *-tl* after vowels and *-tli* after consonants (*-li* after *l*);[19] a few other nouns take the suffix *-in* or zero (Andrews, 2003, pp. 101, 109; Launey, 2011, pp. 4, 6, 16). The Nahua likely read the logograms supplying the proper nominal suffixes whenever context demanded it (Whittaker, 2009, p. 64), and this principle seems to extend to logograms used in rebus spellings. For example, the personal name *co-a* (as transcribed by Lacadena &

[19] Two linguistic details are worth mentioning. First, Nahuatl *tl* represents a lateral affricate /tɬ/, not a consonant cluster. Second, the suffix *-tl* (and its allomorphs) is not "absolutive" in the sense of marking the absolute case as part of an ergative system, but rather in the sense of marking the dictionary form, as described.

Wichmann, 2008, p. 131) in a Nahuatl document is glossed as <coatl> in the Latin alphabet. The second glyph is A-TL ‘water’ and if we assume the scribe had the full form of the noun in mind, then *co-a* reads neatly as *co*-ATL. Likewise, several Nahuatl spellings that have been treated as abbreviated or partial might in fact be full transcriptions.

The sound values of Nahuatl CV signs were systematically drawn from their original logographic values, deploying the noun stem without the absolutive suffix (Appendix 4). However, only in a few cases could rebus operate. For the majority of Nahuatl syllabograms the source stems comprise syllables more complex than the target sound value or are even disyllabic (e.g. *te*$_2$ < TĒN-TLI ‘lips’ and *ne* < NENE-TL ‘doll’). Such cases involve ‘reductions’ and we can classify them as acrophonic. Appendix 4 schematises the origins of Nahuatl syllabograms. A number of inferences can be made. First, the creators of the Nahuatl script applied rebus to logograms representing V, CV and VC monosyllabic stems. Thus the functions of *rebus logogram* and *syllabogram* appear hard to distinguish. When glyphs denoting single-syllable morphemes were no longer available, the choice was to derive V and CV sound values using glyphs that stood for VC and CVC morphemes, disregarding the final consonant. The ‘dropped’ consonant was *-h* /ʔ/, *-i* /j/, *-uh* /w/, *-c* /k/, *-l*, or, most frequently, *-n*. For example, because no **O-TL word existed in Nahuatl, the logogram used selected to represent *o* was OH-TLI ‘path’ (OH- is pronounced /oʔ/). It was a further advantage that the ‘path’ glyph, which had the shape of footprints, was already part of the Central Mexican symbol system. Occasionally, instead of CVC morphemes the creators of the Nahuatl script acrophonised stems of the type $CV_1CV_1(C)$ through haplology, for example *hue*$_2$ < HUĒHUE(H)- ‘old (man)’. This is not surprising, as reduplication is a productive derivational process in the Nahuatl language (e.g. in deriving ‘varietal’ noun

stems and iterative verb stems; Andrews, 2003, pp. 111, 228). Therefore, speakers of the language would have perceived a CV_1CV_1 morpheme as being derived from a CV_1 one, whether by true or false etymology.

Proto-Sinaitic

Proto-Sinaitic is the only case that uses acrophony exclusively. This is linked to the fact the target signs are all segmental/monoconsonantal, while the structure of the source morphemes in the underlying language (be that Proto-Canaanite or an Early Canaanite dialect) is more complex than CV. Rebus seems to have been a less likely strategy. Resorting to acrophony, albeit in an idiosyncratic manner, more based on contextual, rather than purely linguistic, factors, seems to have been necessary. This has to do with the underlying source-words, whose syllabism is complex (*ʔ* < *ʔalp-*, *b* < *bēt*, etc.) and does not follow any obvious phonological pattern. Behind this acrophonic process we need to postulate several conditions at play and three hypothetical explanations, as follows:

> Hypothesis 1, imitation: Was there an attempt to mimic only Egyptian uniconsonantals? Statistically, this seems not to have been the case: only 8 or so out of 26/27 signs recycle Egyptian uniconsonantal sign shapes (for example, Proto-Sinaitic  *k*, from Egyptian  *d*); other types of signs are, in fact, used (e.g. Proto-Sinaitic  *ʔ*, from certain varieties of Egyptian biconsonantal  *kȝ*) (cf. Hamilton, 2006).
>
> Hypothesis 2, semantic categories: According to Demsky (2016, pp. 34–40) the arrangement of Early Semitic letters (*ʔ-b-g-d* order, not *h-l-ḥ-m*) was ordered according to semantic categories: HOMESTEAD (*ʔ* ‘ox’, *b* ‘house’, *g* ‘throw-

stick', *d* 'door', *h* 'rejoicing human form', *w* 'hook'), FIELD (*z* 'olive (tree)?', *ḥ* 'fence'), HAND (*y* 'hand, arm', *k* 'palm of the hand', *l* 'coil of rope, goad'), WATER (*m* 'water', *n* 'snake', *s* 'fish?'), HEAD (*ʕ* 'eye', *p* 'mouth', *ṣ* 'temple of the head?', *q* 'skull?', *r* 'head', *š* 'tooth', *t* 'mark'). This hypothesis is not without problems: for one, some letters may have other sources that would prevent clear semantic groupings: e.g. *z* 'weapon (axe)', *q* 'monkey', *š*/*ṯ* 'bow' (Hamilton, 2006), or second, the semantic groupings largely depend on the *abgad* sequence order being original as opposed to the *halaḥam* (whose sequence is, clearly, less semantically coherent): *h* 'rejoicing human form', *l* 'coil of rope, goad', *ḥ* 'fence', *m* 'water'. Third, the names of the letters were often changed in the later Semitic scripts according to necessity, which makes it difficult to reconstruct the original ones, and their semantics, with certainty.

Hypothesis 3, absence of logograms: Proto-Sinaitic is the only script of our group that does not develop from a logographic system. It is, as far as evidence goes, solely phonetic from the very beginning. If there are no logograms, rebus seems to be less likely. This absence could, albeit not without uncertainties, explain the script's idiosyncratic path. And while it is true that in terms of acrophony Proto-Sinaitic does not follow the patterns seen in the other script formations, this is due to the principle being recreated and imitated, not inferred for the first time. Whereas the creators of Nahuatl, for instance, used the Mixtec-style logography as a basis for phonetisation, the creators of Proto-Sinaitic used a fully developed writing system, Egyptian, as their basis to apply acrophony.

4. Convergent Paths

After this detailed excursus, we can conclude that all image-based writing systems, be they primary or secondary inventions, follow similar constrained patterns in recording sound. This has implications with regard to two other factors at play in our reconstruction, one synchronic to each creation, and another comparative: 1. Linguistic awareness of the agents responsible for the initial steps in developing these writing systems, and 2. Parallels for reconstructing the paths of formation of undeciphered writing systems, whose development is naturally less clear.

In our reconstruction, we can detail a general step-by-step formation according to the following principles: Rebus tends to appear as the *first choice* for phonetisation, as it is direct, intuitive and economical. It uses existing signs (logograms) and expands their values, operating on homophony and syllabic correspondences. Acrophony is the *alternative* to rebus, as it is indirect and requires some linguistic/phonological awareness. It uses existing signs or leads to the invention of new ones. It truncates morphemes and may be syllabic or segmental.

Rebus is used to the highest extent possible, depending on the amount of homophony in the underlying language. When rebus is no longer possible, acrophony becomes necessary. Scripts invented for languages with high monosyllabicity (predominantly monosyllabic morphemes) use rebus exclusively (Old Chinese, Sumerian). The distinction between ‘word’ and ‘morpheme’ is crucial: *a morpheme* is the smallest meaningful grammatical unit in a language, and a *word* is a unit of (linguistic) meaning within a sentence, which may consist of one or more morphemes.

Most other cases use rebus supplemented by acrophony (Egyptian, Anatolian Hieroglyphic, Nahuatl,) and acrophony only (Early Maya, Proto-Sinaitic). This may seem to lead to a conundrum of sorts, considering that the exclusive use of acrophony in Proto-Sinaitic concerned the redeployment of Egyptian graphic shapes and types of

signs (consonantal), without any use of logograms. In other words, Proto-Sinaitic cannot be considered an invention in the same sense as the other scripts in our survey.

This has implications on other scripts, such as Maya: should we infer that Maya, too, with its exclusive use of acrophony, was not invented?[20] From a comparative perspective, it is clear that the Maya signs were phonetised through uses of acrophony that are consistent with the principles of invention (as observed in the Egyptian, Anatolian and Nahuatl systems) and different from 'secondary acrophonies' employed in the context of script reformations (as in the later stages of Anatolian) and adaptations (like Proto-Sinaitic). It is, of course, difficult to draw conclusions when the origins of many early Maya syllabograms remain unclear. However, if the pattern surmised from our survey is correct, in the future we should expect to find at least some cases of rebus proper in this script, especially in its early phases.

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[20] At times, the interpretations of the origin of signs can point either to invention or adaptation. Paradigmatic is the pair comprising T- = YSA  *mu*, depicting a frog(?) with a curl (and its *pars pro toto* version T019, only a curl) and T- = YSB  *b'u*, depicting a frog(?) with a dotted curl (and its *pars pro toto* version, T021, only a conch shell) (see Macri & Looper, 2003, pp. 213-214), which are graphically and phonetically similar. They appear to be the product of an adaptive split, and indeed "in the first half of the Early Classic period there is generally just one sign (Mora-Marin, 2003, p. 226). For Lacadena (2012) *b'u* is a modification of *mu* and the script originally transcribed another (Mixe-Zoquean) language lacking the phoneme /b'/, before being adapted to a Mayan tongue. Conversely, for Mora-Marin (2003, pp. 203, 205, 207, 226) both signs have Mayan values: *mu* was acrophonised based on Greater Lowland Mayan **much* 'frog, toad' and the splitting *b'u* was also phoneticised from Lowland Mayan **b'u*(*h*)*b*' 'tadpole'.

Crucially, when acrophony becomes necessary, it behaves as much as possible like rebus, according to a hierarchy of sonority principle: in other words, the final 'extra' consonant to be dropped is one perceived as weak (i.e. it does not cause much noise). With the exception of /k/ in Nahuatl and possibly Maya, acrophonic processes disregarded vowels, glides, the nasal /n/, liquids and the /ʀ/ trill, the glottal stop, and certain 'post-velar' fricatives (/h/ and pharyngeal /ʕ/). Most of these sounds have the phonological trait of [+sonorant]. Sonorants are sounds articulated with a continuous, non-turbulent airflow through the vocal tract and no stricture (noise) (Crystal 2008: 442). The 'post-velar' fricatives /h/ and /ʕ/ are not sonorants, but at times have been described as closer to approximants, which fit that category (Ladefoged and Maddieson 1996: 168). As a result, all of these speech sounds can be perceived by speakers as weak, in opposition to most obstruents (stops and fricatives), which are articulated with turbulence and therefore may be seen as strong sounds.

Monosyllabicity can be seen as one of the preconditions for the emergence of writing, but what is monosyllabic in Sumerian, Old Chinese and Early Mayan are morphemes, not words.[21] Awareness of the morpheme is seen also in Anatolian Hieroglyphic and Nahuatl. The data from these scripts also supports a number of examples in which monosyllabism at the morphemic level is key, at least where the

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[21] Thus, what to our Western mind is a 'word', in Nahuatl is a nuclear clause or sentence-word (Andrews, 2003, p. 6): cf. morpheme *a-* 'water' vs. *atl* '(it is) water'. Daniels claims that in Sumerian, Chinese and Mayan 'words are generally one syllable long', and that words in these languages 'are clearly identifiable' (Daniels 1992, p. 83). Yet, it was not words but morphemes that were generally monosyllabic in these languages. In addition, devisers of early scripts seem to have had a notion of morpheme, regardless of whether the target language had mostly free or mostly bound morphemes, i.e. whether the language was isolating or synthetic.

target phonetic signs are syllabic. Yet, any theory associating primary inventions of writing with a linguistic feature common to Sumerian, Old Chinese and Early Mayan, but absent from Egyptian (in this case, monosyllabicity is patently absent), cannot be tested, as it is uncertain whether Egyptian was invented secondarily after cuneiform. But what if the key lies in the salience of morphemes rather than monosyllabicity *per se*?

Although also logo-phonetic, Egyptian differs from the Sumerian cuneiform, Chinese and Maya scripts in that its structure is consonantal. Can this preference for consonantism be linked to the salience of morphemes? Perhaps. In Afroasiatic languages like Early Egyptian and the Semitic languages, words as units of speech contrast with roots as units of meaning. Roots have variable forms when used in words, but their consonantal skeleton remains unchanged. They have been defined as what remains of a bound morpheme after inflectional elements (affixes and changing vowels) are removed (i.e. they are a type of morpheme). Hence, these Afroasiatic languages have 'discontinuous consonantal roots' that combine 'vocalic infixes', with or without affixes, to create words (Aikhenvald, 2008, pp. 38–39, 45). It is clear that in the Egyptian script rebus operates in the language's discontinuous morphemes, be they tri-, bi- or uniconsonantal: cf. the very early example of *nw* 'bowl' used to spell part of *t̲ḥnw* 'Lybians'. What we cannot know is whether *at first* rebus operated only in morphemes that also had homophonous vocalism, i.e. whether the correspondence was */naw/ 'bowl' → */t̲(V)ḥ(V)naw/ 'Lybians'. As a consequence, when Egyptian needed to write single-consonant affixes and prepositions, rebus was used with single-consonant roots to produce uniconsonantal signs (e.g. *t* < *t* 'bread'). It was only beyond that that acrophony had to operate on pluriconsonantal roots (e.g. *f* < *fj* 'viper') to generate further uniconsonantals**.**

All this agrees with previous theories (Mattingly, 1992, pp. 21–22) according to which inventions of writing need homophony between *lexical* morphemes and *grammatical* morphemes (morphemic awareness), and thus can rely on monoconsonantism and monosyllabicity alike. However, our work shows that the same mechanisms can be observed when writing systems are invented for languages that do not have a prevalence of either.

5. Implications for Undeciphered Scripts

The discussion detailed above may provide parallels for the paths to formation of other scripts which today remain undeciphered. Cretan Hieroglyphic from the Aegean, the script of Easter Island, Rongorongo, and probably the Indus Valley script may have relied on the principles of rebus and acrophony in similar ways to the ones we have discussed. This is a topic that deserves more investigation and probing, paying full attention to the obstacles and pitfalls looming large when dealing with scripts we cannot read. The prospect of casting new light on these issues, and reaching breakthroughs, remains less gloomy than is generally thought, when the data at our disposal, however scanty, is probed thoroughly.

This is why systematic, global reconstructions of better-known scripts are essential. They create a methodological canvas for the undeciphered ones. The prospect of gaining new insight must therefore include a two-fold process: narrowing down the possibilities of linguistic interpretation, and proposing readings that are in line with general mechanisms observable in the readable writing systems of the world.

The results presented here can contribute in this direction: we should expect the undeciphered iconic scripts of the world to follow the patterns established here, depending on their linguistic structure. While past scholarship has often evoked rebus

(commonly confused with acrophony, as we have seen) to suggest readings of undeciphered scripts, we now need to tread more carefully. There is hope, however. The undeciphered Cretan Hieroglyphic and Linear A scripts of Minoan Crete, for example, feature iconic signs with counterparts in the syllabograms of the closely related Linear B. It has long been suspected that their phonograms were developed through rebus or acrophony: an example is the cat-face sign, probably read as *ma* (Younger 1998: 387; Civitillo 2007: 643-644; Ferrara, Weingarten, & Cadogan, 2016, p. 90). This syllabic value may have been derived from the name of the animal, as it is reminiscent of a typologically common type of word for 'cat' (of onomatopoeic origin), such as Egyptian *mjw* or Mandarin *mao* 'id.'. Likewise, Linear A sign *re* (/le/?) and its Cretan Hieroglyphic counterpart resemble a lily flower, and so perhaps were phonetised by haplology from a pre-Greek word like **le(i)li-*, which may survive in a dissimilated form in Greek as λείριον 'lily' (cf. also Hittite *alel-* 'flower, bloom', Egyptian *ḥrr-t* 'id.'; Blažek, 1996). Similar hints for other signs of these scripts can be detected and a comprehensive investigation of their possible readings is underway.

Also, another undeciphered script that shows continuous long texts and potential linguistic continuity is that of Easter Island, where the native Rapa Nui language is well documented. These two scripts deserve full attention, bearing well in mind that, despite the varieties of scripts and languages, whatever the setting or condition, all mechanisms of script formation appear to follow very similar paths, the world over.

Acknowledgements

Probably in the same way that ancient scripts took shape, this article is the result of cumulative effort, the fruit of constant discussion, and the product of regular tweaking and re-thinking. We are grateful to Ignasi-Xavier Adiego, Alex de Voogt, Christian Prager, and Brent Davis, for

their many references, ideas, and support. We also thank Lorenzo Lastilla for drawing the map. In the initial stages of analysis, we relied on the enthusiasm and knowledge of Erik Boot, who guided us through the meanders of the Maya signs. This article is dedicated to his memory.

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Figure 1. Locations of the invented writings systems treated in the text (by Lorenzo Lastilla).