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Comparison of Linear Elamite and Indus Writing Systems

Andreas Fuls

Department of Geodesy and Geoinformation Science, Technische Universität Berlin, Berlin, Germany.
E- mail: andreas.fuls@tu-berlin.de

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Abstract

Linear Elamite writing was used during the Bronze Age in the southwestern lowlands and central highlands of the Iranian plateau. The comparison of Linear-Elamite and Indus writing from the northern part of the Indian subcontinent contribute to our understanding of literacy in these regions. They are, as far as we can tell, not directly related to each other, but the idea of writing and the general way of creating pictographic and abstract graphemes representing a language and transmitting meaning may have spread from one region to the other since the beginning of the Middle Bronze age around 2200 BCE. Both writing systems share several features such as general methods of sign modification and reading direction, but the type of writing and degree of phonetization seems to be very different. Therefore, the exploration and comparison of both writing systems will contribute to the overall study of the origin of writing in Southwest Asia.

Keywords: Bronze Age, Epigraphy, Linear-Elamite, Indus Writing, Elamo-Dravidian Language.

Article Type: Research Article

Introduction

During the Bronze Age in the southwestern lowlands and central highlands of Iran, the Linear Elamite script was in use from the 23rd to 18th centuries BCE (Figure. 1). Most inscriptions excavated within archaeological projects come from Susa (Desset 2012). The rulers of Elam are known from cuneiform inscriptions in Mesopotamia and thus gave their name to their writing system and the Elamite language.

The origin of Linear Elamite (LE) writing is still disputed. The hypothesis of a fluent transition between Proto-Elamite and LE was proposed by Stève (2000). Desset *et al.* (2022:54) and Mäder (2021:4) propose, too, that LE was derived from Proto-Elamite writing. They "put forward the hypothesis that Proto-Elamite and Linear Elamite scripts were probably not two different writing systems, but the same system at two different chronological stages of evolution" (Desset *et al.* 2022:52). The time gap of about 800 years between ca. 3000 BCE and 2200 BCE, however, is difficult to explain. A possible explanation is the change in writing medium from clay to perishable material that has not survived the test of time. The writing system would have remained in use but would have been hidden from archaeologists. In addition, the dating of some of the findings is uncertain and there might be older objects among the LE texts that could, to some extent, close the gap. However, these explanations remain mere speculations.

Englund (2004:104), in contrast to the above quote, states that "[t]he few so-called 'Linear Elamite' inscriptions from the late Old Akkadian period, that is from a period some eight centuries after the proto-Elamite age, exhibit little graphic and no obvious semantic connection to the earlier writing system." Dahl (2023) comes to a similar conclusion: "It is therefore the proposal here, that linear Elamite had a point of invention, and that it was based partially on recovered proto-Elamite texts. It is further the hypothesis that this invention was the result of schismogenesis[…], where scribes in Susa, confronted both with Mesopotamian cultural expansion in the late 3rd millennium BCE and informed through Puzur-Inshushinak's conquest of Northern Babylonia, used signs from an ancient

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local writing system as the basis for the signs of their new script." At present LE is considered to be a local development with possible influence of cuneiform of Mesopotamia and Proto-Elamite writings from Susa; however, its plausible relationship with Indus writing has never been discussed in detail.

and proposed decipherments of Linear Elamite and Indus signs. Finally, we will compare the methodology of sign construction and graphical similar signs of both writing systems. The aim of the paper is to show similarities and differences between the writing systems and to approach the

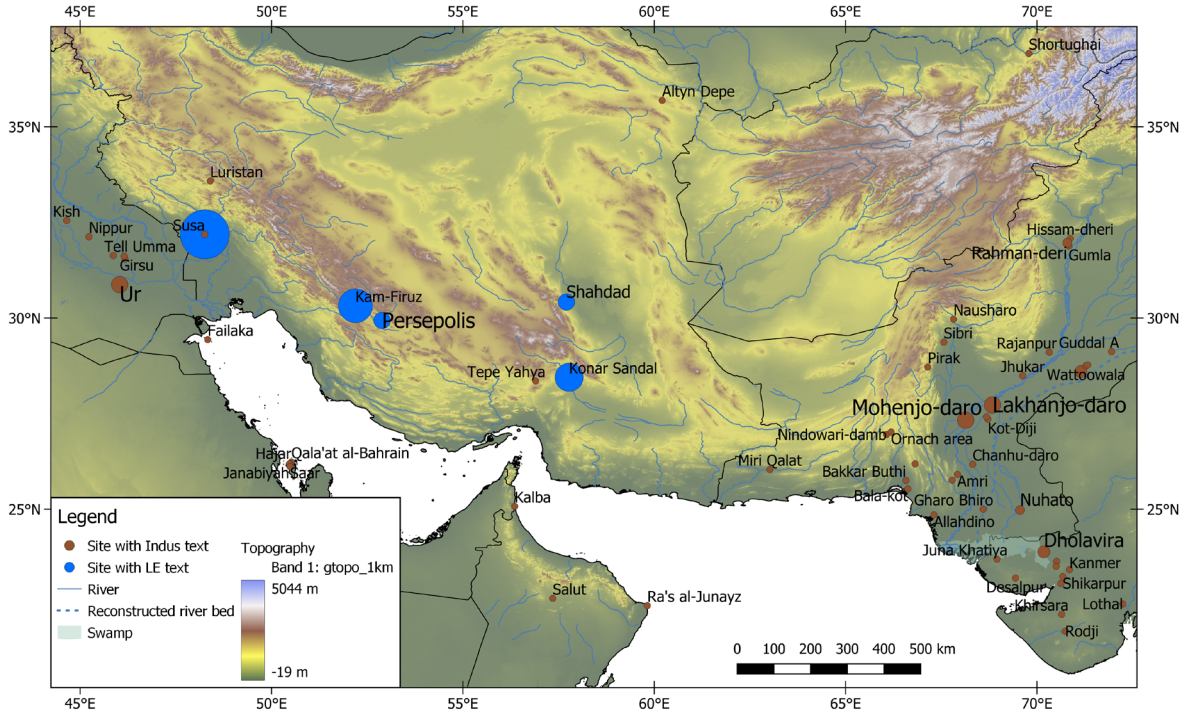


Figure. 1: *Map of artefacts excavated in the Iranian plateau and the Indus valley inscribed with Linear Elamite and Indus signs. Circle size is given according to the number of artefacts in a logarithmic scale for each site.*

The Indus writing system was developed in present Pakistan and north India since the beginning of the Indus culture around 2600 BCE. It is considered an independent development of Indus people, which may have been derived from potter's marker and graffiti on pottery since the Kot Diji Phase (Period 2) starting about 2800 BCE (Kenoyer 2020:4-13). Harappa was the first discovered site of the Bronze age culture, which is the reason why it is sometimes also called Harappa culture. The script and the inscribed material, however, show several differences between the two major sites excavated since 1921: Harappa mostly used tablets and Mohenjo-daro seals. Therefore, Indus writing as a more general term is preferred. It was in use until the decline of the Indus culture (Figure. 2: ca. 1800 BCE).

In the next sections we will discuss the corpus, both sign lists, the type of writing system, the reading directions, word dividers, text classes

question of a potential interaction between both cultures during the historical development of their writing in the 3rd millennium BCE. The question of contact has been raised again since the identification of skeleton remains with genetic markers at the Indus site Rakhigarhi, showing an overlap of 87% with genetic material from the Iranian plateau (both genetic pools split more than 10,000 years ago) and containing 13% genetic material from South Asian hunter-gatherers (Shinde *et al*. 2019). This new line of genetic evidence is the reason for the revival of the discussion about a common Elamo-Dravidian language family (McAlpin 1981, Starostin 2002).

Corpus of Inscriptions

The currently available corpus of Linear Elamite (LE) inscriptions contains at least 39 inscribed artefacts with 141 lines of text (Table. 1). They are digitally available in the Online Corpus of Linear Elamite Inscriptions (OCLEI) developed by Mäder *et al*. (2018). In this paper, three texts have not been

Era	Period	Start	End	
Localization Era	Period 5	1800 BCE	< 1700 BCE	
	Period 4	1900 BCE	1800 BCE	Linear Elamite writing 2150 - 1950 BCE
Integration Era	Period 3C	2200 BCE	1900 BCE	
	Period 3B	2450 BCE	2200 BCE	
	Period 3A	2600 BCE	2450 BCE	
Regionalization Era	Period 2	2800 BCE	2600 BCE	
	Period 1B Period 1A	3700 BCE	2800 BCE	Proto-Elamite writing 3300 - 3100 BCE
Early Food Production Era		ca. 7000 BCE	ca. 5500 BCE	

Figure. 2: *Chronology of Proto-Elamite (3300 - 3100 BCE), Linear Elamite (2150 - 1900 BCE), Indus potter's marks and inscribed pottery (since Period 1) and Indus writing on seals and tablets (Period 2 - 4). Chronology of the Indus culture (After: Kenoyer 2020:3, Modified by Author).*

assigned to the LE corpus, since they may either not contain Linear Elamite signs (text O) or might be a modern forgery (OCLEI texts W and M').

The corpus of Indus inscriptions based on photographs was published in the series '*Corpus of Indus Seals and Inscriptions*' by Joshi and Parpola (1987), Shah and Parpola (1991), Parpola, Pande and Koskikallio (2010, 2019), and Parpola and Koskikallio (2023). They contain photographs and drawings of 4674 objects inscribed with at least one Indus sign and are the basis for epigraphical studies of Indus writing (Table. 1). Most inscriptions were found in the Indus valley (89.2%) and the Gujarat/ Kutch region (9.6%), only 60 inscribed objects were found beyond the core area of the Indus civilization (Figure. 1). The Indus inscriptions are digitized and stored in the online database '*The Interactive Corpus of Indus Text*' (ICIT) and published by Fuls (2022b). At present the corpus of Indus inscriptions contains 4692 objects with 19932 sign positions (18047 signs are legible).

Due to scattered locations of archaeological excavations in Iran, Pakistan, and India, the inscribed artefacts of Linear Elamite as well as Indus writing are not evenly distributed. The majority of LE texts come from the central highlands of Iran (65.5%), most of the other inscriptions are from Susa located in the western part of Iran (32%). Only a small proportion of 2.5% was found in the eastern highlands, Bactria, and Konar Sandal (Desset 2014). However, many inscriptions come from private collections and can no longer be located with certainty.

Then we look at the spatial distribution of Indus texts, we see a noticeable concentration in Mohenjo-daro (38%) and Harappa (41%). About 9% of the texts are from Gujarat and the Kutch region, especially Dholavira and Lothal, and about 1% was excavated at sites in the Eastern Headwaters such as Banawali, Farmana, and Rakhigarhi. The remaining inscribed artefacts were distributed among smaller sites.

Sign lists

Mäder (2018) published a sign list of LE with 110 signs, 99 of them are properly identified signs. Desset *et al*. (2022:34) gives a range from 80 to

Table. 1: *Parameter of the Linear Elamite and Indus corpus. OCLEI: Online Corpus of Linear Elamite Inscriptions by Mäder; ICIT: Interactive Corpus of Indus Inscriptions by Wells and Fuls.*

	Linear Elamite writing	Indus writing
Inscriptions	39 artefacts with 52 inscribed sides and 141 lines of text (OCLEI 2024, excluding O, W, $^{\text{Time}}$M'=L')	5659 texts (3661 complete texts) on 4674 inscribed artefacts (ICIT April 2024)
Sign tokens	1491 readable signs	17993 legible signs
Sign types	99 (Mäder 2021) 80 – 110 (Desset *et al.* 2022)	713 signs (Fuls 2023)
Sign variants	265 (OCLEI 2024) 348 (Desset *et al*. 2022)	ca. 905 variants
Average length of complete texts/phrases	7.5 signs per phrase between word divider sign '|' or space	3.7 signs per line of complete texts

110 identified LE signs, listing variants of signs according to regions with either an approximate time range or an artefact type.

There are many sign variants listed by Desset *et al.* (2022) and Mäder (2018). The criteria used to identify sign variants are a) graphical similarity, b) co-occurrence of different signs on the same artefact, and c) linguistic content based on proposed sign readings. The last criteria, however, contains the danger of a circular reasoning, since any decipherment requires the secure identification of distinct signs and their graphical variants.

In contrast to LE, Wells (2011) established a sophisticated method of sign identification to analyse Indus writing. The process involves several steps in order to distinguish graphemes with similar design but different function, meaning and sound value as separate signs. His criteria include co-occurrence in the same text, the right to left effect of changing sign orientation because of the reading direction, the so-called TAB-effect, and what is most important, the mutually exclusive context of signs based on structural analysis. Therefore, his sign list of the Indus script contains many low frequency signs that cannot be analysed with certainty. They are distinguished as distinct signs as long as no further evidence is available to assign them to graphically similar, more frequent signs. This process of sign analysis yields a current sign list of 713 signs of the Indus script (Fuls 2023).

The problem of sign identification correlates with the corpus size. A reliable identification of signs requires a correspondingly large corpus of inscriptions. While sufficient texts are available for the Indus script, this does not necessarily apply to Linear Elamite. LE texts are usually relatively long and run over several lines, but there are too few of them. Of the 265 graphically distinguishable sign variants, each occurs on average only 5.6 times. For the Indus script with 905 sign variants, the average is 19.9 occurrences, i.e. about three times as many as for LE. In sum, we should consider the sign list of LE provisional and incomplete as long as no further inscriptions are discovered.

Type of Writing System

The number of distinct signs in a sign list is directly related to the question of which type of writing system it belongs to. A high number of several hundred signs indicates a high percentage of logographic signs (representing a word or word root). Sign lists with up to about 150-200 signs may contain only phonetic signs, although the exact number depends on the phonology of the language and the type of syllables: consonant-vowel (CV), vowel-consonant (VC), or CVC syllables. This is called syllabic writing and comprises Abugida writing such as Devanagari and Ge'ez. Alphabetic writing systems using exclusively consonants (C) and vowels (V) are rare and belong to a late period in the history of the development of writing. Abjads, such as Phoenician writing, uses only consonantal signs, with the peculiarity of writing Semitic languages to omit written vowels.

Dealing with an unknown writing system and calculating the number of signs with different phonetic values and/or meanings is a great challenge, as it is unclear before starting a decipherment which graphemes belong to one sign or are to be treated separately as different signs. This means that compiling a sign list is directly related to the question of the type of writing.

The sole criteria most often used to identify signs is graphic similarity. In the case of stamped signs, such as those on the Phaistos Disc, the distinction is an easy task, but in most other cases there are different writing styles and types of handwriting. This is also true for LE and Indus writing, and we can, therefore, only approximately count the number of distinct signs, that is types of graphemes with identical phonetic and logographic values.

On the basis of the ICIT corpus and the method of sign identification by Wells (2015:13-22), we have made a sign list of currently 713 distinct Indus signs. Of this list 218 signs, or about one third, occur only once. Mahadevan (1977) reduces the Indus sign list to 399 distinct signs and his sign list is still used by the researchers despite the outdated corpus (called M77) of only 2906 texts on which it is based. This means that about 130 signs listed in ICIT are missing in his M77 sign list (Fuls 2023:43-44).

Despite the differences between the ICIT and the M77 sign lists, let us analyse the sign frequency distribution of both corpora mentioned above and calculate the absolute entropic redundancy. To analyse and estimate the type of writing system through the comparison with known writing systems we can use the absolute entropic redundancy as a statistical parameter (Fuls 2023:102-112).

Depending on the relative corpus size, the absolute entropic redundancy based on the Shannon entropy increases slowly for alphabetic writing but rapidly increases for logographic writing and word counts. Logographic-syllabic as well as syllabic writing falls in between (Figure. 3). The comparison of Indus writing with for example Japanese writing, Luwian hieroglyphs and Ur III cuneiform shows us that the two sigmoid curves of Indus writing (ICIT and M77 corpora) fall both in the range of logographic-syllabic writing systems. This means that we should expect a mixture of syllabic and logographic signs in Indus inscriptions. It agrees with our present understanding of grammatical markers especially recognisable in Pattern texts of Indus writing (see section "Text classes" below and Wells 2015:24-45).

Depending on the number of distinct signs in the sign list of Linear Elamite (LE) writing, we can calculate three slightly different sigmoid curves (Figure. 3). Taking all 265 sign variants into account, we get the steepest sigmoid curve. After the reduction of the sign list to 154 and 133 signs, respectively, the sigmoid curves become less steep. However, all three extrapolated curves become more flattened for larger corpora and tend to fall at about the same value of the absolute entropic redundancy. They all range between Ge'ez and Persian cuneiform at the lower and Old Akkadian cuneiform at the upper end. These writing systems are well-known and contain more than 90% phonetic signs in their corpora and sign lists. Linear Elamite is, therefore, most probably a syllabic writing system, too, which may use only a few numerical or other logographical signs. This conclusion, despite its statistical uncertainty, agrees with the proposed syllabic nature of LE (*see section Decipherments*).

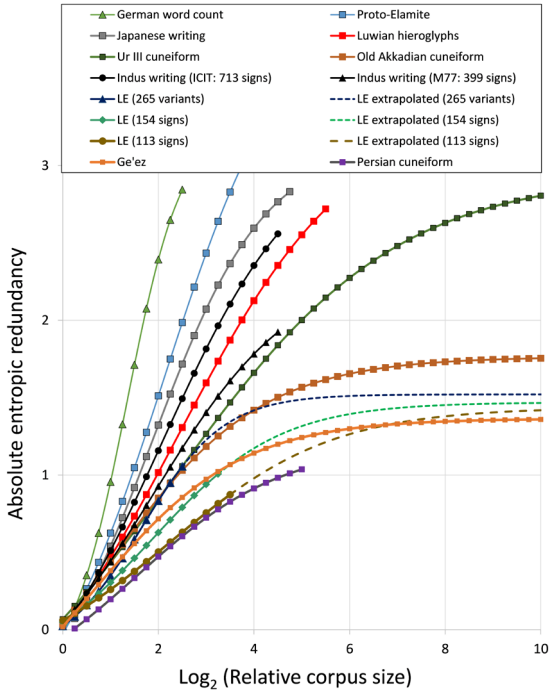


Figure 3: *Sigmoid curves representing the absolute entropic redundancy in relation to the relative corpus size of known and unknown writing systems. The two curves of Indus writing (ICIT and M77 corpora) fall both in the range of logographic-syllabic writing systems such as Japanese writing, Luwian hieroglyphs, and Ur III cuneiform. Linear Elamite (LE) writing, only slightly depending on the number of distinct signs, falls between Ge'ez and Persian cuneiform at the lower end and Old Akkadian cuneiform at the upper end. Therefore, it is probably a syllabic writing system with only a few numerical or other logographical signs.*

Reading Direction

Several methods have been used to determine the reading direction of Indus inscriptions (Mahadevan 1977:10-14, Parpola 1994:64-67, Fuls 2023:4-5). These include epigraphical indications such as blank space at the left end of some texts, cramped last signs at left edge of the texts, positioning the second line below the top line which starts at right edges, and sometimes the incised left-hand sign partially obliterating the previous sign. As a result, about 87% of the Indus texts should be read from right to left. For about 8% of the texts the reading direction is not relevant since sign sequences are symmetrical or contain only one sign. About 4% of the texts are to be read from left to right, which is often determined by means of specific sign pattern known from longer sign sequences. Top-to-bottom and boustrophedon reading are rare: only 0.5% in Indus writing (Fuls 2022b:16-20).

Ashraf and Sinha (2018) developed a statistical method to verify the reading direction of unknown writing systems. The calculation of the Gini-Index G for the left and the right end of words in known writing systems allows us to calculate the difference (dG) between both parameter, which, in turn, indicates the direction of reading: dG is smaller than zero if the script is read from left to right, and it is positive for writing that is read from right to left.

The analysis of 2214 complete sign sequences of Indus texts shows that dG = +0.163 confirming thus that the reading direction is from right to left (Fuls 2023:5). For Linear Elamite the result is not clear, since dG is close to zero (+0.050), mainly

because of a small number of only 107 complete sign sequences representing phrases or words. For this reason, we must rely on epigraphic methods such as blank space at the end of texts to determine the reading direction of Linear Elamite inscriptions. They show that most LE inscriptions are to be read from right to left, starting at the topmost line in case of multi-line texts.

Blank space at the end of a line is only found in some Linear Elamite texts: A, X, Z, A', H'a, I'b, and K'a. They are to be read from right to left, but the direction of reading can be determined epigraphically only for these texts. For the other texts, another method must be used. This involves searching for identical sequences of at least three signs occurring in succession in different texts, of which one text has a known reading direction. The method is comparable with structural analysis where one should search for morphological boundaries. It was applied to two sub-corpora: Texts from Susa written on sandstone monuments (A – I, T, U) and on clay (J – N, P, R) (Figure. 4a), and texts on silver vessels from the collection of Mahboubian (X, Y, Z, H', I', J', K', L', N', O') and Schøyen (F') (Figure .4b). From this analysis it can be deduced that texts C, D, F, G, H, I, U, Y, Yb, F', I'c and K'b are also to be read from right to left, while the reading direction of texts B and E is from left to right. Other LE texts are too short or fragmentary to be analysed in this way. Another conclusion that could be drawn is that the orientation of signs does not depend on the reading direction (as is the case in Egypt and Maya hieroglyphic writing).

Word Divider

A long vertical stroke (sign 1) and sometimes also sign 2 of LE writing are used as a word or phrase divider (Mäder 2018:5). This is the case with texts B, C, D, E, H, I, Q, Z, A', F', J', K'd and O' (sign 1, see Figure. 4, also text O' in Figure. 7). The same can be said, albeit with less certainty, about texts G, J, I'c and K'b (sign 2). In all other texts the signs are written without any word or phrase divider (*scripta continua*).

In Indus writing a word divider is not identified with certainty, although Wells (2011:99) partially

a) Susa sub-corpus

Text	Line	Dir.	Before	Sign sequence	Behind
A	1	R/L!			
B	1	L/R	start		
D	3	R/L	|		
A	4	R/L!	start		blank space
B	3	L/R	start		
C	3	R/L	|		end of line
E	1	L/R			blank space
G	1	R/L	ı		
H	1	R/L	ı		
U	1	R/L	start		
H	2	R/L			
G	2	R/L			
A	3	R/L	start		end of line
B	2	L/R	start		|
C	1-2	R/L	|		|
E	3	L/R			blank space
I	1	B/T	|		
G	2	R/L			
H	2	R/L			
F	2	R/L			

b) Collection's sub-corpus

Text	Line	Dir.	Before	Sign sequence	Behind
Z	4	R/L!	start	|	|
Y	2	R/L			
Y	3	R/L			
H'a	4	R/L!			
F'	2	R/L	|		|
Z	5	R/L!			
F'	2	R/L	start	|	
X	2	R/L!		…	
X	3	R/L!			
H'	2	R/L!			
Yb	1	R/L			
F'	1	R/L	|		
I'c	2	R/L			
K'b	2	R/L			
I'c	3	R/L			
K'b	3	R/L			

Word divider: |
Eroded end of text: ▌
Sign partly eroded:
Sign completely eroded:

Figure. 4: *a: Determination of the reading direction of a) Susa, b: Collection's sub-corpus inscriptions adapted from OCLEI. Direction of reading (column Dir.) is from left to right (L/R), right to left (R/L), or from bottom to top (B/T). On stone monument E the orientation of signs, line numbering and reading direction depend on the orientation of the fragment. An exclamation point '!' marks a known reading direction based on blank space. Signs that are not identical in a vertical (paradigmatic) text position are written in red.*

assigns such a function to one and two short vertical strokes (Indus signs 1 and 2), at least in some texts. Since Indus sign 1 also occurs in terminal position without the need to indicate any word boundary, it is unlikely to function as a word divider at any time (Figure. 5). In sum, Indus texts are written as *scripta continua* and thus do not indicate any morphological boundaries in the sequences of signs.

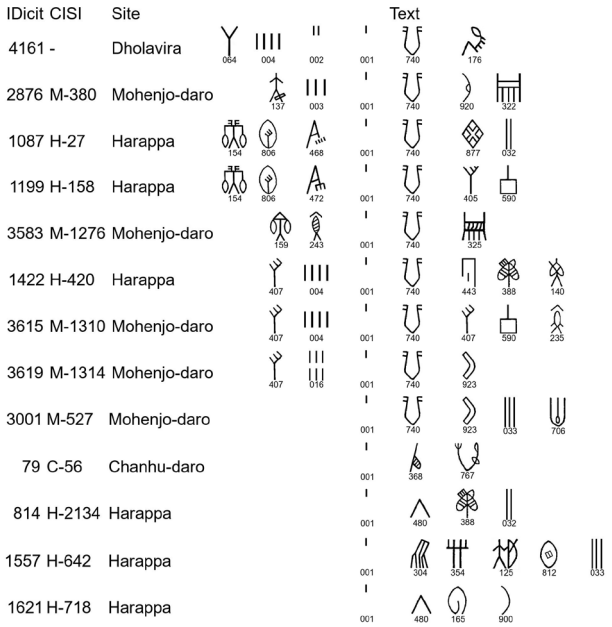


Figure. 5: *Indus texts with sign 1. All sign sequences are to be read from right to left.*

Text Classes

Indus texts are usually short sign sequences that can be classified according to several text classes depending on sign pattern and preferred sign positions (Figure. 6). We can distinguish between Long and Short Pattern texts (containing an Initial, Medial and Terminal cluster), Single Segments, Multiple Segments, Long and Short Complex texts as well as two or three lined texts. A special group of short texts contains the V-shaped sign 700 with either one numerical, anthropomorphic, phytomorphic or zoomorphic sign. Different text classes show that Indus inscriptions can reflect very different contents. Some text classes also fulfiled special functions and were preferably written on a particular artefact type. This is why Pattern texts are mainly found on square seals, numerical texts with sign 700 (NV) on bas-relief and incised tablets, Multiple Segment texts on copper tablets and numerical signs on pottery.

For Linear Elamite we have already distinguished between two sub-corpora, one on monuments and the other on silver vessels. They differ in their sign inventories, at least in part. Since there is no overlap in identical sign sequences, it must be presumed that the content of the texts also differs for the two sub-corpora.

Examples of Long Pattern (LP) texts.

ID	CISI	Terminal cluster TM BC	Medial cluster S798 OS	Initial cluster ICTM
1086	H-26			
2292	M-1706			
2478	M-1906			
2063	L-114			
3039	M-714			
2861	M-365			
1400	H-386			

Examples of Single Segment (SS) texts with two signs.

ID	CISI	Text
30	B-5	
2793	M-272	
236	(Harappa)	
2514	M-1797	
2498	M-1908	
32	B-8	
105	C-17	
3546	M-1195	
2319	M-1829	
4232	(Dholvira)	
1771	H-889	

Examples of Number + Sign 700 (NV) texts.

ID	CISI	Text
3912	H-1550	
717	(Harappa)	
670	H-1891	
487	H-1796	
1390	H-371	

Examples of Anthropomorphic Sign and Number (AN) texts.

ID	CISI	Text
1266	H-241	
1974	Kd-9	
2066	L-118	
5215	(Gola Dhoro (Bagasra))	
2209	(Mohenjo-daro)	

Examples of Long Complex (LC) texts.

ID	CISI	Text
144	Dlv	
2866	M-370	
2852	M-356	

Examples of Short Complex (SC) texts.

ID	CISI	Text
3614	M-1309	
2267	M-1848	
1877	K-1	
3827	M-1633	

Examples of Three Line (3L) texts.

ID	CISI	Line 3	Line 2	Line 1
1169	H-103			
2832	M-314			
2369	M-2122			

Figure. 6: *Examples of Indus text classes. Abbreviations: Initial Cluster Terminal Marker (ICTM), optional sign (OS), sign 798 (S798), Bounded Cluster (BC).*

Decipherments

Two years after the excavation of monuments in Susa, inscribed with a new discovered writing system, had passed when Bork (1905) was already able to decipher some signs by comparing a cuneiform text with the identical Linear Elamite inscription made on the same monument (text A). His decipherment was based on the comparison of part of the royal name Puzur-Sušinak, the name of God Insušinak and the name of the city of Susa (Sušen) that appear in both text versions, the known cuneiform script and the still unknown Linear

Elamite script. A few more signs were decoded in the following decades by other researchers such as Frank, Hinz, Meriggi, Corsini and Mäder, but most of the LE inscriptions remained incomprehensible. A total of 12 LE signs were identified correctly before 2018.

The decipherment of Linear Elamite actually began long before the French excavation which started in Susa in 1897, since the knowledge of the Elamite language is based on the step-by-step decipherment of the trilingual inscription from Behistun back in the 19th century. The Behistun inscription contains an identical text in three languages: Persian, Babylonian and Elamite. Their decipherment laid the foundation for many cuneiform writing systems, including the Elamite cuneiform texts (Pope 1999:85-116). As a result, by the end of the 19th century the Elamite language was known in its basic features and was an important prerequisite for deciphering the Linear Elamite writing system.

In November 2020, the research group of François Desset, Kambiz Tabibzadeh, Matthieu Kervran, Gian Pietro Basello and Gianni Marchesi announced a nearly complete decipherment of Linear Elamite, which was published two years later (Desset *et al*. 2022). The new advance in decipherment was made possible by new texts on silver vessels from a private collection in London. Here, too, the identification of personal names of known kings of the 2nd millennium BCE, listed in ancient Elamite king lists written in cuneiform, played an important role. The research group proposed a new reading of 72 signs, based on the assumption that the LE writing system is a syllabic script. The result is that around 96% of the texts are readable, even if not all the words can be understood (Desset 2023). An example of LE text O' with transliteration of Desset *et al*. (2022) is shown in Figure 7.

Decipherment based on the identification of personal and place names, as shown above, often faces challenge, since their spelling can vary in different writing systems. This is because both the pronunciation and the spelling rules can differ, as they depend on the writing system as well as on the phonology of the underlying language. The phonetic spelling of proper names can therefore vary a lot and phonetic values derived from them in an unknown script should therefore be checked with other parts of the text. Obviously, the more texts are available, the easier it is to check them. However, the size of the corpus is not the only factor, since there are also other methods available for deciphering signs in an unknown writing system (Fuls 2009).

The conditions for deciphering the Indus script are less favourable than for Linear Elamite. The language of the Indus culture is unknown and, even if one recognized the relationship with a more recent language (such as Sanskrit or Tamil that are at least one millennium younger), the language would first have to be reconstructed, for there are no written sources surviving from the same time. A second obstacle is the possibly high number of logographic signs in the sign list with very low frequencies (Fuls 2023:112). This means that most short texts do not have long phonetic spelling of proper names but have logograms with occasionally a few grammatical particles. Longer and complex Indus texts, in contrast to this, may often have the syllabic spelling of words, but constitute only 8% of the corpus (Figure. 6). Furthermore, we do not know any proper names since the time of Indus culture that could enable us to begin a similar decipherment process as is used for Linear Elamite.

Despite these limitations, there are a few reasonable suggestions for reading or understanding of Indus signs. This refers to the signs belonging to the system of volumes and weights (Wells 2015) and the system of numbers (Fuls 2020). Wells (2015:77-99) also proposed some phonetic values, which are based on verified decipherment methods and the Proto-Dravidian language without jumping to hasty conclusions like so many others such as Rao (1982), Fairservis (1992), Sarker (2002), and Muhammad (2020). Still, most of the Indus inscriptions remain obscure.

Methodology of Sign Construction

Hunter (1934) and Gelb (1963) remark that Indus and Linear Elamite writings may have been derived from a common source. This suggestion is based on similar methods of sign construction and graphic similarity. Here are considerations expressed by Fairservis (1976:45): "Some of these signs were certainly due to direct contact, others the result of secondary contacts (as, for example, by means of Lamberg-Karlovsky's 'central place' concept)." A close examination of the two sign lists shows us that both writing systems used a similar methodology to construct signs, i.e. marking, insertion, attachment,

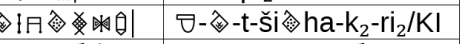
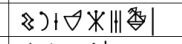
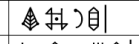
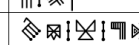
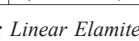
Word	Sign sequence	Transcription
1		e-na-pi$_2$-r-ri-ša
2		-t-ši ha-k$_2$-ri$_2$/KI
3		o-pa-la-i-š-ša-
4		li$_2$-li-pa-r
5		na-pi$_2$-r-ri-ša-ki
6		li-ka-we-ri-š-ša-ki
7		me- -ni-k$_2$
8		ha-t-ta t-ti-k$_2$
9		la- -ni
10		ša-ri$_2$/KI-h
11		ha-s- -ki$_2$- -wa
12		na-pi$_2$-ri-ša
13		nu-ki$_2$-ri-wa-ta-h
14		nu-u-te- -ti
15		šu-t-me
16		ša-t-me
17		-h-t-hi$_2$-t-te-k$_2$-pi$_2$
18		o-po-ha-li$_2$-k$_2$-li$_2$
19		ki-ti- -m-mi
20		nu- -ki$_2$-ri-na-hi-h$_2$-li$_2$

Figure. 7: *Linear Elamite text O' (sign sequences after OCLEI) with transcription (After: Desset et al. 2022). The order of sign sequences and transliteration are normalised in such a way that they must be read from left to right.*

hatching, reduplication, and enclosing by strokes (Figure. 8). Modifications of Indus signs may change their meaning and sound value, since the preferred sign positions in complete texts may often differ (Fuls 2023:77-90). The same cautious observation can be made for Linear Elamite when comparing hatched versus non-hatched signs.

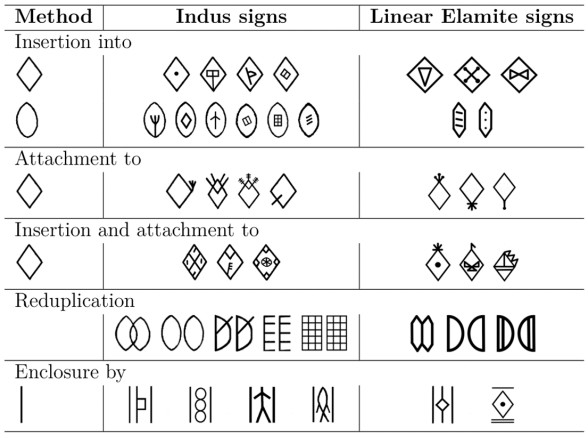


Figure. 8*: Methods of sign construction in Linear Elamite and Indus writing.*

Languages of Indus and Linear Elamite Writing

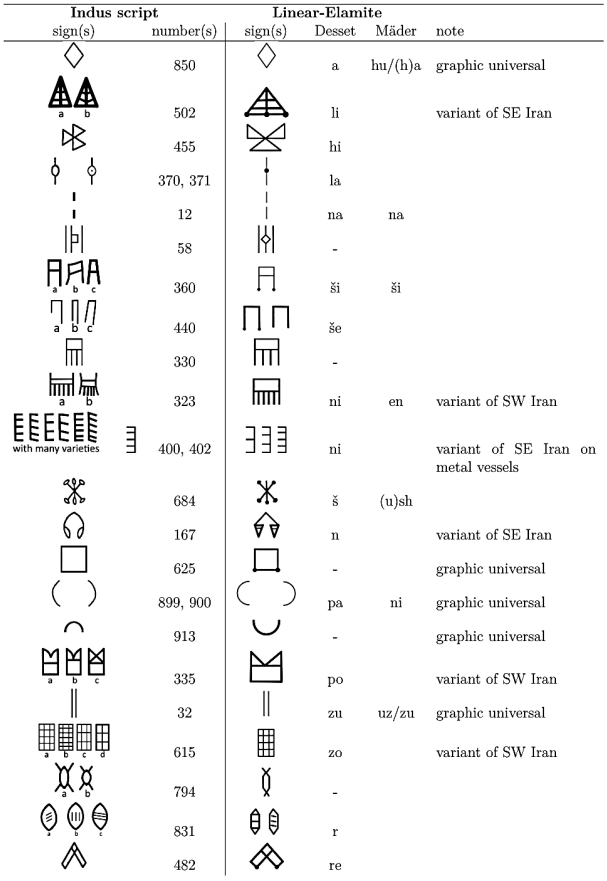
The relation between Indus and Linear-Elamite writing might be even closer if their root languages belong to the same language family which McAlpin (1981) describes as Proto-Elamo-Dravidian. Linear Elamite was written in the Elamite language (Desset *et al*. 2022). In case Indus writing is based on Proto-Dravidian, then both languages may belong to the same language family sharing grammatical and lexical features (McAlpin 1981, Southworth and McAlpin 2013).

Proto-Dravidian and Elamite are two languages spoken in this region at the beginning of the Bronze age. Old Elamite is represented in a few texts dated back to about 2250 BCE, and Middle Elamite is known from many cuneiform inscriptions dating to the 14th century BCE (Tavernier 2020:165). There is a possibility that Old Elamite was already used in the Proto-Elamite writing system since the beginning of the 3rd millennium BCE, but this is not certain as long as Proto-Elamite has not been deciphered. Proto-Dravidian, in contrast to this, should be reconstructed on the basis of Tamil and other modern Dravidian languages.

Southworth and McAlpin (2013) find common word roots in Elamite and Dravidian belonging to the field of words related to hunting and gathering, but they do not share agricultural terms. The authors conclude, therefore, that both languages split at an early stage prior to the introduction of agriculture. This agrees with the genetic evidence of skeletons from Iran and the Indian subcontinent and the early split of genetic markers, at least 12,000 years ago, since the development of agriculture took place much later during the 7th and 6th millenniums BCE.

Comparison of Graphically Similar Signs

The direct comparison of the two sign lists of Linear Elamite and Indus writing shows us that there are several signs with a high degree of graphic similarity (Figure. 9). Some of them, however, have a very simple shape such as strokes, half circles, and squares. They occur in many writing systems around the world and have no specific appearance that could help to identify a writing system. This is the reason why Wells (2011:30-34) is referring to them as 'graphic universals' which cannot be used to prove a relationship of different writing systems. The remaining signs have a complex graphical structure and give the impression that graphical similarity is not accidental. Of course, comparison based solely on graphical similarity may well be biased.



Indus script		Linear-Elamite			
sign(s)	number(s)	sign(s)	Desset	Mäder	note
	850		a	hu/(h)a	graphic universal
a b	502		li		variant of SE Iran
	455		hi		
	370, 371		la		
	12		na	na	
	58		-		
a b c	360		ši	ši	
a b c	440		še		
	330		-		
a b	323		ni	en	variant of SW Iran
with many varieties	400, 402		ni		variant of SE Iran on metal vessels
	684		š	(u)sh	
	167		n		variant of SE Iran
	625		-		graphic universal
	899, 900		pa	ni	graphic universal
	913		-		graphic universal
a b c	335		po		variant of SW Iran
	32		zu	uz/zu	graphic universal
a b c d	615		zo		variant of SW Iran
a b	794		-		
a b c	831		r		
	482		re		

Figure. 9: *Graphical comparison of signs of Linear Elamite and Indus writing. Graphical variants of an Indus sign are labelled a, b, c etc. Proposed syllabic readings by Dessert et al. (2022), alternative readings by Mäder (2018, 2021). Some LE signs are variants occurring only in South-Western (SW) or South-Eastern (SE) Iran.*

It should also be noted that the comparison is made between lists of several hundred signs, which increases the probability of an accidental coincidence. As the proportion of similar signs is relatively small, an exchange between the two writing systems may only have taken place sporadically.

Dahl (2023) warns against postulating a relationship between two writing systems which would solely be based on graphic similarities between individual signs. He emphasises that one should not use the standardised sign forms for graphic comparison but should rely on the actual forms of graphemes. This, however, creates the problem of temporal changes in sign variants. It often happens that inscribed artefacts cannot be dated with certainty, so that it is unclear which stage of script development the graphemes belong to.

So far, text O from Susa (it is currently in the Musée du Louvre, Sb 9382) has been excluded from the LE corpus since the script does not bear much resemblance to Linear Elamite signs: only three graphemes could be identified as LE signs (Figure. 10). The obverse of the tablet is completely engraved, but on its reverse only the top line shows four legible graphemes, and the remaining space on the surface of the tablet is blank except for horizontal auxiliary lines. If instead we compare still recognizable graphemes on the red clay tablet with signs of the Indus culture, we will find some interesting correspondences (Figure.10). There are 20 graphemes on text O resembling Indus signs. Most interesting is Indus sign 853 used in initial text position in ten out of eleven Indus texts, or totalling 91% of all cases. The corresponding similar grapheme on the obverse of text O in the first line also occurs in initial (right most) position. This means that both are not only similar in shape but also share the same positional behaviour. In addition, the Indus sign pair 220 and 33 is also noteworthy, since it occurs 6 times in the Indus corpus in both reading directions. I am a long way from seeing Text O as an original Indus text, since too many places in the text have been eroded, many signs are no longer recognizable and writing on a clay tablet is atypical for the Indus culture. A large proportion of similarities, however, does suggest an exchange between the two writing cultures. It is difficult, however, to date text O, although it might be still possible by means of a special sign pair that also occurs on seal Sb-4.

Seal Sb-4 was found at the cemetery of Sibri (Figure .1), about 8 kilo metres distance from Mehrgarh (Parpola *et al.* 2019:103, 329). The square seal with plano-convex cross-section (L/W/H: 14x11x8 mm) belongs to the Mehrgarh VIII period (the end of the 3rd and the beginning of the 2nd millenniums BCE, probably between 2100 and 1900 BCE; Santoni 1981:58, Jarrige *et al*. 1995:288, 377-378, Figure. 8.33A). It bears an unusual sign pair that is almost identical with one of the graphemes of text O (Figure. 10: sign pair against the yellow background). The sign left of the Indus 'man' sign 95 is not part of the Indus but of the LE sign list (Desset's sign 2). Therefore, the sign pair of seal Sb-4 might be an invention dating between 2100 and 1900 BCE. Due to its provenance in Susa and the unusual combination of many Indus signs, text O may reflect not the Indus but the Elamite language. We may therefore conclude that text O represents an extraordinary mixture of a sign pair from Sibri (Mehrgarh), Linear Elamite and Indus signs dating from the beginning of the 2nd millennium BCE and not from an early stage of LE.

The only conjecture that can be made so far is that the idea of writing, methodology of sign construction, and linear arrangement of sign sequences might be transferred from one region to the other. Linear-Elamite writing can be dated from ca. 2150 to 1950 BCE and the Indus valley culture started at least from ca. 2600 BCE and was in use to around 1800 BCE. It therefore seems more likely that the influence on Linear Elamite came from Indus culture than otherwise.

often deal with some kind of transaction containing numerical information, volumetric measurements, and weights. There is only one monumental text of the Indus culture, the Dholavira sign board, that is known.

We have evidence of a long history of Indus writing from at least 2600 BCE to 1800 BCE, spanning a period of about 800 years. Throughout this time Indus signs did not show significant

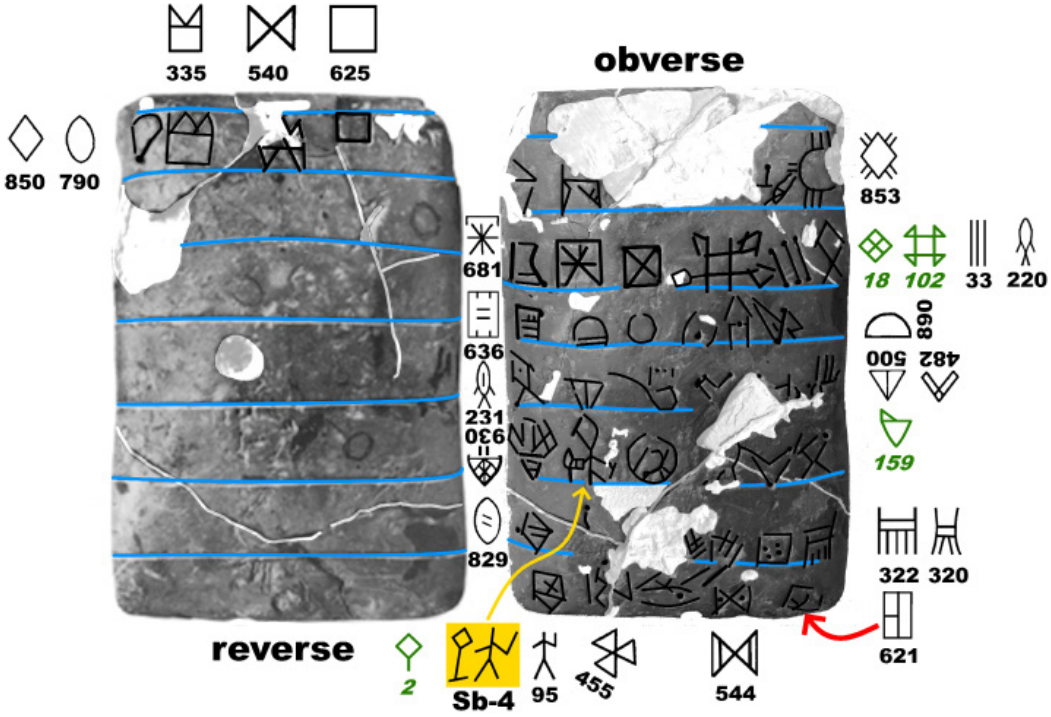


Figure. 10: *Incised clay tablet text O (Musée du Louvre Sb9382, size 11x7 cm) and comparison of the text with LE signs (green, italic) and Indus signs (black). Horizontal auxiliary lines are shown in blue, eroded parts and break lines in white-grey. The seal impression of Sb-4 from Sibri is shown against the yellow background.*

Conclusion

It follows from what we have seen that Linear Elamite and Indus writing are different types of writing systems: LE is, above all else, a syllabic writing, and Indus culture used a highly mixed logographic-syllabic writing system with many signs representing a logogram, or word root. Indus texts are usually short having a maximum of three lines with 17 signs, whereas LE texts run over several lines representing long inscriptions of up to 160 signs. Unlike Indus writing, one can come sometimes across a word divider in LE texts. They also differ in terms of context: LE inscriptions can be found on monuments and silver vessels containing names of kings, whereas Indus texts

graphical changes in shape or function, although determining the exact dating of inscribed artefacts is often problematic, if not impossible, as in the case of surface findings. Artefacts with Linear Elamite writing, on the contrary, are related to a much shorter period of time, from about 2150 to 1950 BCE. The question of their origin is still disputed. It might be that LE was created ad hoc at the time of the king Puzur-Sušinak (ca. 2150 BCE), in the same way as the invention of Han'gŭl, a syllabic writing in Korea, in the year AD 1443 by the monarch Sejong the Great. Still the stimulating influence of another writing system on LE, such as the Indus script or Proto-Elamite, at present cannot be ruled out.

Linear Elamite text V, which has no provenience (Laursen 2010:104, n.4), contains three LE signs and is incised on a circular seal with the motif of a bull, typical for circular seals from Bahrein (Dilmun culture) with the same iconography but inscribed with Indus sign sequences. It belongs to a set of so-called Persian 'Gulf Type' seals found in Dilmun burials on Bahrein and in the Persian Gulf region, dating to approximately 2200-2000 BCE (Laursen 2010:120). We can, therefore, conclude that LE and Indus writing were at the end of the 3rd millennium BCE in close contact.

Indus seal inscriptions were also excavated at sites such as Susa, Luristan, Tepe Yaha and Miri Qalat (Fuls 2022a), but no LE inscription was found at any Indus site. While Indus merchants traded and delivered to various parts, among other goods, also seals and other inscribed artefacts, LE seems to have been a regionally restricted writing system that was only used locally.

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