



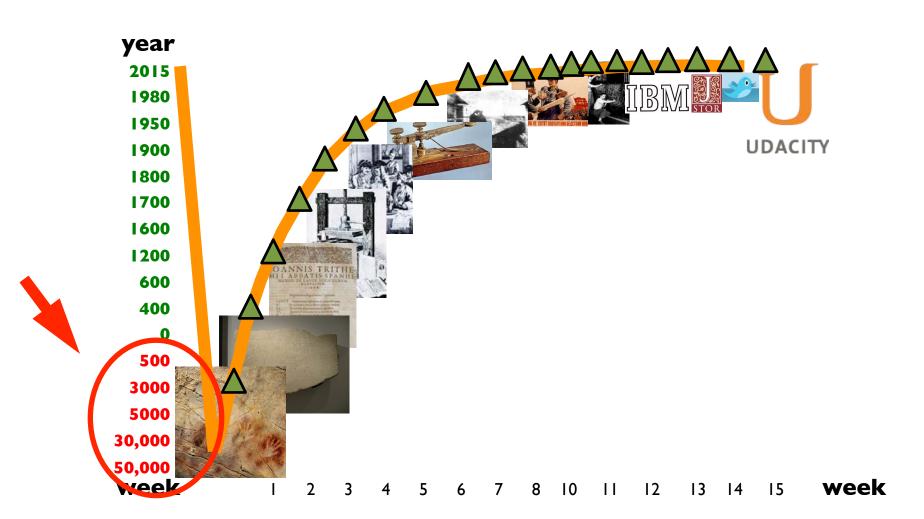
The First Information Technology: Writing Systems

Geoff Nunberg
School of Information, UC Berkeley

IS 103 History of Information Jan. 31, 2013



The journey begins...





Itinerary, 1/31

The Dawn of Information
The Emergence of Representation
The Variety of Signs
Origins and Development of Writing Systems
Types of Writing Systems
Independent Inventions of Writing Systems



What kind of "information" has a history?

The Beginnings of Information

The Emergence of Representation

The Variety of Signs

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... it's always there when we look for it, available wherever we bother to direct our attention. We can glean it from the pages of a book or the morning newspaper and from the glowing phosphors of a video screen. Scientists find it stored in our genes and in the lush complexity of the rain forest. The Vatican Library has a bunch of it, and so does Madonna's latest CD. And it's always in the air where people come together, whether to work, play, or just gab.

What is it that can be so pervasive and yet so mysterious? Information, of course.

John Verity in *Business Week*, special number on the "Information Revolution," 1994



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The Scope of "Information"

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Information (that has a history) always involves the creation, storage, transmission, or manipulation of representations of states of affairs.



What we mean when we talk about "information"

Table 1.6: Worldwide production of magnetic original content, if stored digitally	15
compression methods, in terabytes circa 2002.	

Storage Medium	Type of Content	Terabytes/Yr Upper Estimate	Terabytes/Yr Lower Estimate	1999 Report Upper Estimate	1999 Re Lowe Estima
Magnetic	Videotape	1,340,000	1,340,000	1,420,000	1,420
	Audiotape	128,800	128,800	182,000	182
	Digital tape	250,000	250,000	250,000	250
	MiniDV	1,265,000	1,265,000	N/A	
	Floppy disc	80	80	70	
	Zip	350	350	Table 1.2: Work circa 2002. Upp assume digital Storage M	
	Audio MD	17,000	17,000		
	Flash	12,000	12,000		
	Hard Disk	1,986,000	403,000		
					ande :

4,999,230

3,416,230

Source: How much information 2003

TOTAL

Table 1.3: Worldwide production of printed original content, if stored digitally in terabytes circa 2002. Upper estimate is scanned; lower estimate is compressed.

Storage Medium	Type of Content	Terabytes/Yr Upper Estimate	Terabytes/Yr Lower Estimate	1999 Upper Estimate	1999 Lower Estimate	% Change Upper Estimates
Paper	Books	39	8	39	8	0
	Newspapers	138.4	27.7	124	25	12%
	Office Documents	1,397.5	279.5	975	195	43%
	Mass market periodicals	52	10	52	10	0
	Journals	6	1.3	9	2	-33%
	Newsletters	0.9	0.2	0.8	0.2	0
	C. htestal	4 622 0	300 7	4 400 0	240.0	36%

Table 1.2: Worldwide production of original information, if stored digitally, in terabytes circa 2002. Upper estimates assume information is digitally scanned, lower estimates assume digital content has been compressed.

Storage Medium	2002 Terabytes Upper Estimate	2002 Terabytes Lower Estimate	1999-2000 Upper Estimate	1999-2000 Lower Estimate	% Change Upper Estimates
Paper	1,634	327	1,200	240	36%
Film	420,254	76,69	431,690	58,209	-3%
Magnetic	5187130	3,416,230	2,779,760	2,073,760	87%
Optical	103	51	81	29	28%
TOTAL:	5,609,121	3,416,281	3,212,731	2,132,238	74.5%

Courses they much beforeather 200

Peter Lyman and Hal Varian, How Much Information? 2003



Quantifying "information"

The Beginnings of Information

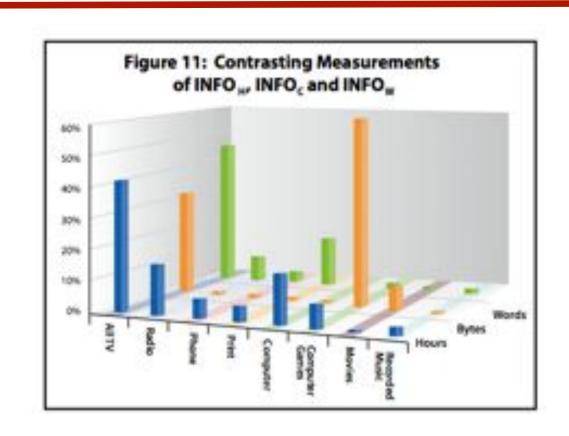
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How Much Information? 2009 Report on American Consumers



The Beginnings of Material Representation

The Beginnings of Information

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The First "Information System": Language



Psamtik I, 654-610 BCE



James V of Scotland

The Egyptians...believed themselves to be the most ancient of mankind....This king...contrived the following method of discovery: He took two children of the common sort, and gave them over to a herdsman to bring up at his folds, strictly charging him to let no one utter a word in their presence, but to keep them in a sequestered cottage, and from time to time introduce goats to their apartment, see that they got their fill of milk.... His object herein was to know... what word they would first articulate. ... The herdsman obeyed his orders for two years, and on one day opening the door of their room, the children both ran up to him with outstretched arms, and distinctly said "Becos." ... He informed his lord, [who then] learnt that "becos" was the Phrygian name for bread. In consideration of this circumstance the Egyptians yielded their claims, and admitted the greater antiquity of the Phrygians.

Herodotus, *Histories*, 2.2



The First "Information System": Language



Psamtik I



James V of Scotland

Early theories: "bow-wow," "uh-oh," "pooh-pooh," etc.

1886: Linguistic Society of Paris forbids "toute communication concernante l'origine du langage" [All papers dealing with the origin of language]

No direct evidence about origins of language No existing "primitive" languages



The Beginnings of Representational Artifacts

"... whereas notations of whatever sort were apparently means of recording the passage of time in terms of culturally significant events."





The First "Information System": Language

Early theories: "bow-wow," "uh-oh," "pooh-pooh," etc.

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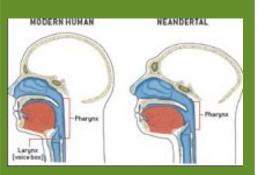
No direct evidence about origins of language; No existing "primitive" languages. Inference from social behavior, etc.



The First "Information System": Language



FOXP2 gene



Was development of language gradual or sudden? Does language presuppose neural modification?

"language" might have emerged w. Homo erectus (1.5 m years) or with mod. Homo sapiens (ca 100-150k years) But surely by 60k BP

"The momentum we see in cultural revolution after [the dispersion] was no longer genetically based... Darwinian evolution in the genetic sense continued, and underlies the rather superficial differences that are observed between different racial groups today... but the newly emerging behavioral differences between the groups were not genetically determined. They were learned, and they depended on the transmission of culture." Colin Renfrew

Evidence from mod. genetics, archaeology, comparative anatomy, etc.



The Beginnings of Representational Artifacts



Henri Breuil





Robot & Jacques Marsal





Cave paintings, Lascaux, France: ca 15-13,000 BC (others perhaps to 30,000 BC)

"Man's first affirmation of himself"

Maurice Blanchot

"Venus of Tan-Tan," Morocco, possibly 250k years old, but may be a naturally occurring object.







The Beginnings of Representational Artifacts



"Images and symbols... were markers of periodic and continuous cultural processes, of rites, and of repetitive myths and stories..." Alexander Marshack





Spotted Horses, Peche Merle





The Varieties of Signs

The Beginnings of Information

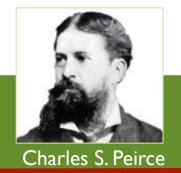
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The Varieties of Signs







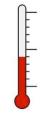


Icon: relation of resemblance (more-or-less) to signified. E.g,





Index: stands in causal/spatial relation to the signified (blaze on tree to act of marking, thermometer to temperature)



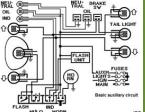
Symbol: arbitrary relation between sign and signified. E.g., written word cat, spoken word /kæt/.





The Varieties of Signs











Icon: sign stands in relation of resemblance or similarity to signified (though often only roughly).











The Varieties of Signs: Indexical

Index: stands in causal/spatial relation to the signified (pawprint to bear, blaze on tree to act of marking, thermometer to temperature)





The Varieties of Signs: Symbols









Arbitrary (or effectively arbitrary) relation between sign and thing signified





tree



Early Indexical Signs

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Earliest signs are mnemonics for record-keeping, geneology, etc. (Tallying systems)

Knotted rope, notched stick or bone, etc. Become frequent in upper paleolithic



Notched Bone, England, upper paleolithic, 12,000 years old



Notched Bone, Turkey, ca 3000 BC



Notched bone, Congo, ca. 25,000 BC -- may represent lunar calendar



Elaborated Indexical System: The Inca *qipu*







Knots of varying colors in llama or alpaca hair

Sequences recorded population, taxes, geneology, astronomy (and possibly names) in base-10 positional system.

System maintained by knot-keepers (quipucamayoq).

Limits: can record only quantity and category; requires extensive convention for intepretation



Early Iconicity

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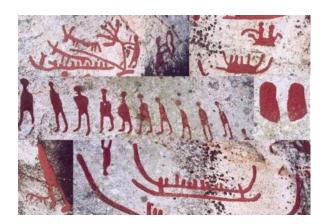
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Petroglyphs, Bhimbetka, India, ca 9000 BC



Rock carving, Hong Kong (Kau Sai), 3000 BC



Petroglyphs, Scandinavia, Bronze Age



Pictographic (Iconic) Communication Systems

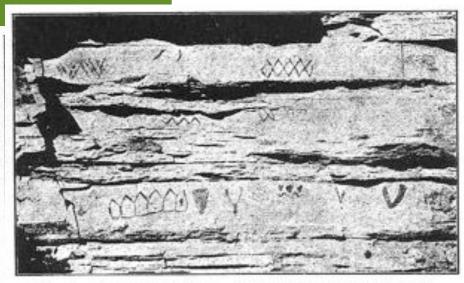
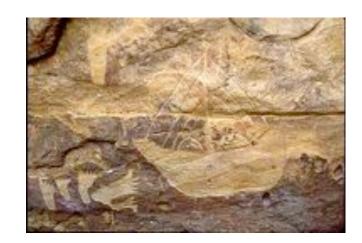
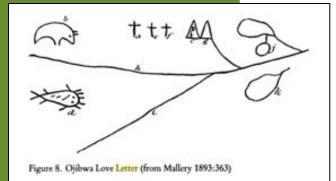


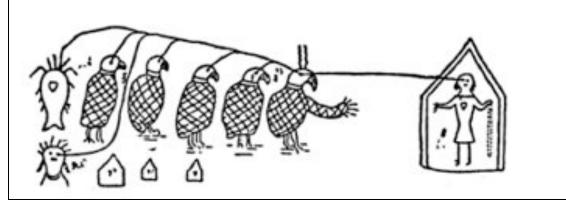
Fig. 4.—Geometrical forms. (From a photograph of rocks).
Fig. 4.—Geometrical forms. (From a photograph of rocks).





Pictographic (Iconic) Communication Systems





"Letter of credence" presented by Chippewa delegation to Washington, 1849

"The chief salutes the president, and his warriors belonging to the eagle and catfish totems are in harmony with him and are willing to accept the white man's ways."



Pictographic Systems

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Yukaghir (Siberia) "love letter," late 19th c.



"Pictographic" Systems

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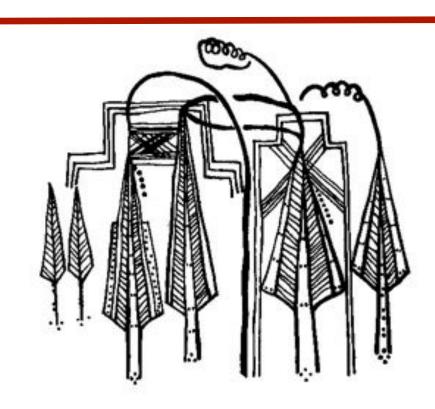
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"I know you're fighting with that Russian girl you broke up with me over. I'm unhappy in my house as I think of you, but you should know there's another guy hitting on me, so get your act together before I get married and have children."



Abstraction in pictographic systems

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Extending pictographic systems to deal with abstract or relational notions. E.g., "brother," "go," etc.

A step toward the development of "true" writing:

Form signs for abstract entities by extending or combining signs for concrete things (ca. 3300 BC)

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foot = "go, come, walk, etc."
person + mountain = "foreigner"
eye + water = "weep," "sad," etc.
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Cf modern use of "metonymic" icons



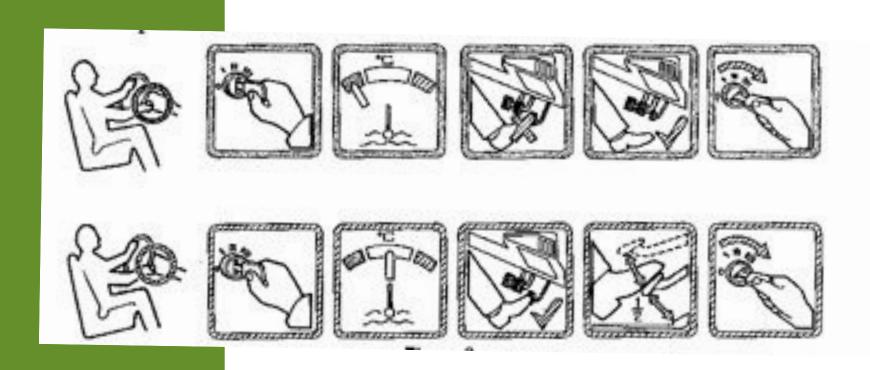






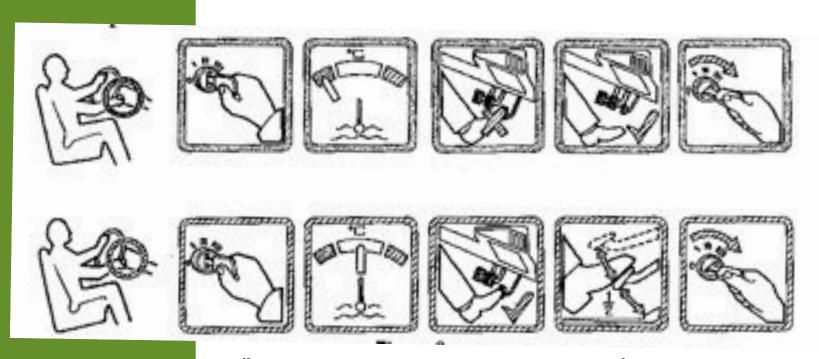


Ideographic (Semasiographic) Systems: the importance of context





Ideographic (Semasiographic) Systems: the importance of context



"Turn the key. If the car is cold, don't step on the gas pedal; if it's warm, depress the gas pedal halfway as you turn the key."



The limits of ideographic/ semasiographic systems

Semasiographic system: symbols stand directly for ideas, not for words of a language.

Cf mathematical notation:

$$10^9 = 1,000,000,000$$

"Ten to the ninth equals a billion."/ "Zehn hoch neun gleicht eine Milliarde," "Dieci alla nona potenza equivale ad un miliardo," etc.

$$\forall x (Fx \rightarrow Gx)$$

"For all x, if F of x then G of x" ("pout tout x si x est F alors x est G") "Everything that is F is G," "If something is an X it's a G,"/
"being F always entails being G," etc.

But language-independent systems appear inadequate to express the full range of thoughts & information (as opposed, e.g., to artificial languages.)



Wilkins' universal language

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Explaining the symbol



The generic character doth signify the genus of space. the acute angle on the left side doth denote the first difference, which is Time. The other affix signifies the ninth species under the differences, which is Everness. The Loop at the end of this affix denotes the word is to be used adverbially; so that the sense of it must be the same which we express by the phrase, For Ever and Ever.

John Wilkins "An Essay Towards a Real Character and a Philosophical Language" 1668



The origins of true writing

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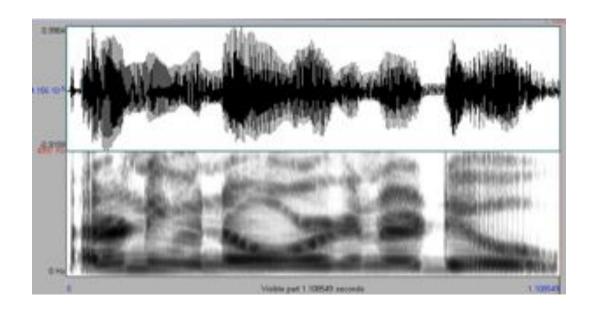
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Writing – what a concept!



wwbenceniewenenie



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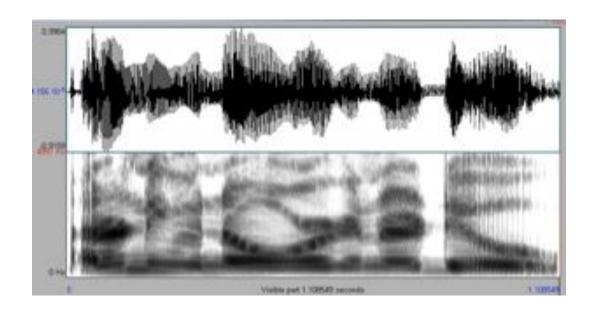
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Writing – what a concept!



a:renewe?wɨrgɔ̃:nedww
I don't know what we're going to do



The origins of true writing

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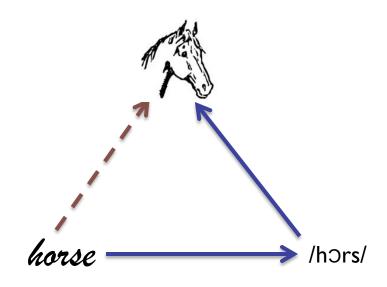
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Writing: symbols represent elements of language rather than directly representing things in the world.



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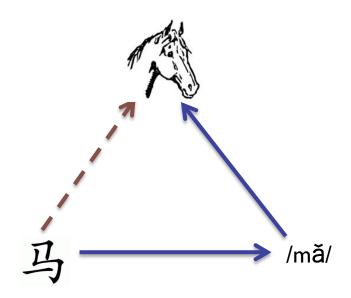
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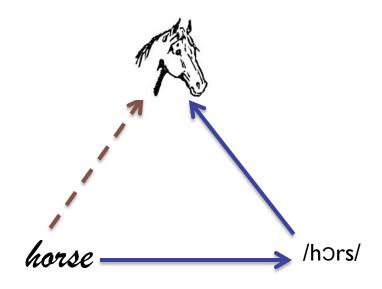
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Glottographic writing: rather than referring directly to reference/ideas, signs are associated with elements of the language (words, morphemes, syllables, phonemes).

Cf "5" vs five," cinque, wŭ, etc.

"\$" vs "dollars," etc.



Origins of Writing in Sumer

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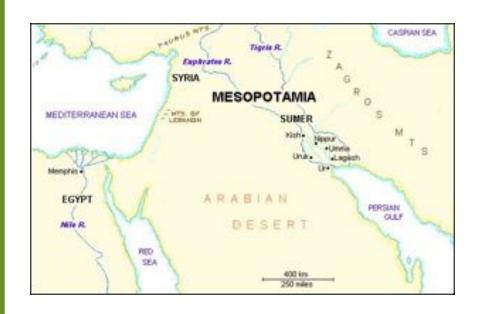
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Origins of Writing in Sumer

8-5000 BC -- earliest use of clay tokens.

4,000 BC -- earliest clay bullae 3500-3300 BC -- earliest clay tablets from Uruk.











Early cunieform



Tokens as origins of Sumerian writing?



Figure 7 Pictographic tablet from Uruk, Iraq, late fourth millennium B.C. The account in the upper central case, for example, shows the sign for sheep and five wedges standing for the abstract numeral s. Courtesy Vorderasiatisches Museum, Staatliche Museen zu Berlin, East Germany.

Evolution from Token to Cuneiform Writing									
Toler	Pictograph	Neo-Sumerioni Die Bebylonien	Nec-Assyrian	Non-Babylonian	English				
1	Œ	囲	M	Ж	Sheep				
4	\$ \$	♦	#	<	Cathe				
*	8	MMI	J=Q(D+III	以市	Dog				
dib		\$	4₩	4	Metal				
9	Θ	À	ÀT.	A	Oil				
	0	,Ing	Tette	A Tree	Garment				
•	•	1	受蛀	倒	Bracelet				
9	>	各值	;iii	杂	Perlyme				



The Origins of "complete" writing

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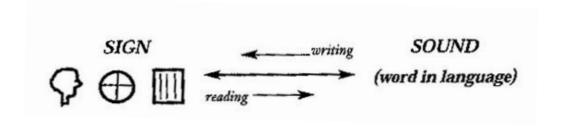
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"Complete" glottographic system: signs denote words/signs of the language



But how to signify "abstract" words? Creation, after, but, believe, faithful, if, etc.

Metaphoric extension (cf extended meanings of head, hand, foot, etc.)



The Rebus Principle













Rebus: Icons of things that stand in for their (phonetic) names



The Rebus Principle













Eye

saw

ewe

duck

deer

"I saw you duck, dear."



Rebus principle leads to logography

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Independent Inventions of Writing Systems Rebus principle allows signs to be reutilized to signal abstract words, functional elements, etc.

"water" $/a/ \rightarrow$ "in" /a/

T "oracle" /me/ → plural suffix /-me/

Accompanied by increasing conventionalization of signs... Creates need for "determinative" signs to indicate how other signs are being used.

Eg. "marsh plant" (/te/) sign also used for name of goddess assoc. w. marshes /eresh/ -- /u/ "plant" used to indicate "marsh plant" use of sign.



Logography to Syllabic System

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Independent Inventions of Writing Systems Logographs ultimately perceived as having purely phonetic value.

Cf English logographs – @, &, £, ¢ imagine the word h@b&

Where does this happen in everyday life?

•



Logography to Syllabic System

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Logographs ultimately perceived as having purely phonetic value.

Cf English logographs -- imagine the word h@b&

Where does this happen in modern life?

Texting: CU@*\$, 2G2B4GOT10, ne14?^







Signs come to stand in for syllables

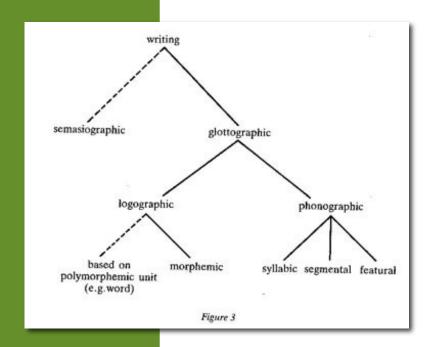
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•



Origins of Alphabetic Writing

Alphabetic system derived from application of syllabic system to different phonological structures.



Logographic: mod. Chinese, Japanese (mixed)

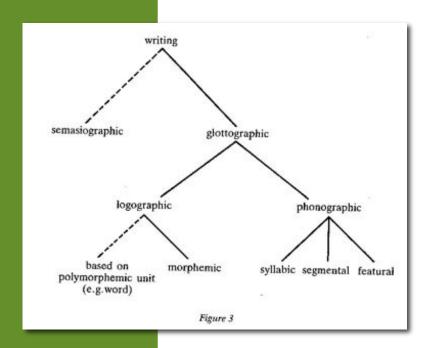
Syllabic: Linear B, Cherokee, Korean Hangul (featural)

Alphabetic: Roman, Cyrillic, Gk, Hebrew, etc,



Origins of Alphabetic Writing

Alphabetic system derived from application of syllabic system to different phonological structures.



Logographic: mod. Chinese, Japanese (mixed)

Syllabic: Linear B, Cherokee, Korean Hangul (featural)

Alphabetic: Roman, Cyrillic, Gk, Hebrew, etc,

Problem with completely phonetic alphabetic systems: ambiguity.

Cf French au, aux, ô, os, haut, hauts, eau, eaux, os, etc.





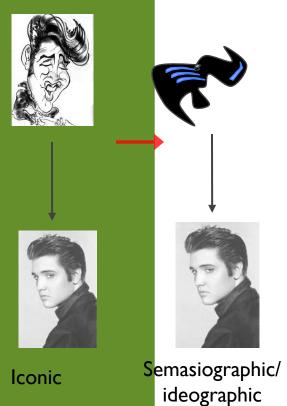




Iconic



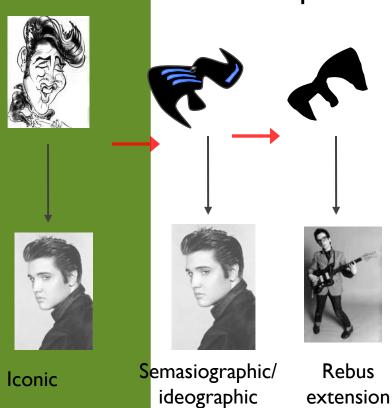
Simplification of sign



Proto-writing

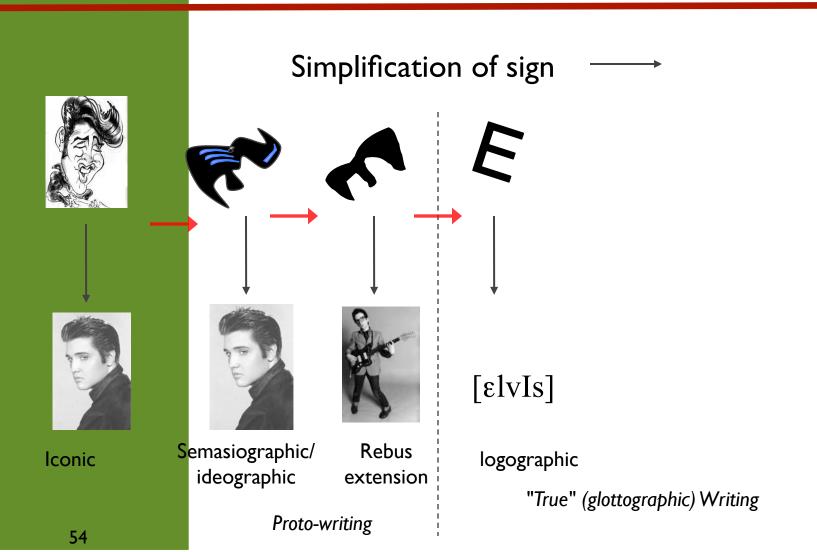


Simplification of sign —

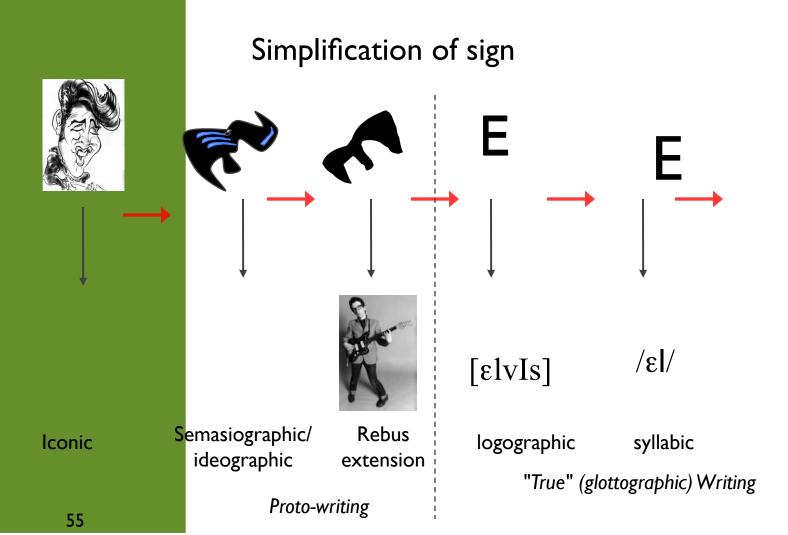


Proto-writing

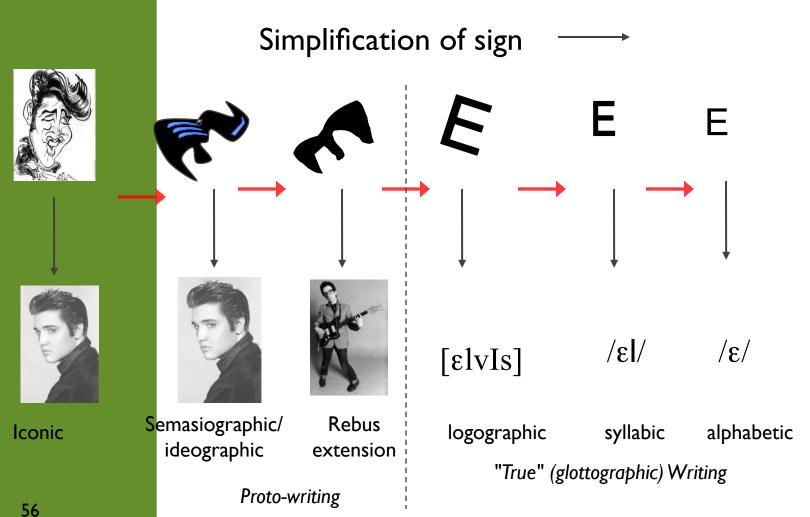




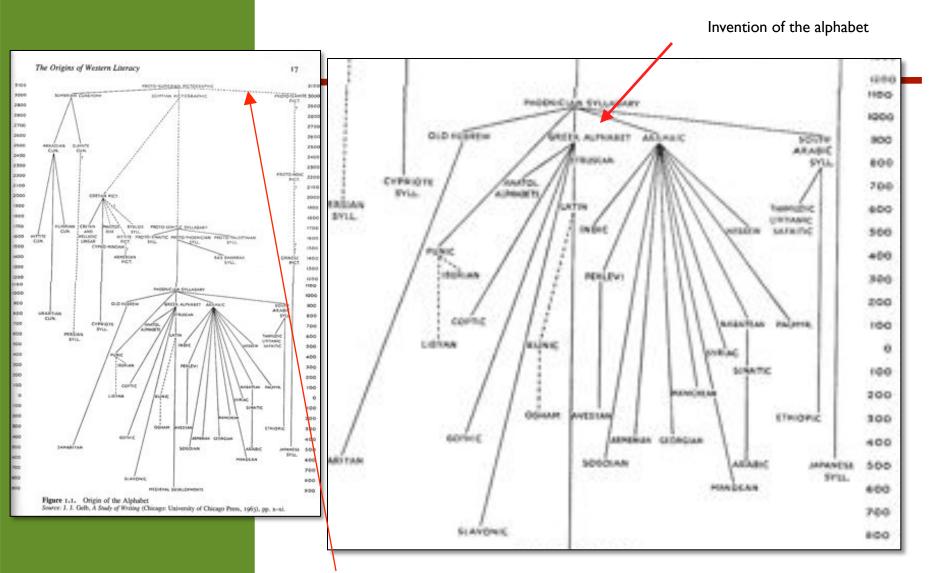








Geneology of Writing Systems



But evidence is slight for derivation of Chinese from proto-Sumerian



Later Developments



Subsequent development of further orthographic elements: word-spacing, punctuation, paragraphing, etc.

> Not fixed till early age of print. Reduce ambiguity, make writing increasingly accessible to wider community or in absence of immediate context.

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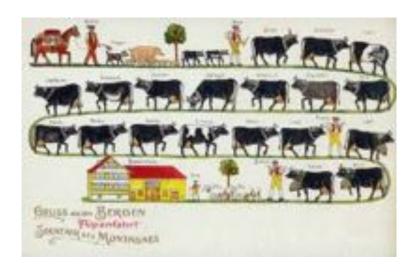


Later Developments

ОХІДОИАФ ЕМІТОРМОК ОТЗОЗТАЎ ПРОКОИИН ЧНТНЧХОІЎ АДЕ:КАІҮПОК АЗ:ИОІЧНТНЎ АІНӨМОИ:ЕΣП ИОІНИАТУЎ ЁДΩКЕИ:ΣҮКЕ ИІЗУЭ́

boustrophedon

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Independent Invention of Writing Systems

The Beginnings of Information

The Emergence of Representation

The Variety of Signs

The Origins and Development of Writing Systems

Types of Writing Systems

Independent Inventions of Writing Systems



Independent writing systems: The Cherokee Syllabary



Sequoyah [George Gist] and the "talking leaves": 1819

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Independently invented writing systems: The Cherokee Syllabary



VOL. L.

NEW ECHOTA, THURSDAY MARCH 6, 1828.

NO. 3.

EDITIOD BY ELIAS BOUDINGTY. PRINTED WHEELY BY

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fanacurage, I CONSTITUTION OF THE CHERO.

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Sec. 3: No person who desire the being of a God, or a future state of reveneda & validments, shall held say office in the elvil department of this Nation.

Sec. 2. The free energies of religious worship, and serving God without distinction, shall forever be allowed within this Notice: Provided, That this liberty of conaclesce shall not be an exectaced as to excost acts of licentiquesess or justify proctions increasistant with the pence or sode-

Sec. 6. Whenever the General Counall shall determine the expediency of appetiting delegates, or other public Agencs, the the purpose of transacting business with the Government of the United States; the Principal Chief shall here pearer to recemranul, and by the salvice and current of the Committee, shall appoint and commission with delegates or Public Agents presedings sages of a Magazine protect in the year. It, and, on all metters of interest touching. Were in the parameters as interest touching. Were in the property of the chipmen of this Nation.

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Nor. 13. The General Council may at oy time propose such assendances to this Countration as two thirds of each home sholl doom expedient; and the Principal Chief shall beau a preclamation, directory all the civil efficers of the several Districts to premulgate the unite on extensively us possible within their respective Districts, at least size mostle province to the next Central election; and if at the first sension of the General Council after such General election, two thinks of such house shull, by present ups, ratify such proposed as a water, amazan panarantpol mendusors, they shall be valid to all intests and perpend reports of this Court | mount maps present necessary teting Previded, That such prepared amendments shell be read on three several dops, in such haven, to well when the mine are proposed, so when they are faully rot-

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Cherokee Phoenix: First American Indian newspaper (1828)



Independently invented writing systems: Korean Hangul



Hunmin Jeong-eum Exemplar (1446): Earliest Hangul text

Writing system invented in mid-15th c. to replace hanja (Chinese-based writing system). Invention credited to King Sejong ("the Great"), who introduced it to increase mass literacy. Possibly influenced by central Asian scripts.

Only "featural" system: symbols representing sounds as features (i.e., "labial,' etc.) are clustered into a single "block" representing a syllable.



Assignment for 2/5

Havelock writes:

The introduction of the Greek letters into inscription somewhere around 700 B.C. was to alter the character of human culture, placing a gulf between all alphabetic societies and their precursors. The Greeks did not just invent an alphabet, they invented literacy and the literate basis of modern thought [55]....It is no accident that the prealphabetic cultures of the world were also in a large sense the pre-scientific cultures, pre-philosophical and pre-literary. [58]

Consider just one aspect or element of this broad claim. On the basis of the specific evidence presented by Havelock and Gough, would you say it is largely true, largely false, or true in some respects?



Assignment for 2/5

Havelock, Eric, "The Greek Legacy," in David Crowley, ed. *Communication in History: Technology, Culture, Society.* Allyn & Bacon. Pp. 55-62.

Gough, Kathleen. 1968. *Implications of literacy in traditional China and India*. In Goody, Jack (ed.). Literacy in Traditional Societies. Cambridge: Cambridge University Press, 44-56.

Additional Materials

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