Legibility in writing systems emerges spontaneously, rather than evolving over time

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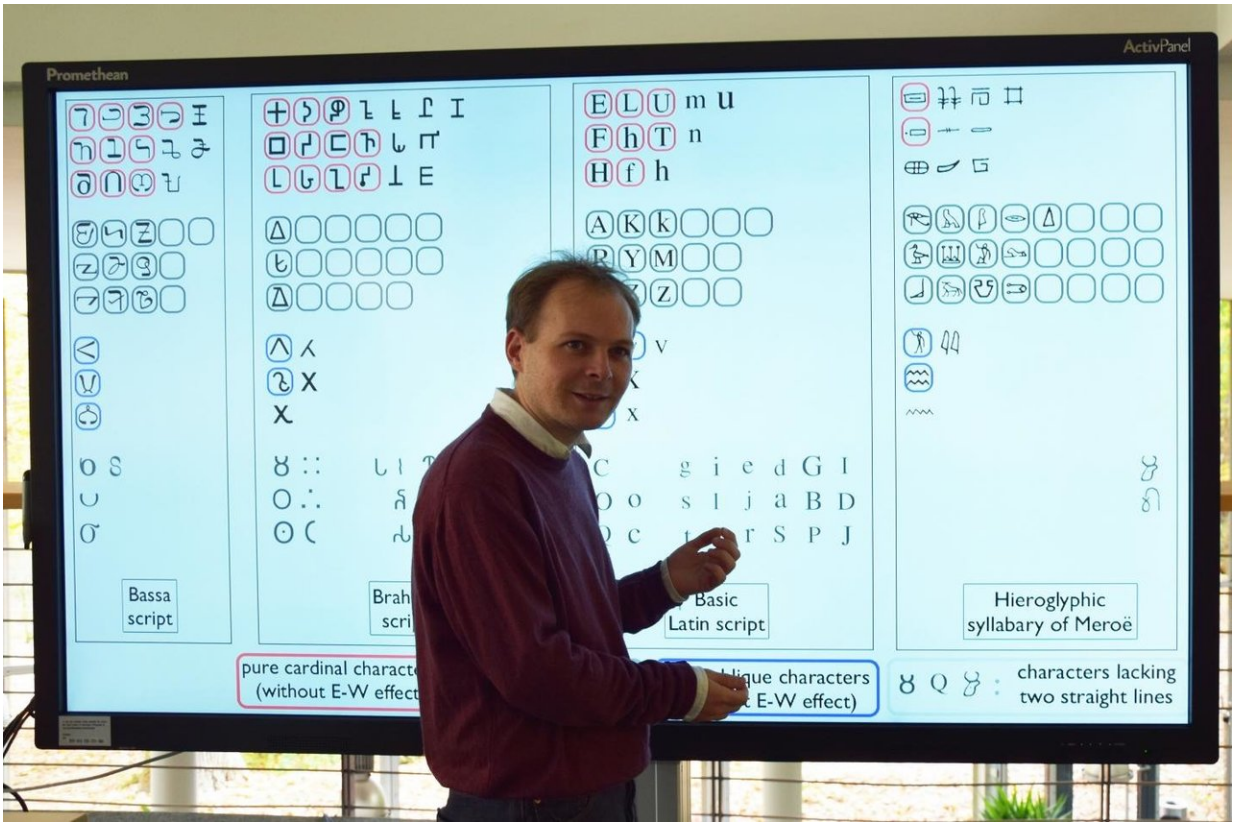

Olivier Morin from the Max Planck Institute for the Science of Human History in Jena analyzed and compared the letters of more than 100 scripts from all over the globe. He found no evidence for a long-term evolution of legibility, but found that the orientation of lines in the letters of most scripts presented surprising and widespread patterns, favoring certain kinds of orientation, symmetries, and angles over others. Credit: MPI-SHH

The visual appearance of most scripts corresponds with the basic constraints of the human visual system, thus facilitating the perception and processing of letters. For example, cardinals (horizontal and vertical lines) are more numerous than oblique lines. But how did it happen? Has the legibility of writing systems gradually evolved through cultural transformation or cultural selection? Or do human cognitive preferences directly affect the shape of the characters?

In order to clarify this question, Olivier Morin from the Max Planck Institute for the Science of Human History in Jena analyzed and compared the letters of more than 100 scripts from all over the globe. He found no evidence for a long-term evolution of legibility, but found that the orientation of lines in the letters of most scripts presented surprising and widespread patterns, favoring certain kinds of orientation, symmetries, and angles over others.

For the study published in *Cognitive Science*, Morin examined the letters of a total of 116 scripts from all regions of the world, with a time span of 3000 years, for features of legibility. In contrast to previous studies, the focus was not on the topography—the spatial structure of the letters—but rather the orientation of the lines within the letters.

Anisotropic features of legibility

Morin used classic visual cognition research to predict three aspects of the shape of letters. (1) Vertical and horizontal lines (as in E, H, L, etc.), which are easier to recognize, discriminate, and memorize, should be more frequent than oblique lines (as in X, Z, W, etc.); (2) Obliques and cardinals should not mix: Letters consisting exclusively of cardinal lines (like E,H,F) or exclusively oblique lines (as in W and X) should occur more frequently than those combining the two (as in K, A and Z); (3) Vertical symmetry is widespread in nature and is recognized more quickly by humans than horizontal symmetry, so letters are more likely

to be vertically symmetrical (as in M, A, W, U, etc.) rather than horizontally symmetrical (as in K, D, E, etc.).

The existence of all three characteristics—cardinal domination, separation of oblique and cardinal lines, and overrepresentation of vertical versus horizontal symmetry—were confirmed by two independent evaluators in most of the scripts in the study, which includes rare scripts that developed independently of Western influences.

The second part of the study examines two hypotheses regarding the cultural evolution of the legibility of characters. The first is based on the assumption that the survival rate of readable scripts is higher than that of ones that are harder to read. Thus, extinct scripts should have fewer characteristics of good readability than today's (cultural selection). The second hypothesis relates to the process of fading or splitting scripts. Writing systems that have developed from existing writing systems into new and independent ones should have a higher degree of readability than their ancestors (cultural transformation).

Both hypotheses were tested for the three characteristics described above by means of phylogenetic analyses. A significant correlation could only be calculated in one case: the cardinality in living scripts was higher than in extinct ones. For all other cases, no significant or even negative correlation was found. These results contrast with previous studies that claimed the legibility of scripts evolved by cultural selection. "Cultural adaptation to cognitive preferences," Morin writes, "may not need long-term cultural evolution."

"One of the joys of science is to find unexpected patterns in things you have seen millions of times," Morin said. "Vision science can help us detect unexpected patterns in cultural forms, like letters, and cultural history can tell us whether they originate in cultural evolution or in the human brain." The paper has wide-ranging implications for the study of

literacy.

More information: Olivier Morin, Spontaneous Emergence of Legibility in Writing Systems: The Case of Orientation Anisotropy, *Cognitive Science* (2017). DOI: 10.1111/cogs.12550

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