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Letters and Symbols Originated across Cultures to Mimic Natural Scenes, Study Says
According to researchers, the shapes of letters and symbols used throughout history by the world's many cultures may have arisen to take advantage of the way human vision has evolved to see common structures and shapes in nature.

Candes Receives Waterman Award
Emmanuel Candes, an applied mathematician in the Division of Engineering and Applied Science, has been selected to receive the National Science Board's prestigious Alan T. Waterman Award, the highest honor awarded by the National Science Foundation.The board cited Candes's development of new mathematical tools that allow efficient digital representation of wave signals, together with his discovery of new methods to economically translate analog data into already compressed digital form--work that promises to improve the digital processing of signals in a vast array of modern technologies.

Moore Foundation Awards Multiple Grants to Caltech
The Gordon and Betty Moore Foundation has recently awarded multimillion dollar grants to the California Institute of Technology for the establishment of three new projects: the Center for Geochemical and Cosmochemical Microanalysis, the Proteome Exploration Laboratory, and the Center for Theoretical Cosmology and Physics. The grants for these facilities total more than $22 million.

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Letters and Symbols Originated Across Cultures to Mimic Natural Scenes, Study Says

PASADENA, Calif.--If a tree falls in the forest and a caveman sees it lying next to a standing tree, what does he do? New evidence suggests that he may proceed to invent the letter "L."

According to a new study in The American Naturalist, the shapes of letters and symbols used throughout history by the world's many cultures may have arisen to take advantage of the way human vision has evolved to see common structures and shapes in nature. Mark Changizi, a theoretical neurobiologist at the California Institute of Technology, says the evidence suggests that letters and symbols have their particular shapes because "these are what we are good at seeing."

In essence, this means that the letters of all writing systems-Chinese, Latin, Persian, as well as 97 other systems that have been used through the years-are visual repetitions of common sights, just as onomatopoeias such as 'bow wow" are aural repetitions of common sounds.

"Evolution has shaped our visual system to be good at seeing the structures we commonly encounter in nature, and culture has apparently selected our writing systems and visual signs to have these same shapes," says Changizi, the lead author of the paper.

Changizi says he got the initial insight for the hypothesis after reviewing the history of computer vision. Engineers have known for some time that the best way to create a system to allow for object recognition is to focus on the junctions of objects. In other words, a robot navigating a room sees the conglomeration of contours in a corner by its "Y" shape, and sees a wall because of its "L" junction with the floor.

"It struck me that these junctions are typically named with letters, such as 'L,' 'T,' 'Y,' 'K,' and 'X,' and that it may not be a coincidence that the shapes of these letters look like the things they really are in nature."

Changizi then proceeded to an ecological hypothesis of why the letters have their shapes, and decided to apply the basic contours of letters in various writing systems and symbols in symbolic systems to their basic topological contours. By this he means that a basic shape like an "L" can be turned into a "V," for example, and any other form that can be bent around so long as you don't cut the object.

He ended up with a catalog of 36 shapes employing two or three contours, and then ranked them according to how frequently they occur in the objects that primitive people would have seen millions of years ago, in pictures across many cultures that he took from National Geographic, and in computer-generated architectural forms.

It turns out that the common contours conglomerations are precisely those forms that frequently show up in the letters of various writing systems, as well as in company logos and in symbolic systems such as musical notations and the like. The forms not found as frequently in nature, by contrast, do not show up so often in writing systems or symbolic representations.

"We tested the hypothesis of whether cultures have selected visual signs and letter shapes to possess the shapes occurring in nature, and the answer is yes," Changizi says. "It's also striking that the systems that are intended to be seen have high correlations to natural forms. Company logos, for example, are meant to be recognized, and we found that logos have a high correlation. Shorthand systems, which are meant to give a note-taker speed at the expense of a commonly recognizable system of symbols, do not.

"So the figures we use in symbolic systems and writing systems seem to be selected because they are easy to see rather than easy to write," he concludes. "They're for the eye."

In addition to Changizi, the authors are Shinsuke Shimojo, a professor of biology at Caltech who specializes in psychobiology; and Qiong Zhang and Hao Ye, both undergraduate students at Caltech.

The title of the paper is "Structures of Letters and Symbols Throughout Human History Are Selected to Match Those Found in Objects in Natural Scenes." The paper is downloadable on the journal's webpage at **http://www.journals.uchicago.edu/AN/journal/issues/v167n5/41010/41010.html**.

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