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## Dictionaries are designed to fit in the brain

Washington, May 1 : [Dictionaries](#) may seem like a tangled web of words but they are actually designed in a form that mirrors the way our brains make sense, suggests a new study.

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The study led by Mark Changizi, assistant professor of cognitive science at Rensselaer Polytechnic Institute suggests that dictionaries are designed in a way that fits in the brain.

"Dictionaries have often been thought of as a frustratingly tangled web of words where the definition of word A refers users to word B, which is defined using word C, which ends up referring users back to word A," said Changizi.

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"But this [research](#) suggests that all words are grounded in a small set of atomic words - and it's likely that the dictionary's large-scale organization has been driven over time by the way humans mentally systematize words and their meanings," he added.

Dictionaries are built like an inverted pyramid with the most complex words (e.g., "albacore" and "antelope") at the top and defined by words that are more basic, and thus lower on the pyramid.

Eventually all words are linked to a small number of words - called "atomic words," (such as "act" and "group") that are so fundamental they cannot be defined by simpler terms. The number of levels of definition it takes to get from a word to an atomic word is called the "hierarchical level" of the word.

Changizi said that the dictionaries we use every day utilize approximately the optimal number of hierarchical levels and provide a visual roadmap of how the lexicon itself has culturally evolved over tens of thousands of years to help lower the overall "brain space" required to encode it.

The [researchers](#) conducted a series of calculations based on the estimation that the most complex words and atomic words which helped them to devise three signature features present in the most efficient dictionaries as well as in their human counterpart, the brain.

They found that the total number of words across all the definitions in the dictionary changes in relation to the total number of hierarchical levels present. Changizi said that the optimal dictionaries should have approximately seven hierarchical levels.

"The presence of around seven levels of definition will reduce the overall size of the dictionary, so that it is about 30 percent of the size it would be if there were only two hierarchical levels," he said.

There were progressively more words at each successive hierarchical level, and that each hierarchical level contributes mostly to the definitions of the words just one level above their own.

Changizi believes his research has potential applications in the study of childhood learning, where scientists could analyze how students learn vocabulary words and possibly develop ways to optimize that learning process.

The study appears in June print edition of the Journal of Cognitive [Systems Research](#).

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