

Our Ability To Think In Terms Of Numbers Is Universal, Abstract, And Independent From Language



*Frederick L.
Coolidge, Ph.D.
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01-24-2025 ~ Frederick L. Coolidge explains the link between numerosity and language.

Most people learn to count and do basic arithmetic at a young age and don't give these skills a second thought. But numerosity or numeracy, the ability to think about and use numbers, is more than a basic skill: It is what underlies the human power of abstraction, metaphor, symbolism, and the essence of thought.

The connection of numerosity to language and culture is a fascinating topic. Scientific research has shown that even cultures that only use numbers up to 2 or 3 [are able to master using larger numbers](#) when they are taught the language required.

Advanced imaging technologies have enabled scientists to look at areas of the brain cortex connected to particular math skills. The frontoparietal region of the brain has been identified as [the location for coordinating goal-directed tasks](#).

How old human numerosity is, how numbers are connected to language or abstraction, and whether animals have numerosity are subjects of debate in the

scientific community. I interviewed [Frederick L. Coolidge](#), a professor of psychology, who specializes in cognitive archaeology and has [written broadly on the subject](#).

Coolidge has taught at the University of Colorado, Colorado Springs, since 1979 and co-directs its Center for Cognitive Archaeology.

He argues that humans are not the only species to have numerosity, that numerosity does not require language, and that it expresses itself culturally.

Marjorie Hecht: How old do you think numerosity is, and why?

Frederick L. Coolidge: Because monkeys possess the capacity for numerosity, and we have a common ancestor with monkeys about 25 to 30 million years ago, this suggests that numerosity has a very ancient origin.

Why? Because evolutionarily it must have been important for the earliest primates, who appeared about 60 million years ago, to be able to distinguish quickly among one, two, or three things. Further, we are descendants of this primate lineage. This ability, subitization, is one of the two core processes in numerosity.

Imagine an ancient primate facing a predator or more than one. They would be at a distinct advantage if they could immediately (as if without overt conscious thinking) take on a single predator as opposed to three! Imagine if they sat there thinking, "Hmm, should I go this way to take on this one predator or should I go that way and take on three predators" (assuming of course, there was no other recourse).

The second core process of numerosity is an analog set of comparisons, that is, distinguishing quickly between a small set and a large set of things (any number of things). Again, imagine an ancient primate trying to decide between a tree with 25 apples versus 50 apples. The ability to quickly distinguish the tree with more apples might be invaluable due to competition with other animals.

MH: Is numerosity inherently abstract?

FLC: Yes, because if oneness, twoness, and threeness can be applied to any type of things, be they tangible like apples or intangible like angels, numerosity is the essence of abstractive thinking. Therefore, because numbers can be applied to

any thing, it is this capacity that underlies abstractive thinking.

As the British mathematician A. N. Whitehead (1911) wrote: "... the leading characteristic of mathematics [is] that it deals with properties and ideas which are applicable to things just because they are things, and apart from any particular feelings, or emotions, or sensations.... This is what is meant by calling mathematics an abstract science."

Further, abstraction in numerosity may give rise to the modern advanced characteristics of language, including analogizing and metaphorizing. Why is "love is a rose" so easily understood? Notice that the properties of a tangible thing like a rose we can readily understand and apply to an intangible abstract concept of love.

One minor problem with analogies and metaphors is where do the similarities stop. In class, I made students ponder the problem of nitrogen-fixing bacteria in a rose's roots and how that would apply to love. The value of metaphorization is not only a transfer of knowledge but also the creation of novel ideas.

MH: Is numerosity independent of language?

FLC: Monkeys and human infants (as young as 8 months old) have the capacity for numerosity. Therefore, it is independent of the faculty of language. Numerosity arises from neurons genetically dedicated to its two core processes, which are located in the lower parietal lobe—specifically the intraparietal sulcus—both in humans and nonhuman primates like monkeys.

I can find no coherent argument that numerosity requires language, sorry. It would be like wasting your time arguing evolution with a creationist.

MH: Does numerosity express itself culturally?

FLC: Yes, the capacity for numerosity may be older than primates, reptiles, and maybe even flatworms that emerged 545 million years ago—and I am not merely being facetious.

There is simply not a lot of grant money for the study of numerosity in amphioxus and planaria, but there should be. I propose that basic mathematics and then advanced higher math (algebra, calculus, etc.) were built upon the foundation of numerosity.

As soon as language became more elaborate with lots of words for things, it was as easy to name the [subitization](#) core process of oneness, twoness, and threeness. [Subitization is the ability to determine the number of elements in a set without counting.] In fact, it was as easy as one, two, three; *ek, do, teen* [Hindi]; *eins, zwei, drei* [German].

Interestingly, the Pirahã tribe in the Amazon have only the [number words](#) for one, two, and many (again the three-thing limit for subitization). So, as soon as we hominins had words for 1, 2, and 3, we figured out there could be words for numbers and then words for amounts greater than that. But subitization got us started. Then advanced math took off yet got its start from that foundation.

When humans could ponder their existence, they could ponder and witness death. This death anxiety wasn't easily relieved. We needed a very powerful rationalization to overcome this major existential anxiety. So, we created gods, typically a single god: God, Allah, Buddha, Brahma, etc. Notice, only one god, expressed by numerosity's (subitization's) oneness. We didn't need more to relieve our death anxiety as one god giving us immortal life is sufficient. Also, notice that the concept of a heaven always accompanies the concept of a god because death anxiety is the chief reason for the conception of a god.

However, subitization subtly expresses itself by urging us to think of twoness and threeness. Thus, Hinduism has one God, Brahma, but three forms, Brahma, Vishnu, and Shiva. Christianity has God, the Son, and the Holy Ghost. Even in comedy, we have three (the Three Stooges) because the limit of subitization appears to be three things.

In summary, does numerosity express itself culturally? God, yes!

By Marjorie Hecht

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