

Pre-verbal number sense common to monkeys, babies, college kids

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Basic arithmetic and "number sense" appear to be part of the shared evolutionary past of many primates; it's the use of language to explain abstractions that apparently takes human math to a higher level.

Elizabeth Brannon, an assistant professor of psychology and neuroscience at Duke University, studies how human adults and infants, lemurs, and monkeys think about numbers without using language. She's looking for the brain systems that support number sense and trying to figure out how this cognitive skill develops.

"Number is one of the more abstract domains of cognition: three coins and three loaves of bread are very different concepts," says Brannon, who appears on a Friday afternoon panel at the AAAS annual meeting called "Comparative Cognition: The Science of Mental Evolution. "Yet, many studies show that babies, even in the first year of life, can tell the difference between quantities."

She runs about 500 babies per year through her testing lab at Duke, as well as macaques, lemurs and the odd undergraduate. Most of the experiments involve computer touch-screens and sets of brightly colored dots.

After seeing the same number of objects repeated in different-looking sets, infants recognize the novelty of a new number of objects. So do macaques. And both college kids and macaques can do a rough sort of math by summing sets of objects without actually counting them. Their

speed and accuracy are about the same, in fact.

That the evolved brain has some fundamental sense of number without language should come as little surprise, Brannon says.

"There are all sorts of reasons why number would be useful for nonhuman animals in the wild. In foraging situations animals need to make decisions about how long to stay in a given patch of food and when to move on," Brannon says. "Territorial animals may need to assess the number of individuals in their own group relative to competing groups to decide whether to stand their ground or retreat."

Understanding the biological basis of our number sense might also help early childhood educators.

Brannon's latest work is aimed at understanding how the human brain changes to accommodate symbolism as a child learns the names of numbers and begins to grasp more abstract manipulations. "If the nonverbal number sense is really providing a critical foundation for math achievement, then this will suggest teaching methods that provide more grounding in the nonverbal quantity system."

Brannon is also exploring the macaque's sense of an empty set, what we'd call zero with our linguistically intensive sense of number. The monkeys are more likely to confuse an empty set with a 1 or a 2 than they are to confuse it with an 8 or a 9, she says, which shows they're putting zero in the proper place on the number line.

"We're trying to understand how the animal mind works. How much of human thought is dependent on language?"

Source: Duke University

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