

Without Language, Large Numbers Don't Add Up

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A study of people in Nicaragua has concluded that humans need language in order to understand large numbers.

Members of the group were born deaf and never learned Spanish or a formal sign language, but they have developed a gesture system to communicate with people around them. The gestures let them express approximate amounts — a little as opposed to a lot — but not exact numbers.

"Up to three, they're fine," says Elizabet Spaepen, a researcher at the University of Chicago and an author of the study. "But past three, they start to fall apart."

Video: A Counting Task

In this study task, the participant is instructed to lay out a number of poker chips equal to the number of knocks she feels on her hand.

She places four chips when knocked six times, three chips when knocked three times and three chips when knocked four times.

Spaepen and her colleagues learned this through a series of experiments with people who hold jobs, use money and are surrounded by friends and family who use exact numbers all the time.

In one test, Spaepen would knock her fist against a study participant's fist a certain number of times and then ask them to respond with the same number of knocks.

"If I were to knock four times on their fist, they might knock my fist five times," she says.

Confirming Earlier Studies

The finding offers a clue about just how much language affects our understanding of numbers, researchers say. That has been a big question since 2004, when other researchers published data on two tribes in the Amazon whose members also lack precise words for big numbers.

"What they have are words that sort of mean one and two," Spaepen says, "and then they have a word to mean many."

Note: This video clip has no sound.

Courtesy of Elizabet Spaepen, University of Chicago

Members of the Amazonian tribes also had trouble matching numbers larger than three or four. But some scholars felt that these earlier studies failed to prove that language was the reason. They pointed out that the tribes lived in groups that didn't use money and had no need for exact numbers.

The new research appears to answer that criticism.

"It confirms that the kinds of problems in perceiving numerical quantities that we found in the Amazonian tribes is not due to just the cultural or environmental circumstances," says Peter Gordon of Columbia University, one of the researchers involved in the earlier studies.

"What's exciting about this new study is that these people are immersed in a culture that has large exact numbers and in

which large exact enumeration is very important," says Daniel Casasanto, a researcher at the Max Planck Institute for Psycholinguistics in the Netherlands who had been wary of earlier studies that tied language to numbers.

Connecting Language And Numbers

The new study, published in the *Proceedings of the National Academy of Sciences*, suggests how language augments our natural ability to understand numbers, Casasanto says. He says the brains of all people — and some animals — can tell the difference between, say, two cookies and three cookies on a plate.

The human brain is also very good at assessing approximate values, like the difference between 10 and 20 cookies, Casasanto says. But he says the brain needs some sort of counting system to tell the difference between 10 cookies and 11.

"What language does is give you a means of linking up our small, exact number abilities with our large, approximate number abilities," Casasanto says. And for people in developed countries, that's essential.

"It has been the tool that gave rise to the society we live in," Casasanto says. "The skyscrapers we work in and the computers that we're talking on right now — all of these things are possible because of exact large numbers and humans' ability to manipulate them."

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