

Numbers beyond words

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One is the loneliest number that you'll ever do, especially if you don't even have a word for it. That's the situation of the Pirahã people, denizens of Brazil's Amazon rainforest who have no term for the number *one* or for any other exact quantity, a new study finds.



WHAT'S IN A NAME? A Pirahã man participates in a new experiment that, researchers say, indicates that his language contains no number words, even for the number one. Edward Gibson

Until now, researchers have not demonstrated the absence of a way to express the number one in any language, according to a team led by Massachusetts Institute of Technology cognitive scientist Edward Gibson.

Yet Pirahã individuals can still identify the number of items that an experimenter places in front of them, Gibson's team reports. The new findings challenge the longstanding idea that number words enable people to think about

and recognize exact quantities of items.



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“These results suggest that number words do not change our underlying representations of number, but instead are a cognitive technology for keeping track of the exact size of large sets over time and in different contexts,” says coauthor Michael Frank.

The new study was published online June 10 and will appear in an upcoming *Cognition*.

The team first examined whether the Pirahã employ counting words, as was described in a 2004 study conducted by psycholinguist Peter Gordon of Columbia University. Gordon concluded that the Brazilian tribe has words for *one*, *two* and *many* (*SN*: 12/10/05, p. 376). However, longtime Pirahã researcher and coauthor on the new study Daniel Everett of Illinois State University in Normal initially questioned Gordon’s results.

The new study explores Everett's contention that no words for exact numbers exist in the Pirahã language. For each of six adult Pirahã volunteers, a researcher placed one wooden spool on a table and added spools one at a time until reaching 10 spools. For each quantity, the experimenter used the Pirahã language to ask volunteers "How much is this?" Four of the same volunteers then performed this exercise as the researcher removed one spool at a time from a set of 10 spools until one remained.

Participants used the same three words for dramatically different ranges of quantities when dealing with increasing or decreasing numbers of spools. For increasing quantities, these words roughly corresponded to *one*, *two* and *many*. For decreasing quantities, the three same words were used to denote from one to six spools, from four to 10 spools and from seven to 10 spools.

These results indicate that the three Pirahã words refer to general quantities, such as *few*, *some* and *more*, Frank says. Many other foraging groups, as well as the Pirahã in Gordon's study, have been reported to have words for *one*, *two* and *many* based only on responses to increasing numbers of items. Some of those groups may, like the Pirahã, reveal an absence of number words when responses to decreasing quantities are considered, Frank proposes.

In a second experiment, 14 Pirahã adults reproduced exact quantities of objects despite lacking number words. Participants facing a line of one to 10 spools almost always chose the same number of un-inflated balloons to put in a matching line. Still, the same individuals often muffed tasks that required them to track and remember precise amounts, such as choosing a matching number of balloons after watching an experimenter drop spools one at a time into a can.

Number words are cultural inventions that greatly enhance the ability to monitor the exact sizes of large groups of objects, the researchers propose. Speakers of languages with number words thus find it easy to recall and re-create the number of spools dropped into a can.

Scientific opinions vary widely on what the new study shows about numerical thinking among the Pirahã. Gibson and Frank's team makes a good case for the absence of Pirahã words that represent exact quantities, including the number *one*, remarks psychologist David Barner of the University of California, San Diego.

Barner's own studies indicate that English-speaking children don't immediately realize that singular nouns, such as *a banana*, represent the numerical equivalent of *one banana*. At 2 years of age, youngsters understand that *one* refers to single items but assume that *a* means *at least one*, he says. As they learn about terms such as *some* and *all*, children gradually adopt *a* as a stand-in for *one*, Barner suggests.

Harvard University psychologist Elizabeth Spelke agrees that the Pirahã lack number words but questions whether they exhibit an underlying knowledge of precise amounts as proposed by Frank. "The prize question, whether exact number concepts such as *seven* depend on number words and verbal counting, is still open," Spelke says.

Pirahã volunteers may have matched appropriate numbers of balloons to sets of spools by using a non-numerical rule of thumb, such as "for each thing on your side, there's a thing on my side," she suggests.

Frank acknowledges that possibility. In further studies, he plans to assess whether the Pirahã understand that, when one object is added to or removed from a large number of identical objects, the quantity has changed. He also wants to see how the Pirahã use general quantifying terms such as *all* and *none* to deal with increasing and decreasing amounts of items.

Columbia's Gordon agrees with Spelke's point and adds that the new data fit with his earlier contention that the Pirahã use words that approximately mean *one*, *two* and *many*. He likens such usages to the English phrase *a couple of*. This phrase typically refers to two items but sometimes gets applied to slightly larger quantities.

In Gibson and Frank's study, the common meaning of *two* got triggered in Pirahã volunteers if they heard it used immediately after the term for *one*, Gordon asserts. Thus, in the ascending spool count, participants only used *one* to refer to a single spool and the term *two* to refer to a pair of spools or sometimes to larger quantities. In the descending count, the *two* term preceded the *one* term, leading to confusion and a more variable use of the terms, Gordon says.

For now, count on Brazil's Pirahã villagers to stimulate further scientific debate about the link between numbers and language.

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