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0 to 100... Not so Quick

How cultures developed higher numbers

by Hannah Halusker

Do you remember when you were in second grade, and you began to count numbers in patterns? Your teacher would have a number line in intervals of 10, and the students would shout in unison, "10, 20, 30!" each time her pointer landed on a number. But, how did your teacher know to teach you numbers in 10's? Why did you have to learn how to count that high, anyway? Yale University historical linguist Claire Bowern and her undergraduate researcher Kevin Zhou set out to answer precisely that question. In the September 2015 issue of *Proceedings of the Royal Society B*, Bowern and Zhou revealed that the Pama-Nyungan language family of Northern Australia added higher numbers to its system for practicality.

For many cultures, higher numbers are not necessary: their people can count on their fingers and use variations of words like "many" to account for numbers beyond ten. This method works for these cultures because they do not think in quantities but rather in shapes or names. For instance, an Amazonian mother knows she has all of her children in her vicinity not by counting them one by one, but by naming them until they're all present; a shepherd takes inventory of his sheep by judging the form they make when they are ushered into their paddock.

When an Amazonian merchant begins trading with a nearby tribe that he's never met before—that's when higher numbers arise. He isn't familiar with this tribe, and therefore does not trust them, so a record of their transaction needs to be tracked meticulously. Dr. Patience Epps, a linguist at the University of Texas-Austin, explains that this is how modern languages began building their number systems many millennia ago.

> "...they do not think in quantities but rather in shapes or names."

The Pama-Nyungan language family became the perfect dataset for studying number systems, as it encompasses 300 languages spoken by about 25,000 people, many of them being Aboriginal Australians. Most of the 300 languages have number systems that stop at 3, 4, or 5. Dr. Bowern used a computer model to reconstruct how the numbers evolved over 6,500 years, and then created a family tree of the languages to track which numbers were added and which were lost in evolution. She and her team concluded that, although some of the languages had lost a number or two over time, most of them had gained numbers. As opposed to adding numbers sequentially (i.e. 1, 2, 3), they added numbers in clusters (i.e. 5, 10, 20). Dr. Bowern attributes this gain to practicality: if you need to count to five, you'll probably need to count higher than ten, too. She also notes that it became easier for cultures to fathom an infinite number system as they added more numbers to their vocabulary. So, the next time you find yourself counting $10 bills from your handsome paycheck, will you appreciate your second grade teacher and your distant ancestors who made the number 10 possible for you?