tion," he says, as speech became the preferred modality for communication for various reasons, such as the need to free the hands for work or to talk in the dark.

But others believe equally strongly that even if movement and language are inseparable, language is primarily an oral, not manual, behavior. Psychologist Peter MacNeilage of the University of Texas, Austin, has developed a theory that monkey oral behaviors (not vocalizations) are precursors of human syllables, and he argues that the mirror neuron system—especially the recent discovery of neurons that respond to lip smacking and nut cracking—bolsters his ideas.

MacNeilage suggests that the brain's supplementary motor area (an area adjacent to the primary motor cortex that is important for motor memory and sequential movements) controls the physical constraints on vocal expression. The actions of chewing, sucking, and licking took on communicative content—a job for Broca's predecessor—in the form of lip smacks, tongue smacks, and teeth chatters. The next stage, says MacNeilage, was to give voice to these behaviors by bringing the larynx into play. This theory fits well with the fact that the unique sounds of click languages, which some speculate may have been the original mother tongue (see next story), do not use the larynx. Once the larynx was involved, a phonology—a set of sounds that could be combined in endless ways to form a large vocabulary—developed, and this in turn paved the way for the emergence of syntax.

"I don't believe manual gestural communication got to the point of the combinatorial phonology that I'm talking about, because if it did we'd still have it," says MacNeilage. In his view, if sign language had become that complex, there would have been no reason strong enough—the desire to talk in the dark notwithstanding—to cause a transition to vocal speech. "Nobody who argues that we went from sign to speech has given us an adequate translation theory," he says.

Others say the "which came first" debate is beside the point. "Evolution selected the ability to combine speech and gesture under a meaning," says McNeill. "The combination was the essential property"; neither gesture nor speech could have evolved without the other, he says. It doesn't matter which came first, agrees Zuberbühler: "Once an individual reaches a certain threshold in its cognitive sophistication, it will inevitably express itself in a sophisticated way," through any means at its command, he says.

The deepest questions—such as how humans became symbolic thinkers and developed "theory of mind," or awareness of others' thought processes—remain far from resolved. Researchers say one way to tackle them will be through ever-finer brain imaging technology so they can, as Bickerton puts it, "find out the flow chart for a sentence in the brain." Harvard's Hauser and colleagues believe that research in animals may identify behavioral analogs for "recursion": the ability to string words together in infinite hierarchical combinations. Arbib predicts that the discovery of other types of mirror systems, in both humans and animals, will help yield a better "taxonomy" of the language conundrum, especially if bolstered by computational modeling. But answers won't come all at once. "I see this as a process of gradual convergence. The problem space is shrinking" at long last, says Bickerton. "It will be solved when that space goes to zero, not when someone comes up with the killer solution."

—CONSTANCE HOLDEN

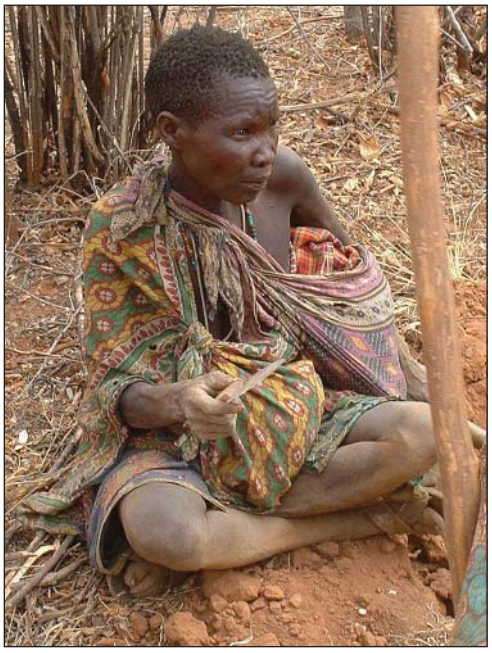
NEWS

The First Language?

Genetic and linguistic data indicate—but can't quite prove—that our ancient ancestors spoke with strange clicking noises

In the 1980 movie *The Gods Must Be Crazy*, a soda bottle falls out of the sky and lands among some strange-sounding Africans. Their excited chatter, punctuated by rapid-fire sucking and clicking noises, sounded intriguing but alien to audiences around the world. But a handful of studies of this seemingly esoteric language suggest that our early ancestors depended on such clicks to communicate. The latest linguistic work points to clicks as having deep roots, originating at the limits of linguistic analysis sometime earlier than 10,000 years ago, and genetic data suggest that click-speaking populations go back to a common ancestor perhaps 50,000 or more years ago.

Although the idea is far from proven, "it seems plausible that the population that was ancestral to all living humans lived in the savanna and used clicks," says vertebrate systematist Alec Knight of Stanford University. Knight estimates that today only about 120,000 people rely on these odd sounds. Even so, they are providing new insights into how humans evolved the gift of gab, particularly when researchers add up the results of different kinds of data. "There's a lot of mileage to be gained by cross-referencing linguistic, genetic, and archaeological data and theories," says Nigel Crawhall, a graduate student studying click languages at the University of Cape Town, South Africa.



CREDIT: NIGEL CRAWHALL

All alone. Researchers ponder why the Hadzabe live so far from other click speakers.

Clicks in context

Today clicks are part of typical conversation for about 30 groups of people, most from Botswana, Namibia, South Africa, and nearby. The only recognized non-African click language is Damin, an extinct Australian aboriginal language used only during manhood initiation ceremonies. Among African click speakers, daily conversations can be dominated by clicks, and sometimes verbal sounds drop out completely.

Adept tongue and inward air movements distinguish clicks from other nonverbal utterances. They are really just very strongly pronounced consonants, says Amanda Miller-Ockhuizen, a linguist at Cornell University in Ithaca, New York. Click speakers have click sounds in common, but they have different words and therefore very different languages.* Some researchers argue that click languages are far more different from each other than English is from Japanese.

But that diversity is only now being

* To hear click sounds, go to hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/index.html

appreciated. In the 1960s, the influential Stanford linguist Joseph Greenberg put all click languages under one umbrella, which he named the Khoisan language family after the two biggest groups included: herders known as Khoe and hunter-gatherers called San. Now, however, historical linguists are challenging Greenberg's classification, examining Khoisan with more stringent analytical methods and splitting it into several language groups. "It's been easy to say they are all in one family," says Bonny Sands, a linguist at Northern Arizona University in Flagstaff, "because nobody has gone and looked."

The latest work divides the Khoisan family into at least three geographically and linguistically distinct ones. And a few of these languages don't fit in any known families, Crawhall notes. For example, in 1995 Sands reexamined the grammar, meanings, and sounds of Hadzane, spoken by about 1000 Hadzabe people in north-central Tanzania, 2000 kilometers away from the majority of click speakers. She "proved that Hadzane cannot be shown to be related to any of the other families," says Crawhall. Rather, says Sands, linguistically Hadzane is unlike any other known language.

That suggests that either Hadzane had a separate origin from other click tongues or that it and other existing click languages derive from a very ancient protoclick language. Sands thinks that there have always been multiple click languages, but "if there was originally only one click family, it must be many tens of thousands of years old," she says. That's further back than linguistic studies can establish.

Tracking ancient populations

But genetic data on click speakers have also been streaming in, and these results can offer a glimpse into the more distant past. In 1991, one study hinted that Hadzabe were an ancient people based on the great diversity in their DNA; mutations accumulate over time, so diverse sequences imply an ancient population. Most recently, at a physical anthropology meeting last year, human geneticist Sarah Tishkoff of the University of Maryland, College Park, reported great diversity in the DNA of the Hadzabe and another click-speaking group in eastern Africa, the Sandawe.

The puzzling origins of these groups and their clicks intrigued Knight and Stanford anthropological geneticist Joanna Mountain. Last year, they decided to use genetic data to decipher the relationship between the isolated Hadzabe and the San in southern Africa. They thought that perhaps the Hadzabe had recently moved into Tanzania from the south, bringing clicks with them, or that the San had been part of a northern group that migrated south. "We expected a recent shared heritage, but the data indicated something opposite [from the recent origins] we expected," Knight recalls.

Knight, Mountain, and their colleagues examined mitochondrial DNA and parts of the Y chromosome from 49 Hadzabe and about 60 people from three other Tanzanian populations. They also gathered Y chromosome data from a San group, the Ju|'hoansi (also known as the !Kung) from Namibia and Botswana, and two non–click-speaking groups in central Africa.

Silent stalkers. !Kung hunters may use clicks while sneaking up on prey in the savanna.

Similar patterns in certain DNA segments indicate relatedness—and the Hadzabe and San turned out not to be closely related at all. The genetic sequences suggest that the two went separate ways very early on in their histories; neither group had migrated recently either northward or southward to bring clicks to the other. "The research suggests that the Hadzabe are the descendants of one of the first groups to split off" from an ancient pool of click speakers, says Crawhall.

Some researchers think the split between the Hadzabe and all other click speakers could have been as early as 100,000 years ago, but Knight puts it between 70,000 and 50,000 years ago. That's roughly the time frame proposed for the exodus of modern humans out of Africa, which some say might have been spurred by the development of language itself. But Knight warns that the dating is the most tentative part of their study.

Such an early origin for clicks appeals to linguist Michael Corballis of the University of Auckland, New Zealand, who has argued for years that 100,000 years ago, our only "words" were gestures: a flick of a finger, a twirl of the wrist, and so on (see p. 1316). "It may be that clicks themselves date back to a time when language was not autonomously vocal; they were a kind of [preverbal] way of adding sound," or a steppingstone to human speech, he says.

Knight thinks that only groups that retained ancestral hunting lifestyles continued to need clicks, and other click languages died out when early humans moved into new environments. That fits with evidence from living Hadzabe, who told Knight that when they hunt, they use clicks—and verbal talk disappears. Filmmaker John Marshall of Documentary Educational Resources in Watertown, Massachusetts, who has made dozens of films of click speakers, has noted this too. "I know from experience that using only clicks to communicate works well when stalking game," he explains. He and Knight suggest that whereas voices can spook animals, clicks mimic rustling grass, a typical sound on the dry savanna and one less likely to send game running.

Plausible as it all sounds, the theory of clicks as the first language is by no means proven. Even though Knight's work expands on Sands's ideas about the history of clicks, she's worried that Knight may be pushing his data too far. Genetic and language evolution don't necessarily go hand in hand. "The most he can say is that [the two] are correlative," she says. Thus there's no way to prove whether clicks made up the mother tongue, she argues.

Meanwhile, some researchers, such as linguistic historian Christopher Ehret of the University of California, Los Angeles, still stand by Greenberg's all-inclusive family for the click languages and downplay the genetic data. Furthermore, whereas most researchers insist that all clicks stem ultimately from the same ancestral tongue, Sands wonders whether clicks might have evolved several times, with Damin in Australia and Hadzane as examples. "Clicks are part of the normal language mechanism that people have," Sands notes, and children make clicks as they are learning to speak.

All agree that nothing can be settled without more work. Knight and Mountain are seeking DNA from more groups, and Sands and Crawhall are scrambling to bag more click languages for the linguists' portfolio. Sands worries that they can't work fast enough; one group has just 10 speakers left. But as the data stream in, Knight remains optimistic. "In the year 2000, we didn't know anything compared to what we know now," he says.

—ELIZABETH PENNISI

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