HUMAN EVOLUTION

How we tamed ourselves—and became modern

'Self-domestication' turned humans into the cooperative species we are today

By **Ann Gibbons**, *in San Diego, California*

Call a man "tame" or "domesticated" and he's not likely to take it as a compliment. But all of us, male and female, may have to get used to it: Some scientists believe that "self-domestication" was key to the evolution of our species. At a meeting here earlier this month, they argued that with our reduced jaws, flat faces, and lower male aggression, humans are as tame as many of the animals we live with. Like dogs, cows, and horses, we show many of the physical traits that emerge during animal domestication. The accompanying changes in behavior, especially among men, might have helped humans evolve more complex language, live atop each other in cities, and work together to create sophisticated cultures.

No one set out to domesticate humans, of course. But at the first-ever symposium on self-domestication of humans (see http://carta.anthropogeny.org/symposia/past_list), held here at the Salk Institute for Biological Studies, researchers outlined a set of linked behavioral and anatomical changes seen in animals that humans have tamed as well as in creatures that have tamed themselves. In the course of evolution, some animals have overcome the fear and stress they feel when encountering humans or unfamiliar members of their own species and become less aggressive. Bonobos, for example, are much less aggressive with each other than are their chimpanzee relatives, researchers noted. Other species may have tamed themselves to live alongside humans, such as seals and ancient cats.

Researchers at the symposium proposed that something similar happened as human ancestors began to live in closer quarters, relying more on each other and on wider social networks to survive. By favoring more tolerant, less antagonistic individuals, natural selection reshaped both our behavior and our appearance. "The hypothesis that humans may have domesticated themselves … has the potential to solve many of the long-standing problems of human evolution," says linguist Robert Kluender of the University of California, San Diego.

The view of humans as domesticated dates back to 1871, when Charles Darwin wrote that "[m]an in many respects may be compared with those animals which have long been domesticated." Darwin also was the first to discover that selective breeding for tameness produced similar side effects in different animals, including smaller brains.

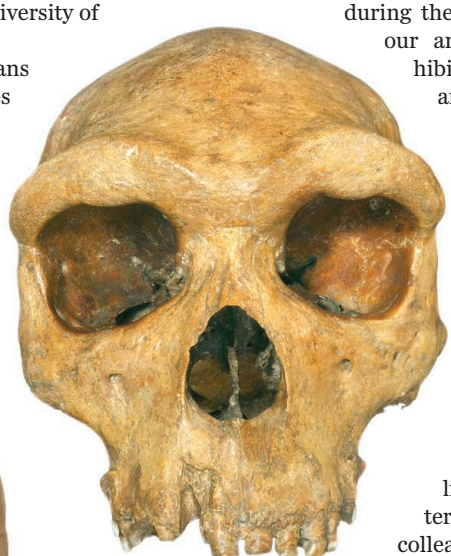
Since Darwin's time, others have confirmed and expanded upon his observations, identifying the elements of a "domestication syndrome." In a renowned study started back in the 1950s, Russian researchers found that captive silver foxes bred for tameness also exhibited a suite of other traits, such as white patches of fur on their heads, curly tails, "feminized" faces with shorter snouts and floppy ears, and skulls in males that weren't much larger than in females. "Just by choosing foxes that were less nasty, they got a suite of other changes," says cognitive biologist Tecumseh Fitch of the University of Vienna.

In a study in *Current Anthropology* in August, paleoanthropologist Robert Franciscus of the University of Iowa in Iowa City and his colleagues identified some of the same changes in recent human evolution. The team analyzed the projection of the brow ridge, facial shape, and cranial volume of 13 early *Homo sapiens* that lived before 80,000 years ago; 41 modern humans that lived 38,000 to 10,000 years ago; and skulls from a global sample of 1367 recent humans. They found that brow ridges shrank and faces shortened during the past 80,000 years, as our ancestors began to exhibit symbolic behavior and spread around the world. Cranial volume also diminished, particularly after the invention of agriculture about 10,000 years ago.

All of these changes tend to make male faces look more like female ones, Franciscus noted at the meeting, and are linked to lower testosterone levels. He and his colleagues proposed that selection for higher levels of social tolerance led to lower levels of testosterone and stress hormones, especially in males, and thus facial feminization. Studies of dog DNA have shown that the genes that regulate aggression affect development of facial shape, he reported at the meeting.

Other speakers proposed that all of these traits, from hormone levels to craniofacial features, have a common root in early embryonic development. Fitch and co-authors Richard Wrangham of Harvard University and Adam Wilkins of Humboldt University in Berlin, who proposed their theory in July in *Genetics*, point out that these traits are controlled by so-called neural crest cells, which in vertebrate embryos form a neural tube along the spine. As development proceeds, neural crest cells break away, migrating from head to toe to form tissues involved in pigmentation, muscles, teeth, bone, cartilage, and adrenal glands, which produce stress hormones as well as testosterone.

The team proposed that this process is



Big brow ridges and teeth suggest that ancient *Homo heidelbergensis* (*above*) may have had more testosterone than modern *Homo sapiens* (*left*).

PHOTOS: THE NATURAL HISTORY MUSEUM/ALAMY (2)

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drawn out in domesticated animals, because domestication selects for animals that develop more slowly. Very young animals—2- to 3-month-old puppies, for example—are naturally less fearful and produce less stress hormones. During that time, puppies exposed to friendly humans can learn to cooperate with people. Prolonging that period of development favors such learning, crucial to domestication. Other studies at the meeting confirmed that domestication lengthens development, with important consequences for behavior. For example, young domesticated Bengalese finches have a longer window of song learning and so can learn more complicated songs than their wild progenitors, reported biopsychologist Kazuo Okanoya of the University of Tokyo.

But slower development also means that fewer neural crest cells reach their destinations, Fitch and colleagues argue. This affects everything from the adrenal glands to coloration of the fur on the face or tail and lengthening of the snout, creating the domestication syndrome, Fitch said. It would also explain why so many domesticated animals exhibit "neoteny": They retain juvenile traits as adults. Mature dogs look like wolf pups, and humans look more like chimp infants than chimp adults, researchers noted at the meeting.

In his talk, Wrangham argued that natural selection triggered just such a process of delayed development and reduced aggression in humans. Ethnologists have observed that hunter-gatherers kill men who steal wives or kill others. As social ties became more important to survival, Wrangham thinks, human ancestors may have inflicted the same kind of capital punishment, weeding out males who acted with intense and confrontational aggression. This doesn't mean that humans are not "a dastardly species," capable of war and torture, he noted, only that selection favored males who could work together, whether for peaceable ends or to carry out "low-arousal" or coalitional aggressive acts such as war.

Others were intensely interested in this idea, but urged more tests. Fitch was among the first to point out the problems with his own team's theory: Humans and bonobos don't seem to have all the traits of the domestication syndrome—no floppy ears or white facial patches for us. A mechanism other than delayed development of the neural crest therefore may explain some features of domestication in humans and bonobos. "It's very daring to talk about the self-domestication syndrome," Fitch says. "The hard work is figuring out how to test it." ■

MIGRATIONS

Epic pre-Columbian voyage suggested by genes

South American DNA found in Easter Islanders

By **Andrew Lawler**

Polynesians from Easter Island and natives of South America met and mingled long before Europeans voyaged the Pacific, according to a new genetic study of living Easter Islanders. In this week's issue of *Current Biology*, researchers argue that the genes point to contact between Native Americans and Easter Islanders before 1500 C.E., 3 centuries after Polynesians settled the island also known as Rapa Nui, famous for its massive stone statues. Although circumstantial evidence had hinted at such contact, this is the first direct human genetic evidence for it.

In the genomes of 27 living Rapa Nui islanders, the team found dashes of European and Native American genetic patterns. The European genetic material made up 16% of the genomes; it was relatively intact and was unevenly spread among the Rapa Nui population, suggesting that genetic recombination, which breaks up segments of DNA, has not been at work for long. Europeans may have introduced their genes in the 19th century, when they settled on the island.

Native American DNA accounted for about 8% of the genomes. Islanders enslaved by Europeans in the 19th century and sent to work in South America could have carried some Native American genes back home, but this genetic legacy appeared much older. The segments were more broken and widely scattered, suggesting a much earlier encounter—between 1300 C.E. and 1500 C.E.

But did Polynesians land on South American beaches, or did Native Americans sail 3500 kilometers into the Pacific to reach Rapa Nui? "Our studies strongly suggest that Native Americans most probably arrived [on Rapa Nui] shortly after the Polynesians," says team member Erik Thorsby, an immunologist at the University of Oslo. He thinks that could support the controversial theory, posited by Norwegian adventurer Thor Heyerdahl more than a half-century ago, that Native Americans had the skills to move west across the Pacific.

But many scientists say that Pacific currents and Polynesian mastery of the waves make it more likely that the Polynesians were the voyagers. They may have sailed to South America, swapped goods for sweet potatoes and other novelties—and returned to their island with South American women.

Sweet potato was domesticated in the Andean highlands, and researchers recently determined that the crop spread west across Polynesia before Europeans arrived (*Science*, 11 June 2010, p. 1344). Another hint of trans-Pacific exchange comes from chicken bones—unknown in the Americas before 1500 C.E.—excavated on a Chilean beach, which some believe predate Christopher Columbus.

Skeptics say that genetic evidence from modern human populations is not enough to prove ancient contact. The genetic clock is often uncertain, says anthropologist Carl Lipo Lipo of California State University, Long Beach. "We need ancient DNA from skeletal evidence—not modern evidence—to resolve this question." ■

Wooden canoes like this one from Easter Island may have brought Native Americans and Polynesians together.

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