The secret to chimp strength

March 30 2009

February's brutal chimpanzee attack, during which a pet chimp inflicted devastating injuries on a Connecticut woman, was a stark reminder that chimps are much stronger than humans—as much as four-times stronger, some researchers believe. But what is it that makes our closest primate cousins so much stronger than we are? One possible explanation is that great apes simply have more powerful muscles. Indeed, biologists have uncovered differences in muscle architecture between chimpanzees and humans. But evolutionary biologist Alan Walker, a professor at Penn State University, thinks muscles may only be part of the story.

In an article to be published in the April issue of *Current Anthropology*, Walker argues that humans may lack the strength of chimps because our nervous systems exert more control over our muscles. Our fine motor control prevents great feats of strength, but allows us to perform delicate and uniquely human tasks.

Walker's hypothesis stems partly from a finding by primatologist Ann MacLarnon. MacLarnon showed that, relative to body mass, chimps have much less grey matter in their spinal cords than humans have. Spinal grey matter contains large numbers of motor neurons—nerves cells that connect to muscle fibers and regulate muscle movement.

More grey matter in humans means more motor neurons, Walker proposes. And having more motor neurons means more muscle control.

Our surplus motor neurons allow us to engage smaller portions of our muscles at any given time. We can engage just a few muscle fibers for

delicate tasks like threading a needle, and progressively more for tasks that require more force. Conversely, since chimps have fewer motor neurons, each neuron triggers a higher number of muscle fibers. So using a muscle becomes more of an all-or-nothing proposition for chimps. As a result, chimps often end up using more muscle than they need.

"[A]nd that is the reason apes seem so strong relative to humans," Walker writes.

Our finely-tuned motor system makes a wide variety of human tasks possible. Without it we couldn't manipulate small objects, make complex tools or throw accurately. And because we can conserve energy by using muscle gradually, we have more physical endurance—making us great distance runners.

Great apes, with their all-or-nothing muscle usage, are explosive sprinters, climbers and fighters, but not nearly as good at complex motor tasks. In other words, chimps make lousy guests in china shops.

In addition to fine motor control, Walker suspects that humans also may have a neural limit to how much muscle we use at one time. Only under very rare circumstances are these limits bypassed—as in the anecdotal reports of people able to lift cars to free trapped crash victims.

"Add to this the effect of severe electric shock, where people are often thrown violently by their own extreme muscle contraction, and it is clear that we do not contract all our muscle fibers at once," Walker writes. "So there might be a degree of cerebral inhibition in people that prevents them from damaging their muscular system that is not present, or not present to the same degree, in great apes."

Walker says that testing his hypothesis that humans have more motor neurons would be fairly straightforward. However, he concedes that

testing whether humans have increased muscle inhibition could be a bit more problematic.

Source: University of Chicago (news : web)