Unexpectedly speedy expansion of human, ape cerebellum

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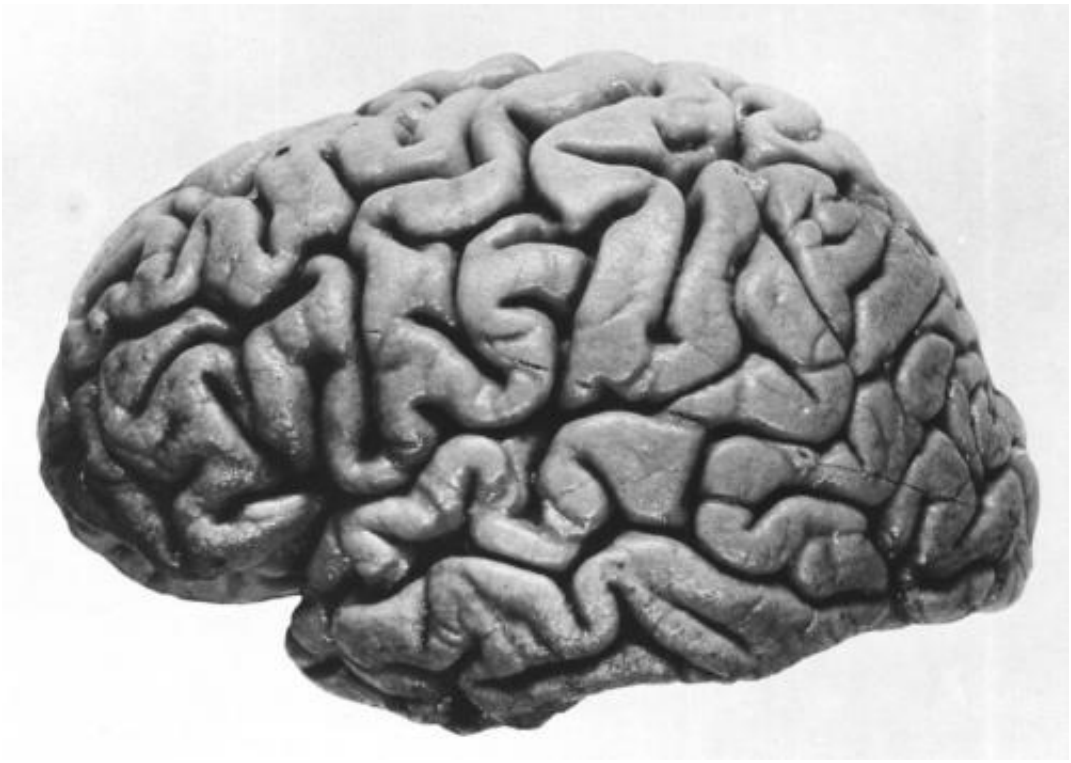

Left hemisphere of J. Piłsudski's brain, lateral view. Credit: public domain

A new study published in the Cell Press journal *Current Biology* on October 2 could rewrite the story of ape and human brain evolution. While the neocortex of the brain has been called "the crowning achievement of evolution and the biological substrate of human mental prowess," newly reported evolutionary rate comparisons show that the

cerebellum expanded up to six times faster than anticipated throughout the evolution of apes, including humans.

The findings suggest that technical intelligence was likely at least as important as social intelligence in human cognitive evolution, the researchers say.

"Our results highlight a previously unappreciated role of the cerebellum in ape and human brain evolution that has the potential to refocus researchers' thinking about how and why the brains in these species have become distinct and to shift attention away from an almost exclusive focus on the neocortex as the seat of our humanity," says Robert Barton of Durham University in the United Kingdom.

The cerebellum had been seen primarily as a brain region involved in movement control, adds Chris Venditti of the University of Reading. But more recent evidence has begun to suggest that the cerebellum has a broader range of functions. The cerebellum also contains an intriguingly large number of densely packed neurons.

"In humans, the cerebellum contains about 70 billion neurons—four times more than in the neocortex," Barton says. "Nobody really knows what all these neurons are for, but they must be doing something important."

The neocortex had gotten most of the attention in part because it is such a large structure to begin with. As a result, in looking at variation in the size of various brain regions, the neocortex appeared to show the most expansion. But much of that increase in size could be explained away by the size of the animal as a whole. Sperm whales have a neocortex that is proportionally larger than that of humans, for example.

By using a comparative method that controlled for those differences in

the way the two brain structures correlate, Barton and Venditti uncovered a striking pattern: both nonhuman apes and humans depart from the otherwise tight correlation in size between the cerebellum and neocortex found across other primates due to relatively rapid evolutionary expansion of the cerebellum.

Barton and Venditti say that the cerebellum seems to be particularly involved in the temporal organization of complex behavioral sequences, such as those involved in making and using tools, for instance. Interestingly, evidence is now emerging for a critical role of the cerebellum in language, too.

While plenty of work remains, the new study establishes the cerebellum as "a new frontier for investigations into the neural basis of advanced cognitive abilities," the researchers say.

More information: *Current Biology* Barton et al.: "Rapid evolution of the cerebellum in humans and other great apes." www.cell.com/current-biology/a … 0960-9822(14)01069-0

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