Wild cat brains: An evolutionary curveball

October 31 2016, by Andy Henion , Sharleen Sakai

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The brains of wild cats don't necessarily respond to the same evolutionary pressures as those of their fellow mammals, humans and primates, indicates a surprising new study led by a Michigan State University neuroscientist.

Arguably, the fact that people and monkeys have particularly large frontal lobes is linked to their social nature. But cheetahs are also social

creatures and their frontal lobes are relatively small. And leopards are solitary beasts, yet their frontal lobes are actually enlarged.

So what gives? Sharleen Sakai, lead investigator of the National Science Foundation-funded research, said the findings suggest that multiple factors beyond sociality may influence brain anatomy in carnivores.

"Studying feline brain evolution has been a bit like herding cats," said Sakai, MSU professor of psychology and neuroscience. "Our findings suggest the factors that drive brain evolution in wild cats are likely to differ from selection pressures identified in primate brain evolution."

Sakai and colleagues examined 75 wild feline skulls, representing 13 species, obtained from museum collections, including those at MSU. The researchers used computed tomography (CT) scans and sophisticated software to digitally "fill in" the areas where the brains would have been. From that process, they determined brain volume.

Sakai's lab is interested in uncovering the factors that influence the evolution of the carnivore brain. One explanation for large brains in humans and primates is the effect of sociality. The idea is that dealing with social relationships is more demanding than living alone and results in bigger brains, especially a bigger frontal cortex.

"We wanted to know if this idea, called the 'social brain' hypothesis, applied to other social mammals, especially carnivores and, in particular, wild cats," Sakai said.

Of the 13 wild feline species examined, 11 are solitary and two - lions and cheetahs - are social.

Here are some of the key findings of the research:

- Surprisingly, overall brain size did not differ, on average, between the social and solitary species of wild cats. But the part of the brain that includes the frontal cortex did differ between the two species.
- The female lion had the largest frontal cortex. Female lions are highly social, working together to protect and feed their young, hunt large prey and defend their territory. In contrast, males may live alone and may be dominant in a pride for only a few years. The larger frontal cortex in females compared to male lions and the other wild cats may reflect the lionesses' demands of processing social information necessary for life in the pride.
- The social cheetahs, in contrast, had the smallest overall brains and the smallest frontal cortex of the wild cats. Small brains weigh less and require less energy, factors that might contribute to the cheetah's remarkable running speeds. "Cheetah brain anatomy is distinctive and differs from other wild cats," Sakai said. "The size and shape of its brain may be a consequence of its unusual skull shape, an adaptation for high-speed pursuits."
- Leopards' frontal lobes were relatively large. Although the leopard is solitary, it is noted for its flexibility and adaptability - behaviors associated with enhanced brain processing and larger brain size in other species.

The study is published online in the journal *Frontiers in Neuroanatomy*.

Provided by Michigan State University