Big brains evolved due to capacity for exercise

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The relatively large size of the mammalian brain evolved due to a capacity for endurance exercise, researchers conclude in a recent study.

In the study published in the journal PLoS ONE this month, anthropologists David A. Raichlen of the University of Arizona and Adam D. Gordon of the University at Albany conclude that the brain size in mammals may have evolved in conjunction with increases in exercise capacity, rather than solely in response to natural selection for higher cognitive abilities.

Mammals have larger brains than non-mammalian animals of the same body size; primates (apes, monkeys, humans, lemurs, and lorises) have larger brains than non-primate mammals of the same body size; and humans have larger brains than non-human primates of the same size. Anthropologists have long attempted to discern the reasons humans and other primates have relatively large brains compared to other animals species. The theories offered include the need for greater cognitive power to process visual information, and an increased capacity to manage complex social interactions in large groups.

Gordon said, "Brains are very energetically expensive to maintain, so most previous research has asked why certain species need big, expensive brains. We're asking a slightly different question: how do species grow and maintain expensive big brains in the first place?"

Earlier research in experimental settings had shown that endurance

exercise boosts brain growth in some mammals. Controlling for associations with body size, the researchers examined the correlation between brain size and a metric known as the maximum metabolic rate (MMR), the measurement of the limit for aerobic exercise frequency and capacity. By collecting brain sizes and MMRs in mammals, they analyzed the relationship between body mass and the correlation of residual brain size to residual MMR. They found a significant correlation between maximum metabolic rate and brain size across a wide range of mammals.

"What we discovered," Gordon said, "is that across distantly related mammal species, those with relatively high capacities for endurance exercise have relatively large brains, while those with relatively low capacities for endurance exercise have relatively small brains. This suggests that the phenomenon observed in experimental lab settings may work on an evolutionary time scale as well."

The next step, the researchers say, is to test the brain-to-exercise relationship in primates, including humans, and determine the underlying mechanism for the brain's growth.

More information: Relationship between Exercise Capacity and Brain Size in Mammals. *PLoS ONE* 6(6): e20601. doi:10.1371/journal.pone.0020601

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