September 4, 2017

Food for thought: recipe for bigger brains

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This Break was edited by Max Caine, *Editor-in-chief* - TheScienceBreaker

There are hundreds of species of primates spread all across the globe that vary greatly in both brain size and intelligence. At the extremes, the great apes (our closest living relatives) have brains that are slightly larger than those of newborn humans, while mouse lemurs have brains less than 1/100th of that size. And although some species are very innovative, have strong self-control, display impressive spatial memory, and/or use many different types of tools, there are many other species which do not possess these skills.

Many hypotheses have been put forth in an attempt to explain why some species have evolved large brains, specifically those whose brains are larger than expected for their body size. Animals with larger bodies tend to have larger brains because they require more processing power for maintenance and control of bodily functions. Part of what makes humans unique is the fact that we have the largest brains relative to the size of our bodies (a.k.a. relative brain size). Our brains themselves are nowhere near the largest in the animal kingdom - think elephants and whales, for example.

The earliest ideas about what drove some species to have relatively large brains were focused on diet. Most primate species eat primarily fruit or leaves, and some also incorporate insects or small animals. Since fruit is clumped in time and space, and often requires extraction from protective skins, researchers suggested that fruit-eating may require greater cognitive complexity and flexibility than leaf-eating. Furthermore, fruit is a relatively higher quality food source, which could help compensate for some of the energetic costs associated with having a larger brain.

Over the past few decades, however, the prevailing idea has been that increased social complexity is what drives primate brains to become larger - also known as the *social brain hypothesis*. Researchers supported this idea with studies showing that primate species living in larger groups have relatively larger brains. Other studies also claimed to show that species with the most socially complex systems should have relatively larger brains; however, studies disagreed as to whether monogamous species or polygynandrous (multi-male multi-female) species have more complex systems and relatively larger brains.

We set out to resolve the following contradictions with a new study. First, does diet or sociality (or both) explain differences in relative brain size across primates? Second, do species with certain mating systems have relatively larger brains than those with other systems? The main problem seemed to be that not many species (i.e. less than 50) were included in most of the older studies, so we collected data from over 140 primate species. We also utilized the newest statistical techniques to see if that impacted the results. Humans were not included in our study because our brains are so exceptionally large. We also do not have a clear average group size or mating system (i.e. not all human societies consider monogamy to be the norm).

We found that primate species that eat higher quality, harder to find foods, such as fruit and/or small animals, have relatively larger brains than those that eat leaves, a low quality and abundant food source. Moreover, our results also indicate that species with larger group sizes do not have relatively larger brains, and that different mating systems do not explain differences in relative brain size across species. These findings not only refuted one of the main predictions of the social brain hypothesis, but also supported the older ideas about the influence of diet on primate brain size evolution. Given that primates often deal with ecological challenges within social contexts, it is likely that selective pressures from both the physical and social environments impacted primate brain evolution.

As for us humans, it's a bit harder to tease apart what initially drove the evolution of our huge brains, but the results from our study suggest that diet may have played at least as strong of a role as social factors. Human evolution is marked by an increase in meat and seafood consumption. These are not only high quality foods, but the technology required to hunt for and cook them demands complex cognitive abilities. It's possible that selection for technological intelligence related to obtaining such foods came first, with associated neurological changes providing the scaffolding for the subsequent development of complex social skills.