Big brains are all in the genes

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Scientists have moved a step closer to understanding genetic changes that permitted humans and other mammals to develop such big brains.

During evolution, different mammal species have experienced variable degrees of expansion in brain size. An important goal of neurobiology is to understand the genetic changes underlying these extraordinary adaptations.

The process by which some species evolved larger brains – called encephalization – is not well understood by scientists. The puzzle is made more complex because evolving large brains comes at a very high cost.

Dr Humberto Gutierrez, from the School of Life Sciences, University of Lincoln, UK, led research which examined the genomes of 39 species of mammals with the aim of better understanding how brains became larger and more complex in mammals.

To do this, the scientists focussed on the size of gene families across these species. Gene families are groups of related genes which share similar characteristics, often linked with common or related biological functions. It is believed that large changes in the size of gene families can help to explain why related species evolved along different paths.

The researchers found a clear link between increased brain size and the expansion of gene families related to certain biological functions.

Dr Gutierrez said: "We found that brain size variations are associated with changes in gene number in a large proportion of families of closely related genes. These gene families are preferentially involved in cell communication and cell movement as well as immune functions and are prominently expressed in the human brain. Our results suggest that changes in gene family size may have contributed to the evolution of larger brains in mammals."

Mammalian species in general tend to have large brains compared to their body size which represent an evolutionary costly adaptation as they require large amounts of energy to function.

Dr Gutierrez explained: "The brain is an extremely expensive organ consuming a large amount of energy in proportion to its volume, so large brains place severe metabolic demands on animals. Larger brains also demand higher parental investment. For example, humans require many years of nurturing and care before their brains are fully matured."

Dr Gutierrez's research concluded that variations in the size of gene families associated with encephalization provided an evolutionary support for the specific physiological demands associated with increased brain size in mammals.

More information: 'Increased brain size in mammals is associated with size variations in gene families with cell signalling, chemotaxis and immune-related functions' Humberto Gutiérrez, Atahualpa Castillo-Morales, Jimena Monzón-Sandoval and Araxi O. Urrutia, *Proc. R. Soc. B* 2014 281, 20132428, published 27 November 2013, rspb.royalsocietypublishing.or … 132428.full.pdf+html

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