You need this hole in the head—to be smart

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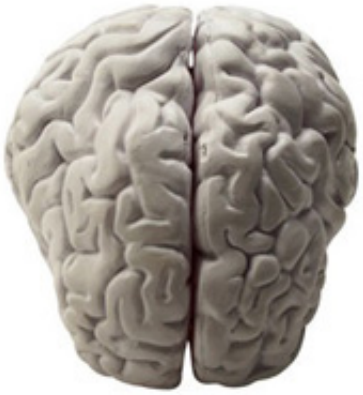

University of Adelaide researchers have shown that intelligence in animal species can be estimated by the size of the holes in the skull through which the arteries pass.

Published online ahead of print in the *Journal of Experimental Biology*, the researchers in the School of Biological Sciences show that the connection between intelligence and hole size stems from brain activity being related to brain metabolic rate.

"A human brain contains nearly 100 billion nerve cells with connections measured in the trillions," says project leader, Professor Emeritus Roger Seymour. "Each cell and connection uses a minute amount of energy but, added together, the whole brain uses about 20% of a person's resting

metabolic rate.

"It is not known how humans evolved to this state because direct measurements of brain metabolic rate have not been made in living monkeys and apes. However, we found that it is possible to estimate brain metabolic rate from the size of the arteries that supply the brain with blood.

"Arteries continually adjust their diameter to match the amount of blood that an organ needs by sensing the velocity next to the vessel wall. If it is too fast, then the artery grows larger, too slow and the artery shrinks. If an artery passes through a bone, then simply measuring the size of the hole can indicate the blood flow rate and in turn the metabolic rate of the organ inside."

Professor Seymour, and former Honours student Sophie Angove, measured the 'carotid foramina' (which allow passage of the internal carotid arteries servicing the brain) in primates and marsupials and found large differences.

"During the course of primate evolution, body size increased from small, tree-dwelling animals, through larger monkeys and finally the largest apes and humans," says Professor Seymour.

"Our analysis showed that on one hand, brain size increased with body size similarly in the two groups. On the other hand, blood flow rate in relation to brain size was very different. The relative blood flow rate increased much faster in primates than in marsupials.

"The significant result was that blood flow rate and presumably brain metabolic rate increased with brain volume much faster than expected for mammals in general. By the time of the great apes, blood flow was about 280% higher than expected.

"The difference between primates and other mammals lies not in the size of the brain, but in its relative metabolic rate. High metabolic rate correlates with the evolution of greater cognitive ability and complex social behaviour among primates."

Provided by University of Adelaide