'Selfish brain' wins out when competing with muscle power, study finds

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Lead researcher Dr Danny Longman rowing with the Cambridge University Boat Club. This is an example of the type and standard of the sample population used in the study. Credit: Danny Longman

Human brains are expensive - metabolically speaking. It takes lot of energy to run our sophisticated grey matter, and that comes at an

evolutionary cost.

Now, a new investigation into the immediate trade-off that occurs inside us when we have to think fast and work hard at the same time is the first to demonstrate that - while both are impaired - our mental ability is less affected than our physical capacity.

Researchers say that the findings suggest a "preferential allocation of glucose to the brain", which they argue is likely to be an evolved trait - as prioritising quick thinking over fast moving, for example, may have helped our species survive and thrive.

Scientists from the University of Cambridge's PAVE (Phenotypic Adaptability, Variation and Evolution) research group tested 62 male students drawn from the University's elite rowing crews. The participants had an average age of 21.

The rowers performed two separate tasks: one memory, a three minute word recall test, and one physical, a three minute power test on a rowing machine.

They then performed both tasks at once, with individual scores compared to those from previous tests. As expected, the challenge of rowing and remembering at the same time reduced both physical and mental performance.

However, the research team found that change in recall was significantly less than the change in power output.

During the simultaneous challenge, recall fell by an average of 9.7%, while power fell by an average of 12.6%. Across all participants the drop in physical power was on average 29.8% greater than drop in cognitive function.

The team say the results of their new study, published today in the journal *Scientific Reports*, add evidence to the 'selfish brain' hypothesis: that the brain has evolved to prioritise its own energy needs over those of peripheral organs, such as skeletal muscle.

"A well-fuelled brain may have offered us better survival odds than well-fuelled muscles when facing an environmental challenge," said Dr Danny Longman, the study's lead author from the PAVE team in Cambridge's Department of Archaeology.

"The development of an enlarged and elaborated brain is considered a defining characteristic of human evolution, but one that has come as a result of trade-offs.

"At the evolutionary level, our brains have arguably cost us decreased investment in muscle as well as a shrunken digestive system.

"Developmentally, human babies have more stored fat than other mammals, acting as an energy buffer that feeds our high cerebral requirements.

"On an acute level, we have now demonstrated that when humans simultaneously experience extremes of physical and mental exertion, our internal trade-off preserves cognitive function as the body's priority."

The adult brain derives its energy almost exclusively from the metabolism of glucose. Yet skeletal muscle mass is also energetically expensive tissue, accounting for 20% of the human male 'basal metabolic rate' - the energy used when doing nothing.

Longman says a limited supply of blood glucose and oxygen means that, when active, skeletal muscle becomes a "powerful competitor" to the brain. "This is the potential mechanism for the fast-acting trade-off in

brain and muscle function we see in just a three minute window."

"Trade-offs between organs and tissues allow many organisms to endure conditions of energy deficit through internal prioritising. However, this comes at a cost," said Longman.

He points to examples of this trade-off in humans benefiting the brain. "The selfish nature of the brain has been observed in the unique preservation of brain mass as bodies waste away in people suffering from long-term malnutrition or starvation, as well as in children born with growth restriction."

More information: Daniel Longman et al, A trade-off between cognitive and physical performance, with relative preservation of brain function, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-14186-2

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