

Larger brains cause a change in personality

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Large animals have large brains, a relationship which is clear across all vertebrates. However, humans, like corvids and dolphins, have larger brains than expected when compared with the size of their body (relative brain size). Evolutionary biologists have long been asking themselves what the causes and effects of such an increase in brain size are. Species with relatively large brains often appear to be more intelligent. However, increasing brain size also comes at a cost: the brain consumes a lot of energy (the human brain uses 15 Watts, or enough to light a dim lightbulb!), and the extra energy necessary to fuel a larger brain must be taken from somewhere else. In that sense, a larger brain may mean a smaller digestive tract, smaller muscles, less fat resources, or fewer offspring. These are called 'trade-offs': a larger brain may allow an animal to act in a more complex way, but it could also reduce their survival or reproduction.

Biologists have studied the effects of brain size mainly by comparing species. Unfortunately, many related factors may confound this data. Now, a group led by Niclas Kolm at the University of Uppsala has devised a way to study the evolution of brain size as it could happen within a species. To do this, they took a population of guppies and artificially selected three groups for large relative brain size, and three other groups for small relative brain size. Within a few generations, the brains of the large-brained group weighed 10% more than those of the small-brained group.

Having obtained guppies with small brains and guppies with large brains, the group studied the effects of this difference in brain size. First, they looked for trade-offs with movement: did the energy the large-brained fish invested in their brains come at the expense of their ability to swim quickly? In order to test this, researchers compared the fish's sprinting speed, endurance performance, and ability to escape a predator. Next, the behaviour of the fish was considered: how did brain size affect their personality? Animal personality is typically studied by placing animals along 5 axes of behaviour: shy-bold, avoidant-explorative, inactive-active, aggressive-passive, and social-asocial. In this case, the boldness, exploration, and activity levels of the guppies were tested.

The results were surprising: although fish with larger brains were equally good at swimming, their swimming behavior was different! Large-brained females were bolder and more explorative than small-brained females, with males of both brain sizes in between. The large-brained females, when confronted with a scary, unknown area, displayed less fear behaviour (boldness) and covered more of the space (exploration). The increased boldness and exploration in large-brained females correspond well with other experiments on the guppies, which showed that large-brained females are better at learning, have strong habits, tend to lead in social situations, and have low stress responses. Together, these factors determine a 'proactive' response to stress, as opposed to a 'reactive' response in small-brained females. Proactive and reactive response types have been found in many different species of animals, including other fish and birds.

That selection on brain size caused a change in personality has important evolutionary ramifications, because it means that (smarter) animals with larger brains may react differently to different situations. In turn, these reactions can influence their reproduction and survival – for example, bolder guppies are better able to escape predation. Thus, selection on intelligence could have a host of other effects on the animal. In further experiments, the Kolm Lab will untangle those effects, casting a new light on the evolution of large brains – including our own.

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