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Tool-using rodents rake in rewards

By teaching rodents to use tools, RIKEN researchers can now more easily study the neural and molecular bases for learning.

The first report of a rodent trained in the laboratory to use tools has shattered standard conceptions that only a select group of "higher animals" such as primates and some birds possess such a capacity. In the first study of its kind, researchers from RIKEN's Brain Science Institute, led by Dr. Atsushi Iriki, have reported, in the March 2008 issue of *PLoS ONE*, that functional understanding of tools may have a wider incidence among animals than previously suspected.

Tool use, as defined within this study, focuses on the functional manipulation of an inanimate object to specifically change the position or form of a second object. One hypothesis holds that the expansion of cognitive ability in early humans was accelerated, if not catalyzed, by their active use of tools. Indeed, early descriptions of human cognitive superiority invoked our "unique" ability to understand and use tools. But, because tool use has been observed in nature - among primates, birds and other animals - such "simplified" views have now given way to more complicated rationales for the wide cognitive divide between humans and animals. Unfortunately, there is considerable debate about precisely how human cognition differs from that of animals; little is actually known and much is conjectured.

Studies focusing on tool use behavior in nature have been limited in scope and cannot address the specific architectural modifications within the brain that are thought to not only accompany but also to facilitate and amplify tool use ability. Precisely controlled experiments with macaque monkeys trained to use tools have already revealed that these monkeys had developed novel brain circuit reorganizations. To overcome the experimental limits inherent within non-human primate investigations, the RIKEN team decided to extend such studies to a rodent model.

The rodent they selected, the degu, is a highly social, naturally curious, chinchilla-like animal native to Chile that, critically, exhibits the manual dexterity and forelimb-eye coordination requisite for tool use. To test and train the degus, the scientists used a simple conditioning approach similar to that traditionally used with non-human primates.

Five adult degus were placed in a chamber containing a transparent fence that separated the animal from a favorite food - a sunflower seed - positioned just out of reach. The animals soon learned that a rake, placed within their reach, could be used to access the seeds. Over a two-month period, the degus were specifically trained, under increasingly more difficult conditions, to use the rake as a tool to obtain the seeds, eventually becoming adept at manipulating the utensil with their forelimbs.

Further trials with four of the five animals demonstrated that they were not unduly influenced by tool properties unrelated to functionality and could distinguish between functional and useless tools - the animals may have understood the functional significance of the tools by forming mental representations of these implements. The scientists propose that the origins of tool use should be recalibrated as arising from the combination of general cognitive faculties rather than from a singular higher cognitive function. They will next begin to address the many intriguing questions raised by this study, beginning with an analysis of expected changes in brain circuitry connection patterns in the trained degu brain. With their new rodent paradigm, the RIKEN researchers are poised to unlock the molecular secrets of brain architectural plasticity underlying learning.

The team's findings challenge the thesis of a specific prerequisite for high cognitive aptitude in tool use, and have expanded our understanding of the cognitive abilities shared between humans and animals, bringing us closer to explaining the yawning cognitive chasm between 'us' and 'them.'

Original work:

Okanoya, K., Tokimoto, N., Kumazawa, N., Hihara, S., Iriki, A.
PLoS ONE, Tool-Use Training in a Species of Rodent: The Emergence of an Optimal Motor Strategy and Functional Understanding

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