

Neural mechanisms of abstract learning

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A new study provides intriguing insight into the way that humans approach novel situations. The research, published in the April 29 issue of the journal *Neuron*, reveals neural mechanisms that underlie our remarkable ability to discover abstract cognitive relationships when dealing with new problems.

It is clear that explicit prior experience is often not required for success in novel situations. For example, we can rapidly work out an unusual mechanism for completing a task, such as opening a door by pulling a rope rather than turning a knob, even without prior experience using that particular mechanism. "This type of ability depends on the discovery of abstract relationships between context and action that are not dependent on a concrete one-to-one mapping between a stimulus and response," explains study coauthor, Dr. David Badre from the Department of Cognitive and Linguistic Sciences at Brown University.

Although it is well established that the frontal cortex supports concrete rule learning, the [neural mechanisms](#) that underlie acquisition of abstract rules are not as clear. "There is some evidence that the frontal cortex might be organized in a front to back (known as "rostro-caudal") hierarchy in which neurons located in the anterior region of the frontal cortex process progressively more abstract representations," says coauthor Dr. Andrew Kayser from the Department of Neurology at the University of California, San Francisco.

To test this hypothesis, the researchers used [functional magnetic resonance imaging](#) (fMRI) to study participants during two learning

tasks, one concrete and one that provided study participants with an opportunity to acquire an abstract rule. "We found that more anterior regions along the rostro-caudal axis of the frontal cortex supported rule learning at higher levels of abstraction," says Dr. Badre.

Based on their observations, the authors suggest that when encountering a novel situation, we may search for relationships between context and action at multiple levels of abstraction simultaneously, a capability that may underlie our remarkable behavioral adaptability and our capacity to generalize our past [learning](#) to new problems. "How we address novel problems in reasoning, decision-making, and selecting action under uncertainty may very well reflect both the adaptability and the constraints conferred by the basic functional organization of the [frontal cortex](#)," concludes Dr. Kayser.

More information: D'Esposito et al.: "Frontal Cortex and the Discovery of Abstract Action Rules." Publishing in Neuron 66, 315-326, April 29, 2010. [DOI:10.1016/j.neuron.2010.03.025](https://doi.org/10.1016/j.neuron.2010.03.025)

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