

Rats climbing up walls for science

By Claire Trageser, San Diego News Network
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Stephen Cowen's rats have some important decisions to make.

For up to three hours a day, these red-eyed rodents are let loose on a maze that asks them to choose how much effort to put in to earn a reward — in this case, a cup of liquid Ensure also known as a high protein drink. The rats can climb over a large barrier to earn more Ensure, or skip the barrier and earn a smaller reward.

Although the exercise might seem like a strange animal mind game, Cowen, a scientist at The Neurosciences Institute in La Jolla, uses it to study how the rats' brains work as they make these decisions. He said the results will help him bring understanding to a big unanswered question in neuroscience: How does the brain weigh costs and benefits in making decisions?

Using an easy-to-construct maze with a series of doors, Cowen trains the rats to learn that certain doors lead to more food than others, and that some doors conceal a large barrier that must be climbed atop in order to reach the food.

Once the rats have figured out which door leads where, Cowen changes things up. He moves the barrier to a different door and switches the doors that lead to different amounts of Ensure. As the rats realize their previous associations with each door are no longer true, Cowen studies the activity in a part of the brain called the frontal cortex.

"The frontal cortex seems to be very important to our ability to adapt, to flexibly change strategies when outcomes change," he said. "When you suddenly have to take some habit, some association you've learned, and reverse it, that's when the higher center of brain is important to this kind of cognitive flexibility."

Cowen's theory is that neurons in the frontal cortex, which he calls the "central executive" or "decider of the brain," respond to a far greater variety of stimuli than the rest of the brain. This variety allows the frontal cortex to make quick associations between different regions of the brain, which helps us make snap



Stephen Cowen holds one of his maze running rats.
(Photo by Claire Trageser)

decisions and judgments.

“In the frontal cortex, the brain’s typical organization appears to break down,” he said. “There a neuron that signals reward from eating something might be right next to a neuron for an auditory cue. There is a great deal of variety of responses, which is critical for an area that is the integration zone.

“That variety is needed to make flexible decisions, because the brain needs to rapidly form new connections with very different neurons,” he said.

Cowen attaches electrodes to the rats’ brains as they go through their exercise regimen to collect data to support this theory. While his results won’t be published for at least six months, Cowen said that his findings already support this conclusion.

The primary motivation for Cowen’s work is to find out more about a mysterious part of the brain, but he said it could also be used to help people whose decision-making capabilities might be damaged.

“Things like chronic gambling might come from the brain’s inability to weigh costs with benefits, so understanding more about that could lead to new forms of treatment,” he said.

Although he has no immediate plans for studies on gambling disorders or other decision-making deficits, he said he would be interested in collaborating with other scientists in human studies. Those studies, however, would likely require a better reward than Ensure — and a much larger maze.

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