Location, location, location!

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It's a classic upper middle class dilemma: Should we buy a perfect second home in a place that takes hours to get to, or should we settle for something closer but not as nice? In the rodent world, an equivalent decision-making situation might be, "Was the food I liked better down this alley or over there?"

By discovering that particular rat brain neurons combine or "integrate" dissimilar pieces of information (e.g. location versus reward), researchers have begun to learn how the brain controls decision-making and goal-oriented behaviors. Examples of these include foraging and navigation in animals and--in humans--whether to buy a particular second home or, in general, whether to favor a long-term benefit over immediate gratification.

Led by Dr. Zach Mainen of Cold Spring Harbor Laboratory on Long Island, the study represents the first time that brain neurons have been shown to integrate spatial and reward information. Its results contrast with a previous "pure economic" view that neurons in the orbitofrontal cortex (or OFC) are involved solely in assessing value.

Moreover, the study--published this week in *Neuron*--has implications for understanding pathological conditions in humans that affect decision-making, motivation, and emotions such as addiction, depression, obsessive-compulsive disorder, autism, and other disorders of thought or mood.

"Ultimately, we're trying to understand how groups of neurons participate in the creation of perception, awareness, and goal-oriented behavior," says Mainen. "With this study, we're getting some of the first concrete clues about how the brain represents an animal's goals."

The research was spearheaded by graduate student Claudia Feierstein, who recorded the activity of OFC neurons while rats performed an odor discrimination task that they had previously learned to accomplish.

In the task, the animal receives a test odor ("A" or "B") by poking its nose into a centrally located odor port. Next, the animal chooses odor A or odor B as being the same as the test odor by poking its nose into a choice port located to its right (odor A) or left (odor B). If the animal chooses correctly, it receives a reward (a drop of water).

As expected, many of the neurons actively signaled "I'm getting a reward" when the animal moved right or left, i.e. toward odor A or odor B.

Surprisingly, however, several of the OFC neurons signaled "I'm getting the reward to my right" whereas several others signaled "I'm getting the reward to my left."

Mainen says that one of his next steps will be to examine what happens in the brain while the animals are learning to recognize new odors. "This may or may not figure into those experiments, but we've already found that about one quarter of the rats we use are significantly below average in learning. Their motivation levels also vary quite a bit, which might be interesting to explore as well."

Source: Cold Spring Harbor Laboratory