Brain activity encodes reward magnitude and delay during choice

9 July 2008

Good things may come to those who wait, but research has proven that humans and animals actually prefer an immediate rather than a delayed reward. Now, a study published by Cell Press in the July 10 issue of the journal *Neuron* reveals how a decision-making region of the brain encodes information associated with the magnitude and delay of rewards.

The preference for immediate reward is called temporal discounting, and the value of reward depreciated according to its delay is referred to as temporally discounted value. Previous animal studies aimed at studying the neural signals associated with the impact of reward magnitude and delay on choice behavior have been difficult to interpret.

"Despite the fundamental role of time in decision making, how the brain encodes the temporally discounted values to guide the animal's choice during intertemporal choice remains poorly understood," says lead author Dr. Daeyeol Lee from Yale University School of Medicine.

Dr. Lee and colleagues examined whether the dorsolateral prefrontal cortex (DLPFC), a part of the brain implicated in decision making and contextual control of behaviors, is involved in temporal discounting and intertemporal choice. The researchers studied the brains and behaviors of animals trained in an intertemporal choice task where reward delays were indicated by clocks. Importantly, the positions of targets associated with small or large rewards and their corresponding delays were randomly varied.

"We demonstrated that the neural signals in the DLPFC related to temporally discounted values did not simply reflect reward magnitude or reward delay. In many DLPFC neurons, signals related to reward magnitude and delay were combined such that neurons tended to change their activity similarly when the reward from a particular choice becomes larger and when it becomes available more immediately," explains Dr. Lee. The results suggest that activity related to temporally discounted values in the prefrontal cortex might determine the animal's behavior during intertemporal choice.

The authors caution that their findings likely reveal only a part of the process, as results from previous studies have suggested that the prefrontal cortex might be one of many brain regions involved in intertemporal choice. "Future studies are needed to investigate how signals related to reward magnitude and delay are processed in other brain areas and combined in the DLPFC, as well as how such signals can be ultimately translated into the animal's motor responses," concludes Dr. Lee.

Source: Cell Press