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Making the right choices in changing circumstances: Cognitive flexibility in the brain

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Choosing what is best is not always simple. Should one choose a small, certain reward, or take risks and try to get a larger reward? New research by Stan Floresco, from the Brain Research Centre at the University of British Columbia sheds light on the brain circuits that interact to help us decide the best strategy to adopt in changing circumstances. These results were presented at the 8th annual Canadian Neuroscience Meeting, taking place May 25-28 2014 in Montreal, Canada.

The studies of Dr. Floresco and his team used rats to show that areas deep inside the brain promote a more visceral bias towards large, but uncertain rewards, while brain regions located in the frontal lobes (which regulate higher order functions such as reasoning and planning), regulate and temper these urges when circumstances show the riskier option may be unlikely to yield reward. "It seems that the more primitive regions of the brain drive impulses to pursue larger rewards, but the frontal lobes take a longer view of the situation and put the brakes on these urges in situations when larger rewards may not be the most profitable ones in the long term", explains Dr. Floresco.

In another study, Dr. Floresco revealed that the activity of dopamine neurons seem to provide the brain with short-term updates of the outcomes of recent decisions that can influence the direction of subsequent ones. "Dopamine neurons show brief increases or decreases in activity when rewards are either received or not. However, we showed

that if we turned these neurons off after a rewarded choice, or turned them on after a non-rewarded one, we could, in essence, remote control the decision making of these animals, making them behave as if they did not receive a reward (that they actually did) or vice versa", says Dr. Floresco.

Dr. Floresco also recently published an important paper highlighting the important and until recently underestimated role of another brain region, called the lateral habenula, in decision making. "An emerging view was that this brain region was primarily involved in signalling when something bad occured. Yet, our results show that its function is much more complex. When we shut down neural activity within this region, animals show random patterns of decision making, suggesting that this region plays a key role in promoting decision biases in one direction or another."

These results show the dynamic competition that exists between signals coming from different brain regions. The integration of these signals requires cognitive flexibility, which is the ability to react differently, update behavior and make appropriate choices in response to changes in one's environment.

Understanding how these signals are transmitted and act in the normal brain can help explain many neuropsychiatric conditions in which this signalling is defective. Schizophrenia is associated with abnormal activity in many of the same brain regions involved in efficient decision making. Delusions associated with schizophrenia can stem from associating strong emotional response to an innocuous situation. Not associating the right affective importance to pleasurable or aversive stimuli can result in inability to feel positive emotions like pleasure and to feel desire, which is one of the hallmarks of depression. Drug addiction can also be considered as a disease of decision making. "By clarifying the mechanisms through which different brain circuits interact

to guide normal decision making, these studies may provide important insight into the brain dysfunction that may occur in these different disorders," concludes Dr. Floresco.

More information: www.can-acn.org/meeting2014

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