How Pessimism Can Hijack the Brain and Subvert Motivation

https://www.psychologytoday.com/us/blog/the-athletes-way/202108/how-pessimism-can-hijack-the-brain-and-subvert-motivation

New research sheds light on how a pessimistic outlook can hijack the brain's ability to stay motivated during reward-driven behavior that involves some discomfort or hardship to receive a dopamine-inducing "prize." These Kyoto University findings were recently published in the peer-reviewed journal *Frontiers in Neuroscience*.

Obtaining a reward such as food or money often involves some labor-intensive work and discomfort. When making a conscious (or subconscious) effort-based choice about whether pursuing a feel-good reward is worth the potential pain or fatigue required to obtain it, different parts of the brain perform a cost-benefit analysis that weighs the pros and cons.

For example, imagine that it's a sweltering hot summer day and you're craving delicious homemade lemonade from a stand that's two miles from where you live. Usually, you'd hop in your air-conditioned car and drive, but you're out of gas. Now your brain has to make a cost-benefit analysis: Is it worth the energy exertion and discomfort of walking two miles in the blistering sun for an ice-cold glass of lemonade?

This hypothetical situation is a classic approach-avoidance (Ap-Av) conflict task in which a reward (cold lemonade) and hardship (hot sun) are inherently linked.

This recent research on the neural dynamics of Ap-Av decision-making suggests that when the brain weighs its desire to obtain a feel-good reward with the intensity of its hedonic tendency to avoid unpleasantness or discomfort, being in a negative mental state tends to make the payoff of a reward seem less enticing and not worth the hardship required to get it.

By microstimulating specific cortical regions in the frontal cortex and subcortical areas of the striatum known to induce negative mental states in monkeys, neuroscientists were able to pinpoint how pessimistic decision-making takes hold in the non-human primate brain.

Notably, the researchers found that triggering an anxiety-like state in monkeys increased their tendency to avoid discomfort for a reward, whereas activating parts of the brain associated with major depressive disorders (MDD) reduced their overall desire for the reward.

Under the larger umbrella of pessimistic decision-making, anxiety seems to trigger a stronger-than-normal inclination to avoid anything that might increase feelings of negativity; depression can diminish desire and make rewards seem inconsequential or not worth the effort.

Interestingly, the Kyoto University neuroscientists found that neurons associated with avoidance behaviors in monkeys were concentrated in a cortical brain region called the pregenual anterior cingulate cortex (pACC), which previous research has linked to MDD and generalized anxiety disorder (GAD) in humans.

"We are facing a new epidemic of anxiety, and it is important that we understand how our anxiety influences our decision making," senior author Ken-ichi Amemori said in a July 27 news release.

"There is a real need for a better understanding of what is happening in the brain here. It is very difficult for us to see exactly where and how anxiety manifests in humans, but studies in primate brains have pointed to neurons in the ACC as being important in these decision-making processes," he added.

In their news release, the authors describe the ACC using an onion metaphor:

"Thinking of the brain as an onion, the ACC lies in a middle layer, wrapping around the corpus callosum, which joins the two [cerebral] hemispheres. The ACC is also well-connected with many other parts of the brain controlling higher and lower functions with a role in integrating feelings with rational thinking."

In the first phase of their experiment, researchers from Kyoto University's Institute for Advanced Study of Human Biology (WPI-ASHBi) measured rhesus macaques' brain activity while they were performing an Ap-Av task that combined a food reward with an annoying blast of air in the monkey's face.

To receive the reward, each monkey had to decide if it was worth the discomfort of an air blast. Modifying the size of the reward and the strength of the air blast made it possible for the researchers to pinpoint how specific neurons in the ACC were activated and deactivated.

Interestingly, artificially-induced pessimism could be "turned on" by microstimulation of the pACC; a small jolt of electricity in this brain region caused monkeys to avoid seeking the reward. Conversely, this pessimistic decision-making mechanism could be "turned off" by giving monkeys an anti-anxiety drug.

After establishing that the pACC was directly involved in pessimistic decision-making, the researchers investigated how neural connections between limbic-connected cortical regions and the striatum might drive "pessimistic thoughts."

According to the news release, "the team found interconnections with many parts of the prefrontal cortex at the front of the human brain, which is associated with higher cognitive function and reasoning." Additionally, they also identified "a strong connection with labyrinth-like structures known as striosomes."

In their paper's conclusion, co-authors Satoko Amemori, Ann Graybiel, and Ken-ichi Amemori write:

"Because one of the major output stations of the proposed pessimistic-decision network, the striosome compartment of the striatum, now has definitively been shown capable of regulating the activity of dopamine-containing substantia nigra pars compacta (SNc) neurons, we emphasize that this network for pessimistic-decision could, via subsets of striosomes, regulate dopamine-related signaling responsible for, or as a modulator of, anxiety-like state."

"The function of the striosome structure has been something of a mystery for a long time, but our experiments point to these being an important node linking pessimistic decision-making to the brain's reward system and dopamine regulation," Ken-ichi Amemori explains.

"The many parallels in brain activation point to a common mechanism for both humans and monkeys," he concludes. "It's important that we have associated striosomes and their extended network with decision making under an anxious condition, and we hope that this study will be useful toward developing brain pathway-specific treatments for neurological and psychiatric disorders in humans."

Read the text and decide if the sentence is true (T) or false (F)

1. According to the new research the prospect of hardship doesn’t affect your motivation.
(T) (F)

2. The classic approach-avoidance conflict task revolves around the relationship between the concepts of reward and hardship.
(T) (F)

3. Causing anxiety-like states in monkeys decreased the likelihood of their taking up risk in exchange for a reward.
(T) (F)

4. We understand fully how anxiety develops and manifests in humans.
(T) (F)

5. Microstimulation of the pACC can affect one's inclination towards pessimism.
(T) **(F)**

Answer key

1. **False**
2. **True**
3. **True**
4. **False**
5. **True**