Brain activity predicts promiscuity and problem drinking

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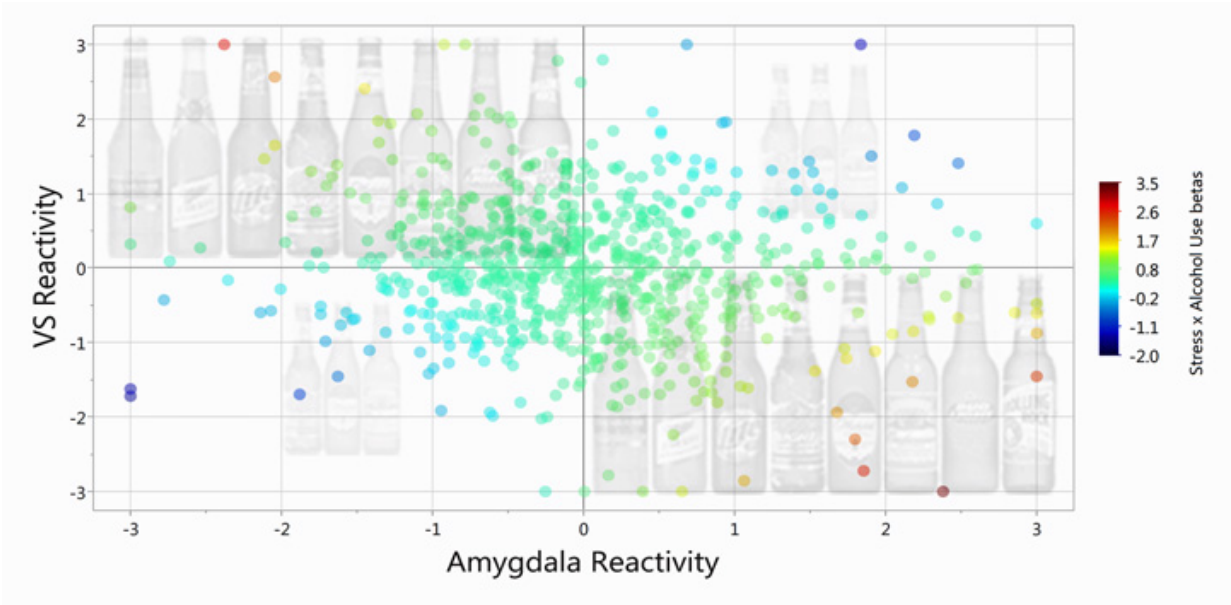

Imbalance in the activation of two brain areas, the ventral striatum (VS on vertical scale) and the amygdala, predicts problem drinking in university students who are dealing with stress. The same two brain areas also predict the number of new sexual partners a person will have several months after his or her brain scan. Credit: Annchen Knodt, Duke University

A pair of brain-imaging studies suggest researchers may be able to predict how likely young adults are to develop problem drinking or engage in risky sexual behavior in response to stress.

The new research is part of the ongoing Duke Neurogenetics Study (DNS), which began in 2010 to better understand how interactions between the brain, genome and environment shape risky behaviors that can predict mental illnesses including depression, anxiety, and addiction.

"By knowing the biology that predicts risk, we hope to eventually change the biology—or at least meet that biology with other forces to stem the risk," said the senior author of both studies, Ahmad Hariri, professor of psychology and neuroscience at Duke University.

In both studies, the team used non-invasive functional MRI imaging to measure the activity of two brain areas that help shape opposing behaviors crucial for survival: the reward-seeking ventral striatum and the threat-assessing amygdala.

In a 2012 sample of 200 DNS participants, Hariri's group showed that having both an overactive ventral striatum and an underactive amygdala was associated with problem drinking in response to stress.

Hariri's team confirmed this finding in the new study using a larger sample of 759 undergraduate students who averaged 19 years old.

The researchers also discovered that the inverse brain pattern—low ventral striatum and high amygdala activity—predicted problem drinking in response to stress both at the time of the scan and three months after. These results were published June 30 in *Molecular Psychiatry*.

"We now have these two distinct profiles of risk that, in general, reflect imbalance in the function of typically complementary brain areas," Hariri said. "If you have high activity in both areas, no problem. If you have low activity in both areas, no problem. It's when they're out of whack that individuals may have problems with drinking."

Interestingly, people with the two different risk profiles may drink for different reasons.

Hariri speculates that those with high ventral striatum activity may be motivated to drink because they are impulsive; combined with a lower danger signal coming from the amygdala, they may be less inclined to reign in their behavior.

In contrast, the participants with low ventral striatum activity usually have lower mood, and an overactive amygdala may make them more sensitive to stress, so they might drink as a coping mechanism.

Balance in the activity of the ventral striatum and the amygdala also predicts sexual behavior, according to the second study, which appeared June 10 in the *Journal of Neuroscience*.

In that study, a team led by graduate student Elizabeth Victor asked a subset of DNS participants (70 heterosexual men and women) how many new sexual partners they acquired over an 11-month period.

For men, the same pattern of brain activity linked to problem drinking—high ventral striatum and low amygdala activity—was associated with a greater number of sexual partners compared to those men with more balanced activity of the two brain areas.

But the pattern for more sexually active women was different: they had higher-than-normal activity in both the ventral striatum and the amygdala—indicating both high reward and high threat.

"It's not really clear why that is," Hariri said. "One possibility is that this amygdala signal is representing different things in men and women."

In women, amygdala activity might be driving general awareness,

arousal, and responsiveness which, when combined with strong reward-related activity in the ventral striatum, leads to a greater number of partners. In contrast, in men, the amygdala signal could be more focused on detecting danger, Hariri said.

Measuring brain-based predictors of sexual behavior is largely uncharted territory, Victor said. Although a previous study tied higher ventral striatum activity to more sexual partners, no prior studies have accounted for amygdala activity.

The next step to examine both risky sex and problem drinking is to add a third brain region: the prefrontal cortex, which is the brain's ultimate decision-maker. This part of the brain may help the researchers predict more accurately which individuals may engage in risky behaviors.

Developing brain-based predictors is important because individuals aren't necessarily aware of their risks, Hariri said, nor are their doctors.

"The key is that these are patterns present before problems emerge," especially in response to stress, Hariri said. "If we know this about an individual, we can anticipate the problems and anticipate what the nature of those problems will be. This knowledge brings us one step closer to preventing the problems altogether."

More information: "Divergent responses of the amygdala and ventral striatum predict stress-related problem drinking in young adults: possible differential markers of affective and impulsive pathways of risk for alcohol use disorder," Yuliya S. Nikolova, Annchen R. Knodt, Spenser R. Radtke, and Ahmad R. Hariri. *Molecular Psychiatry*, June 30, 2015. DOI: 10.1038/mp.2015.85

"Differential Patterns of Amygdala and Ventral Striatum Activation Predict Gender-Specific Changes in Sexual Risk Behavior," Elizabeth C.

Victor, Alexandra A. Sansosti, Hilary C. Bowman, and Ahmad R. Hariri. *Journal of Neuroscience*, June 10, 2015. DOI: 10.1523/JNEUROSCI.0737-15.2015