

Stress Lingers in Pocket of Brain

PHILADELPHIA, Nov. 21 - There may be a reason why some people need a drink or a run after a hard day at the office. The reason resides in the ventral right prefrontal cortex of the brain.

That's the part of the brain that when activated under stress stays active long after the stressful stimulus is over, researchers here reported today. So it's hard to just dump the stress and relax.

The ventral right prefrontal cortex is associated with depression and negative emotions, according to Jiongjiong Wang, Ph.D., an assistant professor of radiology at the University of Pennsylvania here.

It appears to play a central role in how we respond to stress and - unlike many other brain areas - remains active long after the stress is gone, Dr. Wang and colleagues reported in the Nov. 21 online edition of the *Proceedings of the National Academy of Sciences*.

The finding "is compatible with our common experience - you can't just go home and say, 'I'm going to turn the stress off'," Dr. Wang said in an interview.

The research marks the first time that psychological stress has been studied in humans. This is at least partly because of the emergence of a new technique - called arterial spin-labeling perfusion magnetic resonance imaging (MRI) - that directly measures blood flow in the brain over relatively long periods of time.

Other techniques measure blood flow indirectly and can only study relatively short-lived phenomena, said John Detre, M.D., an associate professor of radiology and neurology the senior author of the study.

"This is the first major study to use this approach to look at brain activity and it really opens the door to studying long-lasting effects on the brain and behavior," he said.

Dr. Wang, Dr. Detre and colleagues used functional MRI to scan the brains of 23 healthy volunteers as they tackled a challenging arithmetic problem - counting backward by 13s from 4,000.

While they did the math, an investigator harassed them - saying others were doing much better, urging them to work faster, and requiring them to start over if they made a mistake.

Physiological measures of stress, such as heart rate, went up, as did salivary cortisol, and self-reports of stress, anxiety and frustration. At the same time, Dr. Wang said, blood flow to the ventral right prefrontal cortex went up.

The researchers compared brain activity in the challenging test to what happened during a low-stress test - simply counting backward - and to a baseline scan taken before the testing and one afterward, in which no tasks were assigned.

The results were also compared to a control group of seven participants who spent time in the MRI machine, but weren't asked to perform any tasks, Dr. Wang said.

In a univariate analysis, the researchers found, self-reported stress and salivary cortisol each accounted for a significant amount of the variation in blood flow to the ventral right prefrontal cortex ($p=0.014$ and $p=0.004$, respectively) while such feelings as frustrations and difficulty only accounted for a small proportion.

The researchers concluded that the ventral right prefrontal cortex is the part of the brain active in stress, a finding not entirely surprising, since the region is known to be involved in depression and other negative emotions, Dr. Detre said.

The prefrontal cortex as a whole is the part of the brain involved in planning, predicting, and forming abstract concepts, Dr. Detre said, so again, it's not surprising to find a subsection involved in stress.

But the study also showed that even several minutes after the end of the high-stress challenge, the ventral right prefrontal cortex was still active, he said.

"When we looked at the second baseline - after the high-stress test was over, and they had filled out a questionnaire (about their response), and they had their two-minute cortisol test - we still saw persistent activation in this region," he said.

In the long run, the ability to watch the brain undergo stress may allow researchers to find ways to modulate it, perhaps by the use of medications or relaxation techniques, he said.

Action Points

This study shows that stress is correlated with activation of the ventral right prefrontal cortex and that the activation doesn't stop as soon as the stressful stimulus ends.

By Michael Smith, MedPage Today Staff Writer
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