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Research team finds brain marker that indicates vulnerability to developing post-traumatic stress disorder

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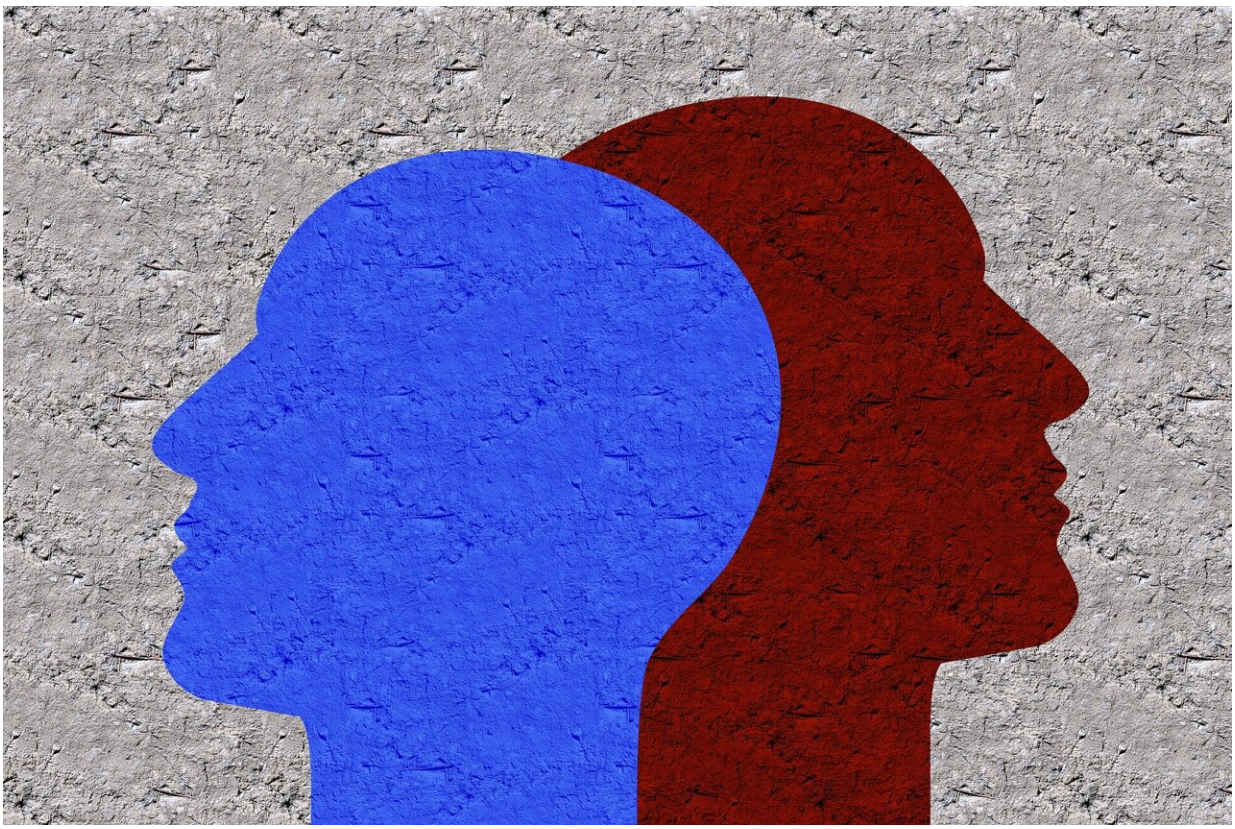

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Understanding one's susceptibility to developing post-traumatic stress disorder (PTSD) is important. If you knew you were at risk, for

example, you might steer clear of jobs that carry more likelihood of high stress and potential trauma or seek treatment as soon as you experienced a potentially triggering event.

Now a research team has found a marker that indicates vulnerability to the disorder. They discovered that heightened activation in one particular brain region in response to seeing surprised and neutral facial expressions appears to be tied to developing PTSD.

A number of symptoms define PTSD, but the researchers were particularly interested in hypervigilance—"always feeling that you need to monitor your environment for potential threats," says Cecilia Hinojosa, who was first author on the research paper in the *Journal of Psychiatric Research* and is now a postdoctoral researcher at Emory University, focusing on PTSD in women.

Previous research had found that hypervigilance may lead people with PTSD to respond with fear to signals that are ambiguous or not clearly threatening—for example, hearing a firecracker might trigger fears of gunshots.

The team, led by Tufts researchers, studied male identical twin pairs using fMRI studies of brain activation. By studying identical twins, who share the same genes, the researchers could show which traits are familial and which are not.

In a set of 12 identical twin pairs one twin had experienced trauma and developed PTSD, while the other was not trauma-exposed. A set of 15 identical twin pairs were used as a control group. One member of that twin set had experienced trauma but not developed PTSD, and the other was not exposed to trauma.

While reactions of people with PTSD to trauma-related imagery have

been studied, no one had previously examined their responses to ambiguous imagery while doing brain activation scans. The research team focused on two brain mechanisms.

Mechanisms of PTSD

The first was heightened activation of the amygdala, a part of the brain that is involved in processing fear-related stimuli, resulting in the fight, flight, or freeze response.

"Every time we experience something that could be potentially threatening in our environment, the amygdala starts a chain of reaction of responses in the brain," says Hinojosa, who as a graduate student worked on the study with Lisa Shin, a Tufts professor of psychology and an expert on PTSD.

The second mechanism is activation of the medial frontal gyrus, a part of the prefrontal cortex involved in inhibiting the amygdala's response to things that are in fact not threatening.

The study, which involved researchers from Tufts, MGH, Duke, and the National Institutes of Health, sought to find out whether people have preexisting brain activation patterns that make them more susceptible to PTSD, or if they acquire that activation pattern because they have PTSD.

While the researchers were expecting the men who had PTSD to show greater activation of the amygdala when observing faces with surprised looks, they hadn't expected that the participants would have the same response to neutral facial expressions. Tellingly, the same was true in the participants' trauma-unexposed twins who didn't have PTSD.

On the other hand, the group who had experienced trauma but not been

diagnosed with PTSD did not show the same heightened amygdala response to either the surprised or neutral faces.

These findings may mean that that individuals who have greater amygdala activation before experiencing trauma may be more vulnerable to developing PTSD, Hinojosa notes.

The findings may also imply that if a person shows preexisting vulnerability to developing PTSD—through heightened amygdala activation—and experiences a traumatic event, "we could potentially provide them with treatments as soon as they experience that trauma to hopefully prevent the development of PTSD symptoms," Hinojosa says.

A final takeaway from the study is that the decreased reactivity in the medial frontal gyrus, which tamps down an excessive fear response, occurred only in the group with PTSD. This suggests that the lowered response in the prefrontal cortex "is an acquired characteristic of PTSD," says Hinojosa, who earned a Ph.D. in experimental psychology.

She pointed to studies of non-human animals, which suggest that chronic stress or traumatic events are neurotoxic. Stress and trauma "could be harming this region of the brain, so it doesn't work as well," she says.

For next steps, Hinojosa says, the study would need to be replicated with larger sample sizes and expand beyond the male-only subjects in the current study.

More information: Cecilia A. Hinojosa et al, Exaggerated amygdala activation to ambiguous facial expressions is a familial vulnerability factor for posttraumatic stress disorder, *Journal of Psychiatric Research* (2022). DOI: 10.1016/j.jpsychires.2022.10.049

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