



# Asian Journal of **Cell Biology**

ISSN 1814-0068



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## When the Brain Knows No Fear: Fear Discovery Could Lead to New Interventions for PTSD

***Researchers at the University of Iowa have pinpointed the part of the brain that causes people to experience fear -- a discovery that could improve treatment of Post-traumatic Stress Disorder (PTSD) and other anxiety conditions.***

Published December 16 in the journal *Current Biology*, the study investigates how the emotion of fear depends on an almond-shaped brain region called the amygdala. The patient in the case study has a rare condition that destroyed her amygdala. UI researchers observed the patient's response to frightening stimuli such as a haunted house, snakes, spiders, and horror films, and asked her about traumatic experiences in her past -- including situations that had endangered her life. They found that without a functioning amygdala, the patient is unable to experience fear.

Studies in the past 50 years have shown the amygdala to play a central role in generating fear reactions in animals from rats to monkeys. This study confirms for the first time that the amygdala is also required for triggering a state of fear in humans. Previous studies with this patient confirmed she cannot recognize fear in facial expressions, but it was unknown until this study if she had the ability to experience fear herself.

Daniel Tranel, Ph.D., UI Professor of Neurology and Psychology and Senior Study Author, said the discovery could lead to new interventions for PTSD and related anxiety disorders. PTSD affects more than 7.7 million Americans, according to the National Institute of Mental Health, and a 2008 analysis by the Rand Corporation predicted that 300,000 soldiers returning from combat in the Middle East would experience PTSD.

"This finding points us to a specific brain area that might underlie PTSD," said Tranel, Director of the UI's Interdisciplinary Graduate Program in Neuroscience. "Psychotherapy and medications are the current treatment options for PTSD and could be refined and further developed with the aim of targeting the amygdala."

Justin Feinstein, lead study author and a UI doctoral student studying clinical neuropsychology, says the findings suggest that methods of safely and non-invasively dampening amygdala activity may help people with PTSD.

"This past year, I've been treating veterans returning home from Iraq and Afghanistan who suffer from PTSD. Their lives are marred by fear, and they are oftentimes unable to even leave their home due to the ever-present feeling of danger," Feinstein said. "In striking contrast, the patient in this study is immune to these states of fear and shows no symptoms of post-traumatic stress. The horrors of life are unable to penetrate her emotional core. In essence, traumatic events leave no emotional imprint on her brain."

In examining the role of the amygdala, Feinstein observed and recorded the patient's responses during exposure to snakes and spiders (two of the most commonly feared animals), during a visit to one of the world's scariest haunted houses, and while watching a series of horror films. Feinstein also measured the patient's experience of fear with a large number of standardized questionnaires that probed different aspects of fear, ranging from the fear of death to the fear of public speaking. Additionally, over a three-month period, the patient carried a computerized emotion diary that randomly asked her to rate her current fear level throughout the day.

Across all of the scenarios, the patient failed to experience fear. Moreover, in everyday life, she has encountered numerous traumatic events that have threatened her very existence, yet, by her report, have caused no fear.

"Taken together, these findings suggest that the human amygdala is a pivotal area of the brain for triggering a state

of fear," Feinstein said. "While the patient is able to experience other emotions, such as happiness and sadness, she is unable to feel fear. This suggests that the brain is organized in such a way that a specific brain region -- the amygdala -- is specialized for processing a specific emotion -- fear."

For Feinstein and Tranel, the most surprising finding of the study was the patient's behavior when exposed to snakes and spiders. For many years, the patient told the researchers that she hates snakes and spiders and tries to avoid them, yet she immediately started touching them at a pet store, stating that she was overcome with curiosity.

Antonio Damasio, Professor of Neuroscience at the University of Southern California and a longtime collaborator of Tranel, helped interpret the findings. The researchers say that the results suggest that our fear behavior is often times controlled at a very instinctual, unconscious level.

"Without our amygdala, the alarm in our brain that pushes us to avoid danger is missing," Feinstein said. "The patient approaches the very things she should be avoiding, yet, strikingly, appears to be totally aware of the fact that she should be avoiding these things. It is quite remarkable that she is still alive."

Feinstein and Tranel conducted the study at the UI Department of Neurology. Ralph Adolphs, professor of neuroscience and psychology at the California Institute of Technology, also collaborated on the project. Adolphs has studied fear and the amygdala for many years, in collaboration with Tranel and Damasio.

The National Institutes of Health and a National Science Foundation Graduate Fellowship provided funding for the study

**Source:** Current Biology, December 16, 2010 DOI: 10.1016/j.cub.2010.11.042