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Ilana Ascher

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No Amygdala, No Worries



By Ilana Ascher

Artwork By Mikaila Hoffman

Jamie is walking down the street late at night, when he notices a figure moving toward him from a side road. His heart immediately starts pounding and he picks up the pace, making it home in half the time it would normally take. This response to a possibly dangerous situation can be attributed to an almond-shaped region of the brain called the amygdala. The amygdala is responsible for processing external cues of fear, including the ability to recognize fear when it is present on others' faces.

Now picture another person walking in the park late at night. It isn't long before she gets accosted by a man, who jumps out at her from the shadows. The man demands money and is baffled when the woman looks him straight in the eyes, says no, and keeps on walking. The assailant, shocked and confused, walks away. This may sound like extreme bravery or stupidity, but for the fewer than 300 people who have been diagnosed with Urbach-Wiethe disease, this reaction is a reality. This rare

disorder causes the amygdala to harden, rendering it useless.

The most well-known case of such brain damage is that of a patient called SM, referred to by her initials for her privacy. In order to further investigate the claim that amygdala damage causes altered fear responses, a team of researchers, supported with NIH grants, ran a series of experiments in which they exposed SM to exotic animals, haunted houses, and horror films. No matter what was tried, the experimenters could not induce a fear response in SM. Though she originally claimed to hate both snakes and spiders--the subjects of the two most common phobias--upon being brought to an exotic pet store, she displayed immense curiosity about the animals. She had to be told a total of 15 times not to touch the larger and potentially dangerous snake. This display of overt curiosity is similar to behavior found in monkeys with Kluever-Bucy syndrome, bilateral lesions on the amygdala. Even after being attacked by a snake, these monkeys would curiously and casually approach it again. Many

people and primates alike would avoid such stimuli, due to the amygdala and its role in processing external cues and producing fear responses based on the cues that manifest from dangerous situations. Furthermore, if SM witnessed someone looking clearly frightened, she would not be able to process this facial expression, since the amygdala is responsible for recognizing fearful faces (Adolphs 2008). The amygdala however is not the only portion of the brain involved in processing fear. This was discovered when SM and other patients were exposed to increased levels of CO₂.

When SM was exposed to a 35% increase in CO₂, thus causing “air hunger,” a feeling of suffocation, she immediately panicked, describing a fearful response. This information supports the idea that the amygdala is not the only portion of the brain engaged in fear responses. In the moments leading up to the experiment, SM experienced no fear, as expected, but as soon as she took a breath of the CO₂, she panicked and tried to tear the mask off her face. This response is not typical of patients with intact amygdalae, many of whom feel nervous coming into the experiment, but do not panic so intensely upon breathing in the CO₂. These findings indicate two interesting, non mutually-exclusive, possibilities in the realm of fear response. The obvious indication is that panic induced by internal threats originates from somewhere outside of the amygdala, possibly in the brain stem. The second possibility is that loss of amygdala function may lead to the development of panic disorder.

The amygdala is a necessary and adaptive aspect of the human brain. Though it may sound relaxing or convenient to experience a lack of fear, panic responses that arise from dangerous stimuli can save a person’s life. When Jamie’s amygdala picks up a threatening external cue, he books

it home, leaving a shadowy figure behind. This figure, a man with a switchblade, is forced to leave Jamie alone and make his way to the park. This is where he begins to stalk his next victim, a woman known as SM, who is walking confidently down the dimly lit path. ●

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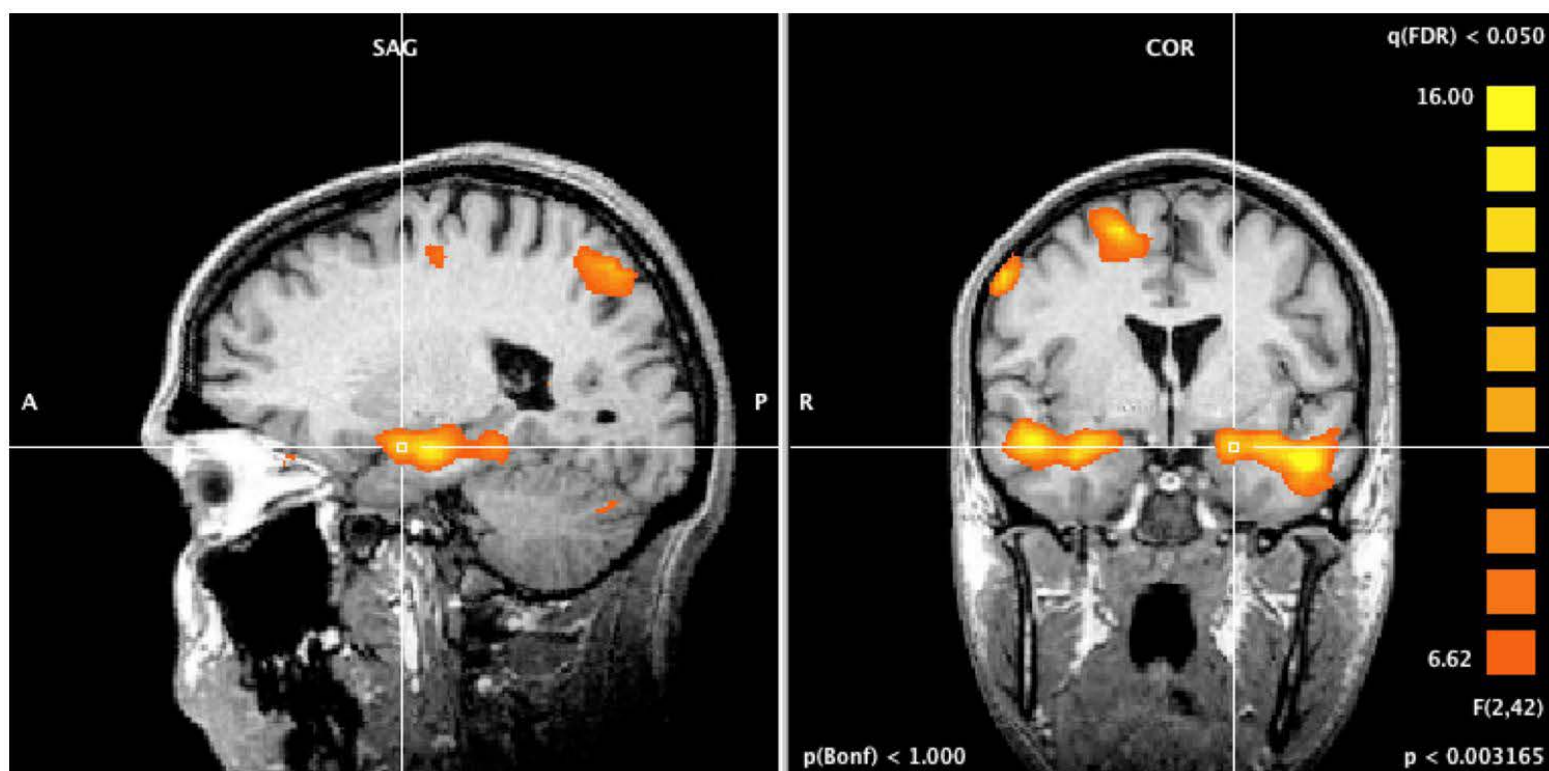


Image courtesy of

Sanchez TA, Mocaiber I, Erthal FS, Joffily M, Volchan E, Pereira MG, de Araujo DB and Oliveira L (2015) *Amygdala responses to unpleasant pictures are influenced by task demands and positive affect trait*. Front. Hum. Neurosci. 9:107.