The Brain's Response to Threat

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The Limbic System. The limbic system is a region deep in the brain that is most important in responding and storing information oÂ-n a real or perceived threat. The following regions in this system are particularly important in the fear response:

- Hypothalamus: The hypothalamus is a small structure that regulates body temperature, appetite, sexual behavior, and reproductive hormones. The hypothalamus plays a role in controlling our behavior such as eating, sexual behavior and sleeping, and regulates body temperature, emotions, secretion of hormones and movement.

- The Pituitary Gland. The pituitary gland develops from an extension of the hypothalamus downwards. It is involved in controlling thyroid functions, the adrenal glands, growth and sexual maturation. The back part of the pituitary gland regulates urine production.

- Thalamus: The thalamus serves as a relay station for almost all information that comes and goes to the cortex (the outer portion of the brain). It plays a role in pain sensation, attention and alertness.

- Hippocampus: The hippocampus stores memory, including emotional memories.

- Amygdala. This small-almond like structure lies deep in the brain and connects with the hippocampus and other parts of the brain. It is associated with regulation and control of major emotional activities, including anxiety, depression, aggression, and affection.

- the limbic system, researchers have specifically identified the hypothalamic-pituitary-adrenal (HPA) axis, as an important region in the fear response.

Release of Steroid Hormones. The HPA systems trigger the production and release of steroid hormones (glucocorticoids), including the primary stress hormone cortisol. Cortisol is very important in marshaling systems throughout the body (including the heart, lungs, circulation, metabolism, immune systems, and skin) to deal quickly with the threat. Among the physical consequences are the following:

- The heart rate and blood pressure increase instantaneously.

- Breathing becomes rapid and the lungs take in more oxygen.

- Blood flow may actually increase 300% to 400%, priming the muscles, lungs, and brain for added demands.

Release of Neurotransmitters. The HPA system also releases certain neurotransmitters (chemical messengers). Those of particular importance in the fear response are dopamine, norepinephrine, and epinephrine (also called adrenaline), glutamate, (gamma)-aminobutyric acid (GABA), and serotonin.

- Neurotransmitters activate the amygdala, which apparently triggers the brain's response to emotions to a stressful event.

- Neurotransmitters then signal the hippocampus to store the emotionally loaded experience in long-term memory. In primitive times, this combination of responses would have been essential for survival, when long-lasting memories of dangerous stimuli would be critical for avoiding such threats in the future.

- During a stressful event, neurotransmitters also suppress activity in areas at the front of the brain concerned with short-term memory, concentration, inhibition, and rational thought. This sequence of mental events allows a person to react quickly to the threat, either to fight or to flee from it. (It also hinders the ability to handle complex social or intellectual tasks and behaviors.)