From The Inside Out: Understanding Generalized Anxiety

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Abstract

Anxiety is a type of mental disorder related to fear– one of the six fundamental emotions. Fear is a response to any perceived threats, causing one to worry excessively. There are multiple neurotransmitters and receptors related to anxiety, as well as many different ways one may contract and treat this mental disorder.

Anxiety and its Correlation to Fear

Fear, one of the six fundamental emotions developed by Paul Ekman, directly relates to the mental disorder Anxiety. Both fear and anxiety are responses to potential threats; fear triggers the flight, fight, or freeze mode in our bodies. During the flight or fight mode, the heart rate rises, breath speed increases, and the senses heighten. In contrast, the heart rate decreases during the freeze mode, resulting in immobility. Interestingly enough, the sympathetic nervous system works during both anxiety and fear-based emotions yet is less engaged during anxiety. When experiencing anxiety, the muscles tense, and one's caution heightens. Although, like fear, anxiety may be used as protection from danger, it can also excessively distress a person, affecting their social life.

Brain Regions, Neurotransmitters, and Key Receptors Used for Anxiety

The brain region that is used during anxiety is the Amygdala. The Amygdala is a small almond-shaped structure located in both the Medial Temporal Lobe and in front of the Hippocampus. The Amygdala is made up of neurons and glial cells that are located in each hemisphere of the brain. The Amygdala is a part of the limbic system responsible for behavior and emotional responses, especially regarding survival. Concerning emotion, the Amygdala plays a role in the following reactions: fear, anxiety, pleasure, and anger. The Amygdala's primary function is to regulate autonomic and endocrine functions and adapt to instinctive and motivational behaviors due to environmental changes. If the Amygdala happens to be stimulated, the outcome would be an emotion of fear and or aggression. In addition to that, the Amygdala attaches emotional significance to our memories and determines how memories are stored. If a memory has substantial emotional meaning, it has a better chance of sticking. With this, the Amygdala also plays a role in forming new memories associated with fear. One must repeat a fearful memory several times to stay in the brain. Conditions involving the Amygdala include anxiety disorders, mood disorders, and panic disorders.

Neurotransmitters carry a message through the synapse, landing, and binding on specific receptors, like a lock and key. The central Neurotransmitter systems that are used for regulating anxiety are Gamma-aminobutyric acid (GABA) and Glutamate. GABA is an inhibitory neurotransmitter and chemical messenger in the brain. GABA slows down and prevents chemical messages from going to other cells within the central nervous system. GABA can produce a calming effect while controlling nerve cell activity that is related to fear, anxiety, and stress. The two types of GABA receptors on nerve cells are GABA-A and GABA-B. When GABA binds to one of these two receptors, the process decreases responsiveness in the cell. GABA works with other neurotransmitters, such as Glutamate and serotonin. GABA is derived from

Glutamate, from a reaction with the enzymes glutamic acid and decarboxylase. GABA is synthesized in the cytoplasm of the presynaptic neuron, which is from the precursor glutamate by the enzyme glutamate decarboxylase. After the synthesizing, GABA is loaded into synaptic vesicles by the vesicular amino acid transporter. For a body to function correctly, these neurotransmitters must be balanced. When there is decreased activity of GABA, it could heighten anxiety. In contrast, increased activity of GABA could prevent health conditions such as Insomnia, high blood pressure, and diabetes.

Heritability, Epigenetics, and Mirror Neurons

Like physical appearance, some mental conditions can be inherited from parents by offspring. Although there are no specific fear or anxiety genes, there is considered to be heritability in anxiety; around 30-67 percent of anxiety can be inherited. Vulnerability genes such as: 5-HT1A, 5-HTT, MAO-A, COMT, CCK-B, ADORA2A, CRHR1, FKBP5, ACE, RGS2/7 and NPSR1 are possibly included in anxiety. These vulnerability genes, as well as environmental factors, work together to shape an anxiety disorder.

Concerning heritability, epigenetics, the study of behavior and environment in genes, can also affect a person's anxiety disorder. Although some life experiences may not affect every generation, permanent epigenetic changes in DNA can still occur, resulting in adjustments in gene expression, metabolism, and endocrine function. Although there are many research gaps, epigenetic modifications show that anxiety-like phenotypes have genes regulating the hypothalamic-pituitary-adrenal axis (the central stress system), neuroplasticity, and neurotransmitters.

One other way anxiety can be formed is by mirror neurons. Mirror neurons are used in our brains to reflect another's brain activities. Activities such as yawning or learning a new dance are possible with the help of mirror neurons. Similarly, mirror neurons also allow people to feel anxiety or stress when they are surrounded by people who are currently experiencing those emotions. Although these factors contribute to the creation of anxiety, factors such as stress or trauma seem to have the most impact. Traumatic situations such as death, abuse, and neglect usually trigger anxiety to form.

Neurological and Psychiatric Conditions Associated with Anxiety

Although the topic of anxiety is broad, there are several different kinds of anxiety orders, including Agoraphobia, anxiety due to a medical condition, generalized anxiety disorder, panic disorder, selective mutism, separation anxiety disorder, social anxiety disorder, and substance-induced anxiety disorder. Although there are a variety of conditions, the primary anxiety disorder is Generalized Anxiety disorder (GAD). GAD has both physical and mental symptoms ranging from muscle tension to excessive worrying. Concerning these symptoms, anxiety can also have significant neurological effects, such as nerve pain, memory loss, vision problems, and more.

Current Methods to Treat or Manage Anxiety

Luckily, there are many different ways to prevent severe anxiety with and without the help of medicine. Activities such as mindfulness, breathing techniques, behavior therapy, cognitive therapy, and exercise can effectively manage one's anxiety. As for medication, the most commonly prescribed drug for anxiety is Benzodiazepines. Benzodiazepines are a kind of Central Nervous System depressant that works to induce feelings of calm, sleep, and

drowsiness. This drug works by aiding the binding of GABA at other GABA receptors in the Central Nervous System. Although this drug seems to work efficiently, the higher the dose, the more exposed people are to side effects. The side effects of Benzodiazepines include drowsiness, dizziness, confusion, memory problems, and more.

References:

"Anxiety Causes Neurological Symptoms." *Calm Clinic - Information about Anxiety, Stress and Panic*, 10 Oct. 2020, www.calmclinic.com/anxiety/neurological-symptoms.

E;, Domschke K;Maron. "Genetic Factors in Anxiety Disorders." *Modern Trends in Pharmacopsychiatry*, U.S. National Library of Medicine, pubmed.ncbi.nlm.nih.gov/25225016/. Accessed 24 Nov. 2023.

"Fear." *Paul Ekman Group*, 13 Nov. 2021, www.paulekman.com/universal-emotions/what-is-fear/.

"The Limbic System." *Queensland Brain Institute - University of Queensland*, 15 May 2023, qbi.uq.edu.au/brain/brain-anatomy/limbic-system#:~:text=learning%20new%20things.-,Amygdala,%2C%20fear%2C%20anxiety%20and%20anger.

"Managing and Treating Anxiety." *Better Health Channel*, Department of Health & Human Services, 23 May 2002, www.betterhealth.vic.gov.au/health/conditionsandtreatments/anxiety-treatment-options#managing-anxiety.

"Neural Basis of Anxiety." *Neural Basis of Anxiety - an Overview | ScienceDirect Topics*, www.sciencedirect.com/topics/neuroscience/neural-basis-of-anxiety. Accessed 24 Nov. 2023.

Northwestern Medicine. "5 Things You Never Knew about Fear." *Northwestern Medicine*, www.nm.org/healthbeat/healthy-tips/emotional-health/5-things-you-never-knew-about-fear#:~:text=As%20soon%20as%20you%20recognize,pressure%20and%20heart%20rate%20increase. Accessed 24 Nov. 2023.

Nuss, Philippe. "Anxiety Disorders and GABA Neurotransmission: A Disturbance of Modulation." *Neuropsychiatric Disease and Treatment*, U.S. National Library of Medicine, 17 Jan. 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4303399/.

Posted May 17, 2019 by UWA. "Our Basic Emotions Infographic: List of Human Emotions." *UWA Online*, 20 May 2019, online.uwa.edu/infographics/basic-emotions/.

Posted May 17, 2019 by UWA. "Our Basic Emotions Infographic: List of Human Emotions." *UWA Online*, 20 May 2019, online.uwa.edu/infographics/basic-emotions/.

professional, Cleveland Clinic medical. "Gamma-Aminobutyric Acid (GABA): What It Is, Function & Benefits." *Cleveland Clinic*,

my.clevelandclinic.org/health/articles/22857-gamma-aminobutyric-acid-gaba. Accessed 24 Nov. 2023.

professional, Cleveland Clinic medical. “The Amygdala: A Small Part of Your Brain’s Biggest Abilities.” *Cleveland Clinic*, my.clevelandclinic.org/health/body/24894-amygdala. Accessed 24 Nov. 2023.

Sawyers, Chelsea, et al. “The Genetic and Environmental Structure of Fear and Anxiety in Juvenile Twins.” *American Journal of Medical Genetics. Part B, Neuropsychiatric Genetics : The Official Publication of the International Society of Psychiatric Genetics*, U.S. National Library of Medicine, Apr. 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6414251/.

“Synaptic Plasticity.” *Synaptic Plasticity - Queensland Brain Institute - University of Queensland*, qbi.uq.edu.au/sahgroup. Accessed 24 Nov. 2023.

“Understanding Fear, Anxiety, and Phobias.” *Understanding Fear, Anxiety, and Phobias | McLean Hospital*, 15 June 2023, www.mcleanhospital.org/essential/fear-phobias.

“What Causes Anxiety Problems.” *Mind*, www.mind.org.uk/information-support/types-of-mental-health-problems/anxiety-and-panic-attacks/causes/. Accessed 24 Nov. 2023.

“What Is Epigenetics?” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 15 Aug. 2022, www.cdc.gov/genomics/disease/epigenetics.htm#:~:text=Epigenetics%20is%20the%20study%20of,body%20reads%20a%20DNA%20sequence.

Šimić, Goran, et al. “Understanding Emotions: Origins and Roles of the Amygdala.” *Biomolecules*, U.S. National Library of Medicine, 31 May 2021, www.ncbi.nlm.nih.gov/pmc/articles/PMC8228195/#:~:text=The%20amygdala%20contributes%20to%20these,a%20conscious%20feeling%20of%20fear.