Neurobiology of the Emotion of Disgust

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Emotions are conscious mental reactions (such as anger or fear) subjectively experienced as strong feelings usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body (APA). While there is a large amount of different emotions felt by humans every day, only 6 of them are considered universal across all cultures and backgrounds. Those six emotions are happiness, anger, sadness, fear, surprise, and disgust, and all emotions stem from those. Of those emotions, disgust is very often overlooked, and is not seen as being nearly as vital to our daily life as the other five core emotions. Nonetheless, it is still extremely important in our day to day lives, helping us avoid disease and to make moral choices.

There are various neurotransmitter systems involved in disgust, just like any other emotion. Firstly, similar to other emotions, serotonin has a large role in the emotion of disgust, regulating the intensity and expression of the emotion. In addition dopamine, which is usually known for being part of the reward system, also has the role of reducing the threshold for disgust in certain circumstances, making one react when they otherwise would not. Finally, epinephrine and norepinephrine cause many of the physiological effects associated with the emotion, such as nausea, increased heart rate, and the urge to run away (Sherpa, 2024).

While the neurotransmitters themselves are extremely important, the receptors that read them are what actually gives them value. Out of the three neurotransmitters mentioned above, serotonin is generally considered the most vital to the emotion of disgust, with dopamine, epinephrine and norepinephrine being used more in the other core emotions. The serotonin receptors linked most to disgust are the 5-HT1A receptors, 5-HT2A receptors, and 5-HT3 receptors. Firstly, 5-HT1A receptors help manage aversive responses, which in the case of disgust is the desire to avoid the cause of the feeling. Secondly are the 5-HT2A receptors, which attend to sensory perception of the stimuli causing the disgust (Hornboll et al., 2013). Finally, there's the 5-HT3 receptors which cause the actual feeling of nausea that is associated with visceral disgust (Tuerke et al., 2012). Moving on to the dopamine receptors that contribute to disgust, the main three receptors are D1 receptors, D2 receptors, and D3 receptors. The first dopamine receptors are D1 receptors, which end up processing the stimuli causing the disgust (Zafiri et al., 2022). Then, there are the D2 and D3 receptors, which are both thought to influence the intensity of the disgust responses (Kobiella et al., 2010).

The amount and the way that disgust is expressed is very different between people, with some feeling disgust from experiences that others see as mundane tasks, and others may not even feel squeamish doing things that others find horrific. This is due to a mix of genetic and environmental factors that mess with the factors contributing to an individual's expression of disgust. The two main factors that determine how a person gets disgusted by a stimuli are propensity, which determines how likely a person is to have the sensation of disgust, and sensitivity, which determines how intense the feeling of disgust actually is. According to a twin

study done by Sherlock et al., “approximately half of the variation in [...] disgust is due to genetic effects” (Sherlock et al., 2016). This in turn also means that the other half of disgust propensity and sensitivity is due to environment and upbringing. An example of an environmental effect on disgust propensity is that a child who has accidentally eaten rotten food will likely be much more likely to be disgusted by food in general due to the negative experience.

There are various pathological and neurological disorders that interfere with normal expression of disgust, and one of the most prominent that we see in modern society is obsessive compulsive disorder (OCD). Both sensitivity and propensity for disgust are greatly heightened in most cases of OCD, meaning that not only are people with the disorder more likely to feel disgusted at a stimulus, but it is much more likely that the feeling of disgust they do get is also stronger (Rockwell-Evans et al.). This can lead to many obsessive behaviors that are characteristic of the disorder. In addition, a heightened level of disgust in general can lead to many social consequences. Moral and social judgement are often just extensions of disgust in social environments, so heightened disgust propensity and sensitivity means a greater likelihood to be more judgemental, which is generally considered a negative trait.

Despite this heightened sensitivity and propensity, there are ways to mitigate and treat the disgust caused by OCD. The target of the treatments of the disgust component of OCD generally rely on increasing tolerance in order to reduce both propensity and sensitivity to the emotion (Rockwell-Evans et al., 2023). According to a study by Kayla Thayer, an associate professor of psychology at Nova Southeastern University, one of the most effective methods of treatments is exposure based interventions, which attempt to reduce propensity by exposing individuals to triggering situations in a safe environment in order to diminish the person’s visceral reaction to specific stimuli. In addition, the study also states that cognitive behavioral therapy is another method for treating disgust related symptoms of OCD, potentially leading to decreased disgust sensitivity due to cognitive restructuring(Thayer et al., 2021).

Disgust, like all other emotions, is extremely complex, and serves as a necessary part of our survival instinct. Despite this, disorders like OCD can make the emotion become an issue in day to day life, preventing ordinary function. Nonetheless, these issues can be mitigated by treatments such as CBT and exposure therapy.

Bibliography

1. Zafiri, Daphne, and Sevil Duvarci. 'Dopaminergic Circuits Underlying Associative Aversive Learning'. Frontiers in Behavioral Neuroscience, vol. 16–2022, 2022, https://doi.org/10.3389/fnbeh.2022.1041929.
2. Kobiella, Andrea et al. "Human dopamine receptor D2/D3 availability predicts amygdala reactivity to unpleasant stimuli." Human brain mapping vol. 31,5 (2010): 716-26. doi:10.1002/hbm.20900
3. Sherlock, James M et al. "The quantitative genetics of disgust sensitivity." Emotion (Washington, D.C.) vol. 16,1 (2016): 43-51. doi:10.1037/emo0000101
4. Thayer, Kayla K., et al. 'What Therapists Need to Know about the Treatment of OCD When Disgust Is Part of the Clinical Presentation'. Journal of Affective Disorders Reports, vol. 6, 2021, p. 100209, https://doi.org/10.1016/j.jadr.2021.100209.
5. Hornboll, Bettina et al. "Acute serotonin 2A receptor blocking alters the processing of fearful faces in the orbitofrontal cortex and amygdala." Journal of psychopharmacology (Oxford, England) vol. 27,10 (2013): 903-14. doi:10.1177/0269881113494106
6. Tuerke, Katharine J., et al. 'Double Dissociation between Regulation of Conditioned Disgust and Taste Avoidance by Serotonin Availability at the 5-HT3 Receptor in the Posterior and Anterior Insular Cortex'. Journal of Neuroscience, vol. 32, no. 40, Society for Neuroscience, 2012, pp. 13709–13717, https://doi.org/10.1523/JNEUROSCI.2042-12.2012.
7. Rockwell-Evans, K., Peterson, N., Paulsen, R., Rudd, J., & Martinez, M. (2023). *Yucky, ooey, gross, and gooey: The role of disgust in OCD*. International OCD Foundation. https://iocdf.org/wp-content/uploads/2023/07/The-Role-of-Disgust-in-OCD.pdf
8. Sherpa, S. (2024, October 15). *Feelings & the neuro-chemistry of emotion*. Mya Care. https://myacare.com/blog/feelings-the-neuro-chemistry-of-emotion