NEUROANATOMY

Apathy or empathy: the systems behind guilt analyzed

What makes us feel guilty when we silently walk past a panhandler or say "no thanks" when asked to round up our purchase for charity at the grocery store? Brain scanning of individuals in guilt-causing situations implicate the amygdala, insula, and superior temporal sulcus.

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The neural regions that affect our feelings of guilt and the emotions that follow have largely been unknown. Guilt can be described as one of the cornerstones and a large contributor to our behavior in society.[1] Altruism, the act of selflessness for others, is a belief that many of us practice today. In recent studies, altruism has been concluded to be a factor in why we feel guilt in situations such as declining to give charitable donations.[2] Guilt proneness can also be a factor in individuals' personalities, where those who are more prone to feelings of guiltiness are calmer in angering situations and more willing to accept their past mistakes.[3,4] However, while we have known the emotional causes behind feelings of guilt, there has been a lack of imaging studies done to determine the neural regions and structures behind it as well as how it affects further decision making.

In an article published in 2017, Ambrose Ty, Derek Mitchell, and Elizabeth Finger conducted an imaging study in which they observed individuals' brains during a guilt-causing situation. The study's participants were asked to donate to fictitious charities; however, if they chose not to donate, the fictional money would go towards their compensation for participating in order instead to intensify emotional tension in the situation.[5] Observations from the study conducted by Ty, et al. in 2017 observed that "the amygdala, insula, and [superior temporal sulcus] were activated during choices to not-help when compared to choices to help." The insula was previously found to activate when experiencing guilt-causing events again or anticipating guilt.[6] It was also observed that ventrolateral prefrontal cortex (vlPFC) and dorsomedial prefrontal cortex (dmPFC) activity were associated with individuals' proneness to guilt and how they responded to guilt-causing situations.[5] Ty, et al.'s (2017) research implicates that neural structures related to our personality can be responsible for how we as individuals can process guilt differently, and structures related to how we experience emotions determine how we respond and react to guilt.

Previous studies have suggested that the vlPFC and dmPFC, STS, insula, amygdala, and the anterior cingulate cortex all play a part in how we feel guilt and attempt to avoid it.[7,8] The studies' methods varied from presenting guilt-causing situations with witnesses and without, to reading guilt-causing statements to participants. Increased activation of the medial prefrontal cortex (mPFC), a brain region involved in morality and decision making, was also related to guilt in Takahashi, et al.'s 2004 study of guilt and embarrassment through participants reading sentences. A study by Steven Greening, et al., also suggested that the dmPFC is involved in charitable acts, where people can view losses to charity as greater to losses for themselves.[9]

Ty, et al.'s study began with gathering 23 healthy participants with written consent. The participants were placed in a functional magnetic resonance imaging (fMRI) machine and shown

a website that asked them to choose if they wanted to donate to any fictional charities for people in need. If the participants chose not to, the sum of money that would have gone to the charity would instead be added to the participants' compensation money for the study (all participants received an additional $15 after the study regardless of their choice in this situation). If the participant declined, a negative feedback screen would be shown and ask the participant again but with only half of the donation value. If the patient did choose to donate in any situation, a positive feedback screen would be shown. The fMRI machine measured activation levels of participants' brain structures during the scenarios. Following the imaging process of the study, participants were asked to rate their feelings of guilt or compassion during any of their decisions in the scenarios from 1-5, with 1 being "not at all guilty/compassionate" to 5 being "very guilty/compassionate".[5]

Increased activation in the insula, STS, and the amygdala was observed in situations where the participant chose not to donate, suggesting that areas of the brain relevant to emotional processing and negative feedback contribute to guilt. They also found increased activation in the dmPFC and vlPFC which correlated with guilt-proneness when participants were presented with a second opportunity to donate after initially declining.[5] The study implicates the insula, STS, and amygdala as primary factors in creating feelings of guilt following a decision, whereas the vlPFC and dmPFC are responsible for how likely individuals are to experience guilt and how they make decisions following feelings of guilt. This study was important in replicating results found in previous studies such as Takahashi's while following a different experimental technique. The study further verifies that brain structures relevant to emotion also play a role in guilt, and those involved in personality are involved in restitution and proneness to guilt.[5] This study contributes to the research on finding exact answers for how guilt is processed in the human mind. Everyone is different, and that is the most interesting part about neuroscience and psychology: how everyone is structured similarly but can function and react so differently to similar situations.

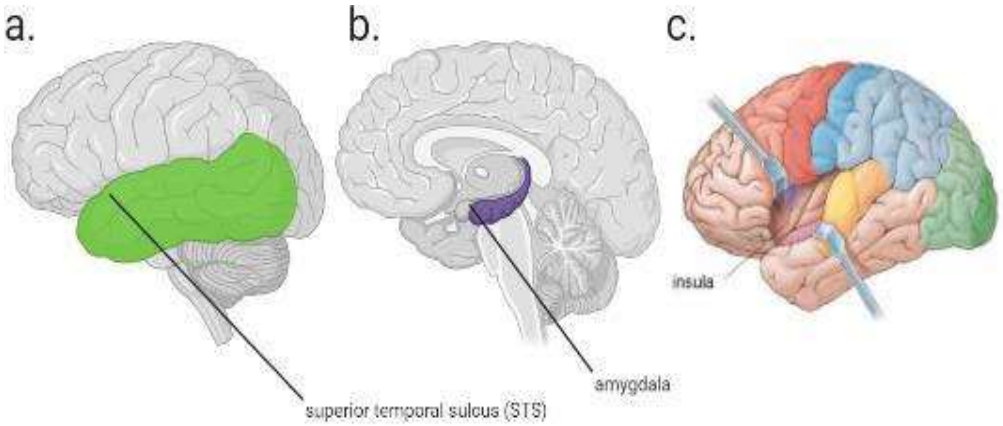

Figure 1. Brain structures implicated in guilt
The superior temporal sulcus is the first sulcus inferior to the lateral fissure and has been implicated in theory-of-mind behaviors (1a).[10] The amygdala is a structure responsible for emotional responses (1b). The insula, or insular cortex, performs "sensory and affective processing to high-level cognition" (1c).[11]

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