Self-Enhancement and the Medial Prefrontal Cortex

Subjects: Biology

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Self-enhancement (SE) refers to the tendency to maintain an often unrealistic, positive view of the self. In order to maintain this tendency, SE creates a false self-perception where one makes judgments about oneself that are ungrounded in reality. Self-enhancement is typically defined as something that occurs continuously, meaning when one produces an unrealistic, positive view of the self, it is maintained for an extended period and extends across all dimensions of cognition, including exaggerating potential success in the future, only acknowledging positive feedback, falsely reporting higher test scores, and overestimating social approval.

frontal cortex PFC self-enhancement self-deception SE

1. The Prefrontal Cortex and Self-Enhancement

The Prefrontal Cortex (PFC) mediates or is involved in self-awareness, language, inhibition, planning, and abstraction, whilst also interacting with most other areas of the brain directly or indirectly [1][2]. The primary function of the PFC centers around executive functions, for which it has obtained the moniker of “central executive” [3]. Furthermore, the PFC’s subdivisions (e.g., the dorsal and medial PFC, the medial orbital frontal cortex, etc.) act as functionally specific processors that can operate and interact with one another [4][5], which, in turn, influences other cortical and non-cortical regions. Another prominent function of the PFC, at least in humans, is a “first-person-evaluator” [6], which refers to its ability to allow humans to develop and maintain a sense of self [7][8][9][10][11][12][13]. This function of the PFC dates to the early beginnings of neuroscience [14][15]. Alongside these significant processes, one must emphasize the PFC’s equally essential functions, such as memory [16][17], modeling outcomes [18], abstract thinking [19][20], emotion [21], cognitive control of internal goals [22][23], and language processing [24].

Here, the researchers suggest that self-enhancement (SE) stands as a critical underlying factor as to why the PFC might have evolved so dramatically in humans. Self-enhancement is described as the tendency to unrealistically perceive one’s image of oneself in a positive direction [25][26][27]. When one self-enhances, they typically exaggerate their strengths and downplay their weaknesses. While the evolutionary advantages of other frontal cortex functions are immediately obvious (e.g., abstract thinking, planning, and emotional regulation), SE’s contribution may be less noticeable. Through analyzing how SE occurs, how the PFC is responsible for it, and its potential evolutionary purpose, the researchers hypothesize that the PFC evolved, in part, to develop SE.

The evidence that SE is mediated via the PFC is not simply correlational, as Transcranial Magnetic Stimulation (TMS) studies have produced direct evidence for the involvement of the medial PFC, or MPFC [28]. This has been shown by demonstrating that stimulation of the MPFC reduces the tendency to self-enhance [29][30]. More specifically, disrupting the MPFC while participants were rating themselves or their best friend caused them to perceive themselves as less "enhanced" compared with no disruption of the MPFC. These studies demonstrate a causal link between the MPFC and SE, as "virtual" removal of the MPFC leads to a reduction in SE.

Self-enhancement appears to be mediated through an accumulation of processes centered within the PFC, which is not surprising given its rich interconnected nature [4][5][31] and its many functions, such as pain processing [5], memory formation [32], creativity [33], etc. Among the vast array of functions of the PFC, some appear to be more directly involved with SE, including memory retrieval [34], conscious deliberation [35], morality [36], emotion regulation [2][3], and self-evaluation [37][38][39].

The PFC is involved in autobiographical (i.e., episodic, first-person) memory recall [40] and the recollection of self-relevant information [41]. During the retrieval process, the PFC often places an emotional value to autobiographical memories [42]. Lin et al. observed this in a typical fMRI design [34]. Scans were taken while participants took part in autobiographical memory recall tasks, where they would recall an autobiographical memory and evaluate it emotionally. Their analysis revealed the presence of blood oxygen level-dependent signals in the ventromedial PFC (vmPFC) during the retrieval of the memory. These signals would modulate depending upon the emotional intensity, therefore, correlating with the emotional intensity of the memory. These findings suggested that the vmPFC processes self-relevant information and is involved in associating emotional values with autobiographical memories. The extent of complexity that the value has is unknown, but it has been observed that during activation of the vmPFC, memories can be associated with simple values, such as "liked" and "positive" or "disliked" and "negative" [32][34]. Due to the SE involving the creation of illusory realities, this function is likely essential in order for SE to occur. Self-enhancement could involve the changing of a previous event from a "disliked" memory to a "liked" memory or vice-versa. This simple value change could lead to a completely different outlook on a previous event, regardless of the reality it holds.

2. Consciousness, Morality, Self, and Self-Enhancement

Conscious deliberation is a process where one forms a perspective and prediction of the future based upon (typically) past, present, and future considerations [35]. The neural network most involved in this process consists of the vmPFC, medial temporal lobe, and medial posterior regions, which are commonly considered the default mode network [43][44]. Among the numerous brain areas involved in this neural network, the vmPFC plays an essential role by mentally simulating events in the future [45][46]. Mentally simulating the future allows individuals to self-enhance, and this is typically correlated with activity in the PFC [47][48]. As noted previously, some individuals deem the occurrence of positive future events as far more likely to occur than negative ones [49]. Furthermore, most individuals demonstrate a higher probability to self-enhance when speculating upon events that are relevant to personal goals [50] and focus on short-term consequences relating to themselves [51]. Research for how the vmPFC causes SE to occur is still ongoing. However, studies have suggested possible mechanisms. The vmPFC has been

found to modulate mental simulations of future events by modulating the associated emotional valence, making the intensities of emotions invoked by the mental simulations either more or less intense [50]. The vmPFC does this with both near and future events through the activation of different sections of itself [52][53][54]. Alongside conscious deliberation and memory retrieval, the PFC also accomplishes SE during the development of morality via manipulating emotional context.

Moral decision-making is the evaluation of actions while considering established norms and values [55]. The moral decision-making process is often a conscious and effortful task [56]. Through interacting with other brain networks, such as the temporal lobes and subcortical limbic structures [57], the PFC allows for moral decision-making [58]. Moreover, the PFC can change the desirability of moral decisions through these interactions, alongside interactions with the striatum [36]. This leads to the development of morality, such that if an individual views an action as desirable, they will associate it with being morally right to avoid the psychological repercussions and potential conflicts [59][60]. This process, the researchers believe, is often the basis for SE. Due to the power of SE, one can create an illusion of reality by convincing themselves that an action is morally right when, logically, it is wrong. By continuously desiring to perform morally wrong actions and repetitively associating them with being morally right, one can self-enhance, regardless of any actuality.

SE can result in numerous nuances in moral decision-making. In addition, the principles of utilitarianism and deontology are of interest when discussing the researchers' current argument about moral decision-making, and it can be explained through the trolley problem. A viewpoint from a utilitarian perspective would support that killing a loved one over a group of people is morally correct, as the positives outweigh the negatives. However, a viewpoint from a deontological perspective implies that both choices are morally incorrect, as purposefully harming others is unacceptable, regardless of the situation. Regarding previous statements, when activity in the MPFC is increased, it causes the affected person to feel more conscious of their decisions and the impact they will make. This, in turn, makes them more likely to perform SE, which is based on the idea that the PFC can change the desirability of certain actions; thus, an individual will see a certain action as desirable and associate it with being morally correct. When applying this to the trolley problem, saving a loved one over a group of unknown people appears more desirable. Therefore, the individual will SE and create a false reality, in which it seems they made the morally correct decision, even though it is logically wrong, to avoid conflict and psychological repercussions.

Persons with Narcissistic Personality Disorder (NPD) have excessive SE [61]. Typically, one’s emotions will fluctuate depending on events within their everyday life. This is demonstrated in studies examining how emotions are altered depending upon a person’s inclusion or exclusion from social groups [62]. Individuals with NPD have exhibited the ability to consistently and sturdily self-enhance their emotions during moments that were meant to invoke insecurity, causing them to feel positive emotions, such as grandiosity and high self-esteem [61][63]. These persons appear to use SE as a defensive measure against negative emotions, such as humiliation or shame, causing further SE by associating themselves with positive characteristics, such as “thick-skinned” [64][65]. This ability to self-enhance to avoid negative emotions, as well as increase positive ones in a similar fashion, has been seen in healthy individuals as well, albeit to a lesser extent [25][66]. NPD is associated with excessive activity in the

PFC [67][68], and disruption of the PFC via TMS appears to decrease the degree of sub-clinical NPD an individual may possess [69].

Self-evaluation is a conscious process, whereby a decision is made regarding oneself [70]. The medial PFC (MPFC) mediates the conscious processes associated with self-evaluations [37][38][39]. More specifically, it has been suggested that the MPFC plays a role in allowing the consciousness to access self-knowledge [71][72][73]. Alongside this, the MPFC associates mental states or perspectives when accessing self-knowledge [72][74]. Through both performing self-evaluations and associating mental states with self-knowledge, the MPFC creates illusory realities regarding the present and past self [75]. Specifically, through associating unrealistic perspectives with the present or past self, one may create an objectively false self-image. This method of SE can be exhibited even by healthy individuals, causing them to associate with overly positive characteristics when they, in fact, lack those traits [76]. Such behavior plays a vital role in making individuals overconfident during task performance. Since individuals are able to self-enhance when considering one's self-knowledge, individuals can self-enhance their self-perceived abilities [76][77]. As a result, individuals appear to develop overconfidence biases [78], where they believe they can perform better than their objective skills allow them to [79]. These changes in self-evaluation have also been found to boost implicit self-esteem, which affects how individuals evaluate objects that are relevant to their identity [80]. For example, people have been found to inflate the monetary value of their property [81], view individuals who are similar to them as more attractive [80], and view individuals within their social group more positively [82][83][84].

In a society where one's intelligence is valued, it is not surprising that SE is seen in persons reporting what they "know". This behavior of overclaiming can be isolated to the PFC using a word knowledge test. Participants were randomly presented with a list of words and asked if they knew the definitions. Unbeknownst to the participants, 50% of the words were fake, and, thus, claiming knowledge of these words was impossible. Without TMS and under sham conditions, overclaiming occurred at a significant rate. However, following MPFC TMS overclaiming was reduced [85]. The role of the MPFC in overclaiming appears to expand under conditions of social pressure [86], which implies that overclaiming via the PFC likely exists to give one a social advantage. This makes sense, as overclaiming knowledge can lead to personal gains [87][88][89][90].

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