The unfairness of being prosocial

A new study shows that brain responses to unfairness during economic decision-making can predict current and future depression indices. Neural response patterns in the amygdala related to inequity tracked indices of depression, particularly for prosocial individuals who tend to be most self-sacrificing.

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Despite growing economic inequity across society, our desire to aid, comfort and share resources with those less fortunate than us varies widely. Some people, who could be called individualists, approach decisions from a more selfish viewpoint of maximizing gains for themselves, while others tend to be more self-sacrificing and willing to promote equity (prosocial individuals). Indeed, prosocials have an almost unrivalled capacity to give up their time and energy for others, even at a cost to themselves. The same deep empathic concern for disadvantage observed in prosociality, however, is also commonly found in depression — a major health concern characterized by emotional distress and rumination that is the fourth leading cause of disability worldwide. But why might a stronger concern for others, or more specifically for equality among individuals, be linked to depression?

Tanaka et al. tackle this question in an exciting study now published in *Nature Human Behaviour*, providing new insight into the neural mechanisms underlying economic inequity and its relation to the symptomology of depression. In healthy non-clinical individuals, they measured: (a) depression indices at the time of the experiment and again one year later; (b) sensitivity to unfairness while playing an ultimatum game during functional magnetic resonance imaging (fMRI); and (c) an individual's social value orientation via a separate behavioural task. In the fMRI experiment (the ultimatum game), one player (a proposer) offers a way to split a pool of money (for example, 500 yen). The other player (a responder) can accept the offer, allowing both players to receive their share, or reject it, whereby neither player receives anything. Participants were always in the role of responder, making economic decisions to accept or reject when given fair offers (50/50 split), disadvantageous unfair offers (other > self) and advantageous unfair offers (self > other).

Importantly, some participants (that is, the prosocials) were self-sacrificing and rejected money from unfair offers that did not promote equity, while others (the individualists) were more selfish and kept the offered money despite inequity. An interesting question was whether the inequity of the offer (that is, monetary difference in the distribution of assets between self and other) would be differentially represented in the brain as a function of this social value orientation. The authors postulated the involvement of two temporal medial lobe structures — the amygdala and hippocampus — given their involvement in stress, mood disorders and sensitivity to unfairness during economic decision-making.

To explore a potential biological link with depression, the authors employed model-based multivoxel pattern analysis (MVPA) methods. Rather than measuring simple magnitude changes, MVPA allows for the input of neural activity patterns in a specified region (such as the amygdala) evoked by a defined feature (such as inequity) that then can be used for prediction of another variable (such as depression). They could then compare their MVPA-predicted depression indices to real-life depression symptoms measured by a widely used self-report inventory. They discovered that neural responses tracking disadvantageous inequity in the amygdala/hippocampus did in fact predict both current indices of depression and the change in symptoms a year later in all participants (both prosocials and individualists). Such findings could not be attributed to demographics (age, gender, income or social hierarchy) or even behaviour during the ultimatum game itself (rejection ratio).

The authors next included advantageous unfair offers in their MVPA analysis, and the results were even more striking. Notably, the neural response pattern tracking both advantageous and disadvantageous inequity in the amygdala/hippocampus now only predicted depression in prosocials but not individualists. The authors reasoned that
this was due to prosocials disliking any type of unfairness. This finding speaks to the core values of prosociality — a greater empathic concern for others, even when there is a cost to self. This is consistent with the authors’ finding that prosocials scored higher on depression indices, especially for feelings of guilt. Interestingly, the results offer a tantalizing translational perspective on previous research showing that amygdala responses to unfairness positively correlate with a prosocial's distaste for it.

That the amygdala and hippocampus both track sensitivity to unfairness (correlating with depression) fits well with the finding that both structures are functionally and structurally compromised in depression. One possibility is that neural responses to unfairness are reminiscent of a hypothalamic–pituitary–adrenal (HPA) axis stress response, which is thought to be a precursor to depressive episodes. Stress triggers the release of cortisol from the HPA axis, leading to an excitation of regions such as the amygdala — a dynamic that maps onto the current finding. However, the exact direction of this brain-mood relationship — whether neural reactivity to unfairness leads to depression, vice versa, or some third variable mediates the two — remains to be explored.

Another outstanding question is whether a heightened neural or physiological response to unfairness competes with executive processes necessary for emotion regulation. Individuals afflicted with depression have diminished capacity for emotion regulation coupled with high reactivity to negative affective states, including stress. In previous studies of economic unfairness, a region implicated in emotion regulation (the dorsolateral prefrontal cortex) was significant for regulating reactions to unfairness, with disruption of this region by transcranial magnetic stimulation leading to more acceptance of unfair offers. It is also worth considering whether engaging in strategies aimed at enhancing positive feelings, such as reminiscing about positive memories (which has been shown to reduce the HPA axis stress response), would also be effective for diminishing negative feelings associated with unfairness.

A final thought is whether depression can be predicted by neural responses to other decisions or social behaviours that evoke similarly strong feelings of unfairness, or even other negative affective states (for example, moral dilemmas inducing guilt or conflict, experiencing social or romantic rejection, or the mere experience of a stressful event). The thought-provoking work by Tanaka and colleagues provides an appealing approach to explore these questions and highlights potential risk factors that can precipitate or exacerbate the debilitating nature of depression.

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