

Scientists observe altruism and selfishness in brain activity

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Prosocial behavior is fundamental to the sustainability of society, enabling people to work in groups, to create larger and more successful social structures, and to contribute to the common welfare. However, despite the importance of altruism, science has only a limited

understanding of how prosocial behaviors and selfish behaviors are represented in the brain. Additionally, individual transition between self-benefiting behavior and altruistic behavior is not well understood.

An international, multidisciplinary group of scientists designed an experiment to answer two specific questions: What makes some people more prosocial than others? And how does the brain enable people to value the welfare of others? They have published their results in the *Proceedings of the National Academy of Sciences*.

The study reveals the neurological representation of prosocial and selfish behaviors in specific brain structures. Additionally, the authors report that they are able to distinguish between prosocial behaviors and selfish behaviors based on the spatial gradients of activity in the median [prefrontal cortex](#) (MPFC), and to quantify individual differences in prosociality.

Assessing behavioral and neural processes for altruism

The experiment involved 30 test subjects. The researchers designed a prosocial learning task that placed two participants in an aversive condition—a clinical description for blasting loud, annoying sounds at them. One of the subjects, whose brain activity was monitored via fMRI, was presented with a set of choices between two alternatives to achieve a higher probability of benefiting either herself or the other subject by reducing the duration of aversive sound exposure.

In different conditions, two of three options were represented visually by fractal images and associated with a system of earned points—a SELF condition, in which only the participant in the scanner benefited, an OTHER condition, in which only the other participant benefited, and a

BOTH condition, in which both participants benefited. One of the two options presented per experiment had a higher probability of yielding points than the other: 70 percent vs. 30 percent. The subject in the scanner learned about these probabilities through trial and error. Participants were told that they would be exposed to the unpleasant noise for five minutes after the task, and that earned points would be used to reduce the duration of the noise for themselves and/or the other participant.

The researchers predicted that if subjects valued the welfare of others, then the other-regarding outcome (meaning the points earned through decision making to reduce the aversive noise for the other) would increase their performance above the level of pure chance and earn more points for the other participant than if they selected randomly.

Results

- Altruistic subjects chose the OTHER option significantly more often than chance level when there was a high reward probability (HRP). Some subjects showed equal preference for the HRP option in the SELF and OTHER condition, while others showed such a preference only in the SELF condition.
- The researchers hypothesized that the ventral and dorsal subregions of the MPFC would be involved, respectively, in assessing self- and other-regarding values. They found that the MPFC was engaged in computing the value of the chosen option in all three conditions.
- The value signal for SELF was stronger in ventral regions of the MPFC, while the OTHER value signal was stronger in more dorsal regions.
- Spatial separation of self- and other-regarding value signals in the MPFC was stronger in the selfish group than in the prosocial group; the difference between the groups arose mainly in the

OTHER condition—that is, the value signal was only significant in selfish individuals and attenuated in altruistic subjects. This supports the idea that prosociality requires a shared value representation for SELF and OTHER.

- Selfish individuals appear to use cognitively demanding processes in order to interrupt the the process of prosocial valuation. The authors note that these processes merit further investigation.
- The authors write, "Our results suggest that the [ventromedial prefrontal cortex](#) is tightly associated with subjective valuation regardless of the choice's beneficiary, whereas the dorsomedio prefrontal cortex is involved in more general other-specific processing commonly required for other-regarding choices invariant across individuals."

More information: "Spatial gradient in value representation along the medial prefrontal cortex reflects individual differences in prosociality." *PNAS* 2015 ; published ahead of print June 8, 2015, [DOI: 10.1073/pnas.1423895112](#)

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