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Neurobiology

On Where Altruistic Behaviour can be found in Our Brain

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ABSTRACT
What neuroscience has found about the brains of "selfish" and "selfless" people.

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We, human beings, are made in a way as to understand each other through external features, such as voice tone, facial expression and body language. All this information together with the natural context allows us to quickly and intuitively interpret the behaviour of others, their actions, and their possible motives. These interpretations, though sufficient in daily life, are subjective and very much context-dependent, and thus not satisfactory for scientists. To understand what is *really* driving our behaviour scientists need to look 'under the hood': to observe the activity of our brain, and find tangible fingerprints of what incites us to act – our motives.

Now we can do this using a big donut-like machine that you've surely seen in the movies: *fMRI,* or *functional magnetic resonance imaging* method. With this method we can monitor rapid changes of the blood flow in the fine network of tiny vessels that penetrate our brain and supports it with oxygen. The logic is simple: naturally every second we're faced with different psychological tasks that are immediately broken down in our brain into 'smaller' sub-tasks, performed by different sub-regions of our brain. The brain region that is more active at a given time craves for more oxygen and thereby the local vessel network paces up the blood circulation. And this we can see through *fMRI*.

This is the way the group of researchers at the University of Basel tried to map a typical activity pattern that could represent a function of motives in our brain. They took into investigation a curious instance of motivation: altruistic behaviour. To do this, they asked participants to play a game of three players, where the tested person ('subject') underwent *fMRI* recordings while playing. The game would simulate three different types of altruistic ('helping others at own expense') behaviour:

1) We see someone suddenly in pain. This observation can make us empathic for this person; which, in turn, can motivate us to help them. Scientists named this decision *empathy-driven altruism*.
2) If, on the other hand, we feel a sudden pain and someone helps us, we may help them back later on. Scientists named this decision *reciprocal altruism.*
3) Finally, if we decide to help someone for no obvious reason, scientists termed this decision '*homegrown' altruism.*

The game was played in a roulette-style: every round a random player received non-dangerous electric shocks. The way to escape the shocks was to allocate sums of 'money' on the own or others' score. A special scheme of electric shocks put each subject into the right emotional context: the subject's shocks were painful only half of the time, while the 'victim's' charges were mostly painful. The neutral partner was always getting painless charges. Note that the *empathy-driven* and *reciprocal altruism* were tested in two different groups of subjects.

Brain activity through time showed that altruistic behaviour in the given exercise reveals itself as activity of three functionally connected brain regions: the anterior insula (AI), the left ventral striatum (VS), and the anterior cingulate cortex (ACC).

It's not the first time these regions come up as related to altruistic behaviour. And that's great, because it makes us surer that indeed these are the right regions to focus on. But the study went further than that. Using a more refined analysis, scientists realized that two very similar behaviours – *empathy-based altruism* and *reciprocal altruism* – show different activity patterns in these three regions. This means that just by looking at the brain activity, one can understand which motive drove the subject to help: empathy, or reciprocity. This kind of knowledge was never accessible to us before, and psychologists blindly had to assume that different motives could only lead to different behaviours.

The researchers studied their data from yet another angle. They used the '*homegrown' altruism* score to classify the tested subjects into two hypothetical groups – 'selfish' and 'prosocial'. They found that this division was supported at the neuronal level: the two groups of people strongly differed in the connectivity of their altruistic network: between ACC and AI regions. But what was really surprising is that the people who more frequently offered help to neutral participants (the 'prosocial' group), also had a tendency to be *reciprocal* altruists, that is to share more often their help with the person who helped them before. On the other hand, the subjects who rarely offered help to neutral participants were more willing to share their help following the empathy motive, i.e. when their act was moved by the sheer view of other person's pain.

The results of this study, as of any other laboratory study, have to be interpreted with caution: laboratory tests are designed painstakingly, while the "real world" around us is uncontrollably messy, and the conclusions of the tests cannot be plainly applied to it. So we shouldn't right now point at one of our "prosocial" friends and cry to them: "Aha! So you're not so selfless in the end!" What is really great is that we now have new profound insights into the neural underpinnings of human motives, something that, until now, was purely a mental concept.