I feel you: Emotional mirror neurons found in rats

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Researchers from the Netherlands Institute for Neuroscience have found that the rat brain activates the same cells when they observe the pain of others as when they experience pain themselves. In addition, without the

activity of these mirror neurons, the animals no longer share the pain of others. Finding the neural basis for sharing the emotions of others is an exciting step toward understanding empathy.

Why is it that people can get sad when they see someone else crying? Why is it that people wince when a friend cuts his finger? As many psychiatric disorders are characterized by a lack of empathy, finding the neural basis for sharing the emotions of others and modifying how much an animal shares such emotions is an exciting step toward understanding empathy and these disorders. The findings are published in *Current Biology*.

Human neuroimaging studies have shown that when people experience pain, they activate a region of the brain called the cingulate cortex. When they observe someone else in pain, the same region is activated.

The researchers formulated two speculations: (a) The cingulate cortex contains mirror neurons, i.e., neurons that trigger feelings of pain and are also activated when people see the pain of others, and (b) this is the reason why people wince and feel pain when observing the pain of others. This intuitively plausible theory of empathy, however, remained untested because it is not possible to record the activity of individual brain cells in humans. Moreover, it is not possible to modulate brain activity in the human cingulate cortex to determine whether this brain region is responsible for empathy.

Rat shares emotions of others

For the first time, researchers at the Netherlands Institute for Neuroscience were able to test the theory of empathy in rats. They showed test rats other rats receiving an unpleasant stimulus (mild shock), and measured what happened with the brain and behavior of the observing rat. When rats are scared, their natural reaction is to freeze to

avoid being detected by predators. The researchers found that the rat also froze observing another rat exposed to an unpleasant situation.

This finding suggests that the observing rat shared the emotion of the other rat. Corresponding recordings of the cingulate cortex, the region thought to underpin empathy in humans, showed that the observing rats activated the same neurons in the cingulate cortex that are active when the rat experienced pain in a separate experiment. Subsequently, the researchers suppressed the activity of cells in the cingulate cortex through the injection of a drug. They found that observing rats no longer froze without activity in this brain region.

Same region in rats and humans

This study shows that the humans share the pain of others by activating the same cells that trigger actual pain. So far, this had never been shown for emotions—so-called mirror neurons had only been found in the motor system. In addition, this form of pain empathy can be suppressed by modifying activity in the cingulate cortex.

"What is most amazing," says Prof. Christian Keysers, the lead author of the study, "is that this all happens in exactly the same brain region in rats as in humans. We had already found in humans that brain activity of the cingulate cortex increases when we observe the pain of others, unless we are talking about psychopathic criminals, who show a remarkable reduction of this activity."

The study thus sheds some light one these mysterious psychopathological disorders. "It also shows us that empathy, the ability to feel with the emotions of others, is deeply rooted in our evolution. We share the fundamental mechanisms of empathy with animals like rats. Rats had so far not always enjoyed the highest moral reputation. So next time, you are tempted to call someone 'a rat,' it might be taken as a compliment..."

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