Area of the brain affected by autism detected

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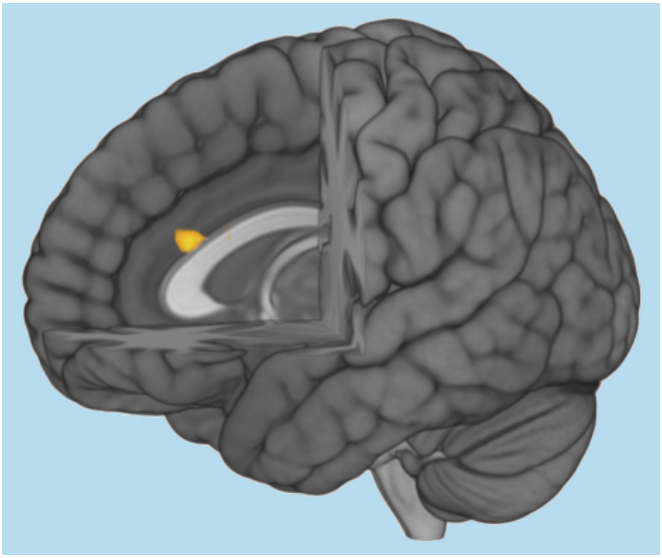

Unusually weak neural responses (yellow spot) in the anterior cingulate cortex: autistic people find it hard to imagine themselves in somebody else's position. Credit: Joshua Balsters / ETH Zurich

Brain researchers at ETH Zurich and other universities have shown for the first time that a region of the brain associated with empathy only activates very weakly in autistic people. This knowledge could help to develop new therapies for those affected by autism.

Professor Nicole Wenderoth and her senior scientist Joshua Balsters, both researchers at ETH, have used functional MRI images (fMRI) from autistic adolescents to discover unusual activity in a particular region of the brain, the anterior cingulate cortex (ACC).

The researchers were aware that activity in this part of the brain is coupled with the "theory of mind", which makes it possible for most people to understand others because they can imagine themselves in their place. Empathy, the emotional counterpart to the "theory of mind", is also based in this region of the brain.

The model cannot be updated

The researchers were able to detect the unusually weak neural activity in this part of the brain when the autistic subjects observed how a third person was either positively or negatively surprised. In the control subjects without autism, neural activity showed a marked response.

"People don't like surprises," says Wenderoth, Professor for Neural Control of Movement at ETH Zurich, "which is why, through environmental stimulus, the brain continually develops models of what is going on in the minds of others." This ability is enormously important for social interactions. "People with autism, however, cannot update the model in their head in such cases because the response in the cingulate cortex is too weak," says Wenderoth.

Games in the MRI

In order to see into the heads of the study participants – 16 autistic and 20 typically developed adolescents without autism – they were placed into an MRI scanner, where they observed a game they had previously played themselves.

The game involved guessing which of two doors had a reward behind it. If the player opened the right door, it turned green and they received a euro as a prize; if they guessed wrongly, the door turned red and had nothing behind it. This rule applied during the majority of the game, but sometimes – at random intervals – the computer swapped the colours; the red door led unexpectedly to a prize, while the green door revealed nothing. After each round, the researchers asked the subjects if they had expected the prize or nothing.

Predicting creates difficulties

Their findings showed that if autistic subjects played the game themselves, they had no problems answering whether receiving the prize or nothing was surprising or expected. When they watched another person playing the game, however, they found it much more difficult than the non-autistic subjects to classify the result of a round as a surprise.

After an unexpected result – e.g. if the selected door turned green but there was no prize behind it – there was a clear neural response in the ACC of the non-autistic participants of the control group, but there was much less activity in the autistic adolescents.

Social deficit linked with abnormal activity

"The results of our study suggest that the anterior cingulate cortex reacts atypically to the deviation between expectation and actual events in people with autism. Their neuronal activity only shows a slight change during situations in which other people experience something unexpected," says ETH senior scientist Balsters, who designed the experiment and conducted it with participants in Ireland. "This made it clear to us that the social deficit of autism sufferers is associated with this abnormal activity in the ACC."

The new findings could help to improve behavioural therapies for individuals with autism disorders, such as when teaching affected individuals how to behave. "It's often unclear whether autistic people can't do something or are simply not motivated to do it," says Balsters. He thinks that it may prove promising to offer a specific reward to those affected in order to train their social behaviour. "The brain is sufficiently plastic when we carry out the therapy properly," he says.

More information: Joshua H. Balsters et al. Disrupted prediction errors index social deficits in autism spectrum disorder, *Brain* (2016). DOI: 10.1093/brain/aww287

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