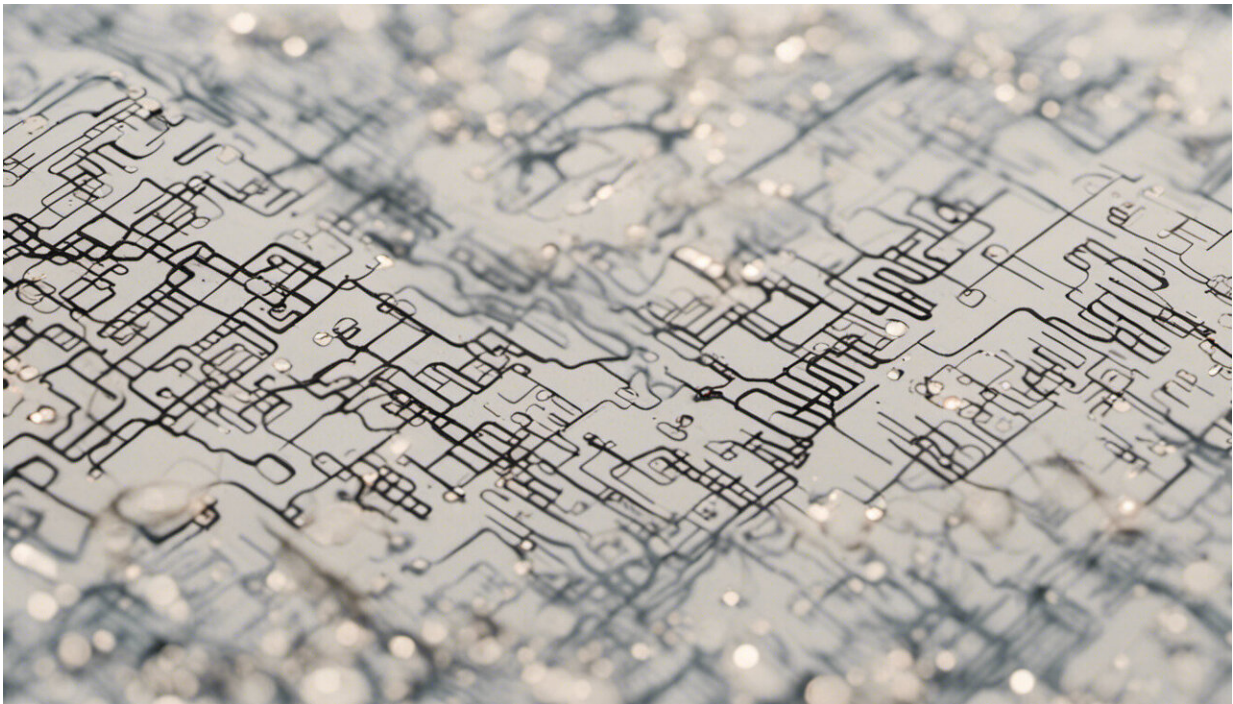


Predicting antisocial behaviour from the neurobiology of empathy

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Credit: AI-generated image ([disclaimer](#))

Empathy encourages prosocial behavior, while an empathy deficit has been linked to psychological disorders. By further examining the mechanisms involved, new research hopes to offer risk analysis and better treatment for antisocial behaviour.

A lack of [empathy](#) is considered to be one of the hallmarks of a range of psychiatric conditions, including Conduct Disorder, Antisocial Personality Disorder, Narcissistic Personality Disorder, Intellectual Disability and Major/Mild Frontotemporal Neurocognitive Disorder. If this trait can be identified early enough it is anticipated that predictions can be made about the likelihood of [antisocial behaviour](#) manifesting into adulthood, holding out the prospect of effective strategies for intervention, including drug treatment.

The EU-funded project MATRICS recently published a study outlining the results of their research into the degree to which emotional states can be socially transmitted in mice ([emotional contagion](#)). They were interested in the indication of empathy and how this correlated with the mice's behaviour. The team found that mice scored to be Emotional Contagion Resistant (ECR) displayed characteristics of reduced sociability, impaired memory of negative events and reduced physiological response to external stressors.

Emotional contagion

Publishing in the journal *PLOS ONE*, the team outlines how they started with 40 genetically identical male mice. These mice were left alone for 18 days, then at seven weeks old they were evaluated against an emotional contagion test. This allowed the researchers to select two subgroups of mice exhibiting extreme traits, either very high or very low emotional contagion.

To investigate whether low levels of emotional contagion correlate with other behavioural measures, the team performed a series of social behavioural tests on the mice at different ages, looking at aggression, pain perception and response, memory and punishment learning. The tests included: a resident-intruder test at 15 weeks; social approach test at 22 weeks; novel object recognition test at 25 weeks; cued fear-

conditioning test at 26; response to restraint stress at 27 weeks and a hot-plate [test](#) at 28 weeks. Four weeks after the end of the behavioural testing, blood and brain samples were also collected.

The study showed that profiles with low emotional contagion correlated with impairments in social behaviour, emotional memory and physiological stress reactivity. Crucially, the team also found links with neurochemical changes in brain pathways within these [mice](#) showed increased levels of the hormones oxytocin and vasopressin, along with reduced density of the receptors for a protein called brain-derived neurotrophic factor in the parts of the brain influencing behaviour.

The underlying neurobiological mechanisms

Empathy is central to determining the quality of social relationships, as well as ultimately influencing individual fitness. It develops alongside emotional and cognitive processes. Emotional [contagion](#) is often considered to be one of the basic building blocks of more complex empathy, requiring the ability to physiologically adopt another's emotional state. Empathy for pain is one such example and has been demonstrated to be socially transmitted in rodents.

Some of the neurobiological mechanisms underlying empathy have been uncovered with evidence for the involvement of the prefrontal cortex, anterior cingulate cortex, ventral tegmental area, thalamus and amygdala areas of the brain in controlling empathetic behaviour.

The MATRICS (Multidisciplinary Approaches to Translational Research In Conduct Syndromes) project was set up to increase our understanding of the prevalent condition known as Conduct Disorder (CD), which affects 2-10 % of children.

CD is characterised by aggression, limited prosocial behaviour, reduced

emotionality, shallow or deficient affect, diminished physiological stress reactivity, social norm violation and antisocial behaviours. Due to its complex nature it is still little understood. As well as using animal models, the project is working with existing data-sets to which it is applying machine learning tools to develop algorithms to predict aggression into adulthood. This will then allow for pilots for new medication and neuro/biofeedback treatments.

More information: Giovanni Laviola et al. Low empathy-like behaviour in male mice associates with impaired sociability, emotional memory, physiological stress reactivity and variations in neurobiological regulations, *PLOS ONE* (2017). [DOI: 10.1371/journal.pone.0188907](https://doi.org/10.1371/journal.pone.0188907)

Project page: matrices-project.eu/

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