

# ADHD medicine affects the brain's reward system

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The scientists' model shows how some types of ADHD medicine influence the brain's reward system.

(Medical Xpress)—A group of scientists from the University of Copenhagen has created a model that shows how some types of ADHD medicine influence the brain's reward system. The model makes it possible to understand the effect of the medicine and perhaps in the longer term to improve the development of medicine and dose determination. The new research results have been published in the *Journal of Neurophysiology*.

In Denmark approximately 2-3 per cent of school-age children satisfy [diagnostic criteria](#) for ADHD, and therefore it is crucial to know how the medicine works. With a new mathematical [reconstruction](#) of a tiny part of the brain region that registers reward and punishment, scientists from the University of Copenhagen are acquiring new knowledge about the effect of ADHD medicine. When reward and punishment signals run

through the brain, the [chemical dopamine](#) is always involved.

"It has been discussed for years whether treating ADHD with Ritalin and similar drugs affects the [reward system](#) to any significant degree, simply because the dosage given to patients is so low. We are the first to show that some components of the dopamine signalling pathways are extremely sensitive to drugs like Ritalin. We have also developed a unified theory to describe the effect of such drugs on the dopamine signal," says Jakob Kisbye Dreyer, postdoctoral candidate at the Department of [Neuroscience](#) and Pharmacology, Faculty of Medical and Health Sciences, University of Copenhagen, where the model was developed.

He emphasises the importance of knowing exactly what happens during treatment with drugs like Ritalin. This is in order to develop better and more targeted medicine, as well as to understand the psychology underlying ADHD. The actions of human beings are motivated by an unconscious calculation of cost relative to expected gain. The scientists' results show that ADHD medicine specifically reduces signals about anticipated punishment.

## Reward and punishment

In the brain, dopamine contributes to series of processes that control our behaviour. Actions such as eating, winning a competition, having sex or taking a narcotic drug increase dopamine release. Scientists think that dopamine helps motivate us to repeat actions that have previously been associated with reward.

"Control mechanisms in the brain help keep the dopamine signal in balance so we can register the tiny deviations that signal reward and punishment. We discovered while trying to describe these control mechanisms that our model can be used to examine the influence of

Ritalin, for example, on the signal. Suddenly we could see that different pathways of the reward system are affected to different degrees by the medicine, and we could calculate at what dosage different parts of the signal would be changed or destroyed," says Jakob Kisbye Dreyer.

## Different dosage, different effect

Drugs such as [Ritalin](#) can have paradoxical effects: high dosage increases the patient's activity while low dosage reduces it. Therefore it can be a laborious process to find the right dosage for a patient.

"We can explain this double effect using our theory. The dopamine signal in the part of the brain that controls our motor behaviour is only affected at a higher dose than the dose usually prescribed for treatment. Also, our model shows that the threshold between a clinically effective dose and too high a dose is very low. That may explain why the small individual differences between patients have a big impact on treatment," says Jakob Kisbye Dreyer.

In the long term, the scientists hope that their new insight will help doctors determine the correct dose for each patient. The model can also help us understand what signals in the brain affect not only [ADHD](#), but schizophrenia, Parkinson's disease and drug abuse as well.

**More information:** [jn.physiology.org/content/earl ...  
.00502.2012.abstract](http://jn.physiology.org/content/earl...00502.2012.abstract)

Provided by University of Copenhagen

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