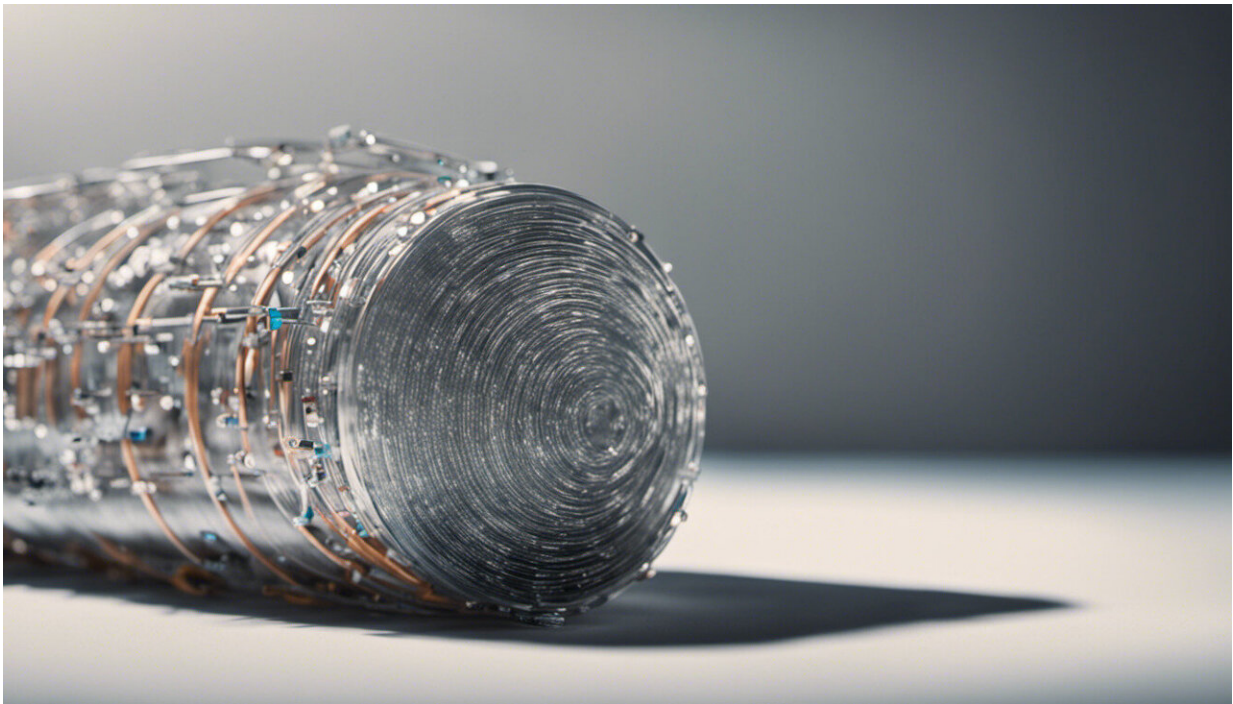


# ADHD: Emotional problems may be the missing link

June 12 2023, by Barbara Jacquelyn Sahakian and Christelle Langley

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Attention deficit hyperactivity disorder (ADHD) is one of the most [common mental health disorders](#) in children, affecting 7.2% of people [under the age of 18](#) worldwide. Many of these children [will still have ADHD](#) in adolescence and adulthood.

ADHD is diagnosed using criteria from a document called DSM-5, which [include symptoms](#) of inattention, hyperactivity and impulsivity. But it is becoming increasingly clear to researchers that the condition also comes with self-control problems, affecting the ability to regulate emotions.

For example, 2.1% of children with a diagnosis of ADHD also have [a mood disorder](#), such as depression, while 27.4% have an anxiety disorder. Many also have outbursts of verbal or physical aggression.

These previously understudied aspects of the condition are now providing fresh insights into what's going on in the brain of someone with ADHD—raising hopes for new and improved treatments.

If ADHD is not treated effectively, it can have major effects on a child's mental health and well-being, as well as educational attainment. It may also impact on parents and siblings, as well as other children in the classroom.

So what is the neural link between ADHD and emotions? In our new study, [published in \*Nature Medicine\*](#) with colleagues at Fudan University in China, we identified a general brain basis—that we call the Neuropsychopathological Factor (NP Factor)—underlying symptoms of multiple mental health disorders, from depression to ADHD.

By using a combination of neuroimaging, cognitive and [genetic data](#), we discovered that many mental health conditions may be linked to a unified, genetically determined problem of "synaptic pruning."

This process typically occurs in childhood and removes extra synapses (brain structures that help brain cells transmit electrical or chemical signals) in order to ensure that our brains are efficient and connections between regions are optimal.

This problem with pruning may be an underlying cause, explaining why children with ADHD often have other mental health conditions too. Ultimately, it leads to delayed development of the prefrontal cortex, which is responsible for the "cognitive control" we have over our emotions and behavior. That means people with ADHD can struggle with their emotions.

Delayed development of the prefrontal cortex may also explain why children with ADHD often have cognitive deficits, such as problems with [executive functions](#) (for example planning, self-monitoring, self-control and working memory). But then, so do children with depression and anxiety. So which is ultimately the root of the problem?

One [recent and large study](#) of 11,876 children, aged 9-12, provides a clue. At the University of Cambridge, we found that the cognitive deficits in children with more ADHD symptoms were related specifically to problems with attention, rather than emotions.

Children with anxiety and depression symptoms only exhibited those deficits if they also had problems with attention. So it seems that one possible route to helping children with ADHD or mood disorders with [cognitive development](#) is to focus on improving their attention.

## Treatments

Another way to learn more about ADHD is by studying the effects of the drugs used to treat it. The main pharmacological treatment for ADHD is called methylphenidate, or Ritalin.

Methylphenidate roughly works by increasing [three chemicals in the brain](#): dopamine, serotonin and noradrenaline. Dopamine [can improve](#) attention, learning, working memory and motivation, while noradrenaline [reduces impulsivity](#) and boosts attention. Serotonin is

known to [improve symptoms](#) of anxiety and depression.

We know a considerable amount about which areas of the brain these drugs target. Indeed, the dopamine system affects multiple brain regions.

One study showed that attention was improved by methylphenidate treatment and that this was associated with increases in dopamine in the brain's [ventral striatum](#) (a region involved with reward and motivation). This means the dopamine reward/motivation circuit in the brain is probably important in ADHD.

Another study showed that methylphenidate improved working memory, which is known to be affected by dopamine, and showed increased blood flow to the [prefrontal and parietal cortices](#) –important areas for executive function. This research suggests that cognitive control, which is associated with frontal areas, can be improved by methylphenidate.

It also backs up our finding that ADHD is linked to delayed development of the prefrontal cortex, making it harder to exert [cognitive control](#).

Similarly, a further study showed that methylphenidate [significantly improved](#) emotional symptoms in adults with ADHD. But we still don't know whether methylphenidate is working to control emotion in a top-down way through the prefrontal cortex, or whether it is working directly on emotion processing itself, or a combination of both.

That said, it is now becoming clearer that a problem with regulating emotions is a core symptom of ADHD, and not simply a co-occurring issue. As such, emotional dysregulation is an important target for treatment.

Cognitive behavioral therapy is effective in treating problems of self-control and low mood. This should be offered to children with ADHD,

in conjunction with pharmacological treatments.

## ADHD on the rise

The number of ADHD diagnoses are rising across the world, and so are prescriptions of methylphenidate. Indeed, according to the National Health Interview Survey, the prevalence of diagnosed ADHD among [children](#) and adolescents aged four to 17 in the past 20 years [have increased](#) from 6.1% to 10.2% in the US.

In the UK, a study estimated that the use of ADHD medications [has increased by almost 800%](#) from 2000 to 2015.

With the increasing use of technology and remote school and work, we are multi-tasking and splitting our attention, [rather than focusing it](#) on one task at a time, more than ever. It may be that the prevalence of ADHD will increase even more in the future as coping strategies become less effective and people seek help and ultimately receive a diagnosis.

Ironically, some of the solutions may rely on technology, such as cognitive training using game apps on an iPad or mobile phones, [for example Decoder](#), which has been shown to improve attention in young adults.

The more we learn about [brain](#) basis of ADHD, the easier it will get to treat.

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