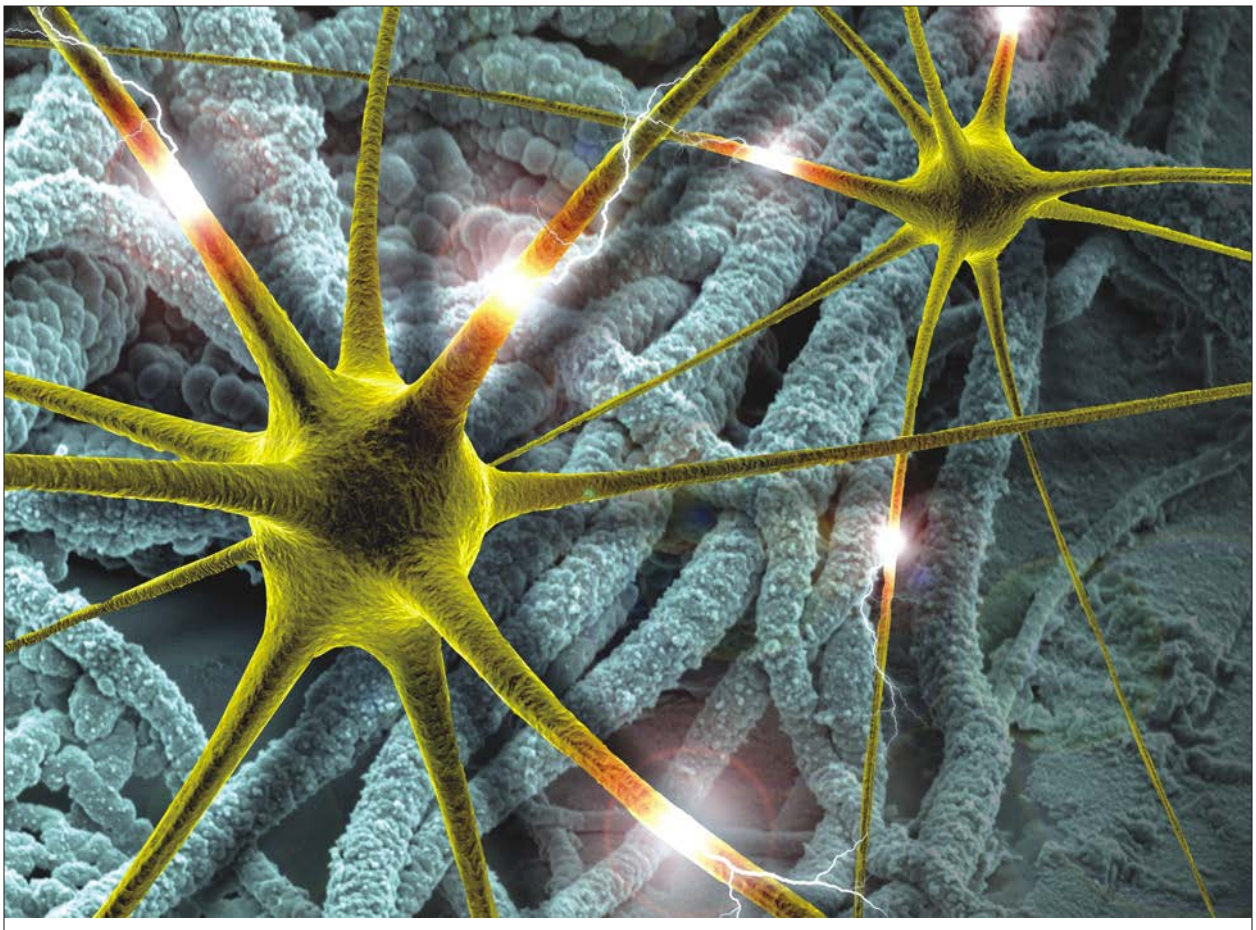

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Gene Linked to ADHD Allows Memory Task to Be Interrupted by Brain Regions Tied to Daydreaming

Neuroscientists at Georgetown University Medical Center (GUMC) say brain scans show that a gene nominally linked to attention deficit hyperactivity disorder (ADHD) leads to increased interference by brain regions associated with mind wandering during mental tasks Presented at the annual meeting of the Society for Neuroscience, these researchers believe their findings are the first to show, through brain scanning, the differences in brain network relationships between individuals with this particular form of gene and others with a different form.

"Our goal is to narrow down the function of candidate genes associated with ADHD, and in this study, we find this gene is tied to competition between brain networks. This could lead to increased inattention, but it likely has nothing to do with hyperactivity," says the study's lead author, Evan Gordon, a doctoral candidate in the Interdisciplinary Program in Neuroscience at GUMC "This is just one gene, and it does not cause ADHD but likely contributes to it. The disorder is believed to be due to a myriad of genetic factors." The gene in question is DAT1; its protein produces the dopamine transporter that helps regulate dopamine transmission between brain cells. The DAT1 gene comes in two alleles, or forms -- DAT1 10 and DAT1 9. People who inherit two 10 alleles (10/10) are said to be at greater risk for developing ADHD than people who inherit 10/9 alleles. Rarely does someone inherit two 9 alleles, according to Gordon; he says, in fact, that the10 allele is slightly more common than the 9 allele.

The biological significance of inheriting a DAT1 10 allele is that the brain produces excess quantities of dopamine transporters, and that results in less dopamine signaling between neurons. Too many dopamine transporters quickly scoop up dopamine released by neurons, leaving fewer available to actually reach other neurons and pass on a signal. If there are fewer transporters, more dopamine stays in the synapse between neurons, triggering a reaction. That is important, Gordon says, because dopamine is important for "gating" the transfer of information between brain regions -- that is, allowing or preventing new information to come in. "The belief is that dopamine helps teach certain brain regions how and when to gate, and that 10/10 carriers are not gating as quickly or effectively as is possible." That is exactly what the researchers found when they used functional MRI (fMRI) on a group of 38 participants. Half of the groups were 10/10 carriers and half were 10/9 carriers, and none of the participants were diagnosed with ADHD.

The researchers investigated the activity in two areas of the brain, the default mode network (DMN), which is associated with mind wandering or daydreaming and is active when the mind is at rest, and task-positive networks (TPNs), which are active during problem solving and other cognitive work. In this study, participants were asked to remember letters they saw on a screen inside the fMRI machine, and to recall them, thus activating TPNs. Scanning demonstrated that in 10/10 carriers, the mind wandering areas tended to communicate with regions performing memory tasks more strongly than in did in 10/9 carriers. "Dopamine in the 10/10 carriers was not doing a good enough job in preventing the mind wandering regions from interfering with memory performance regions, resulting in less efficient cognition," Gordon says. They also found no differences between genotype when the participants were at rest after their memory tasks.

"That tells us that the DAT1 genotype affects gating only when release of dopamine is high, such as during a memory task and that less dopamine signaling leads to increased inattention," he says. "Being a DAT1 10/10 carrier does not mean a person has ADHD; it is not a diagnostic marker," Gordon says. "It has been viewed as a contributing factor, and now we know one reason why." The study was funded by the National Institute of Mental Health.