

Tic Basics: Causes



What Causes Tics?

Like other medical conditions (e.g., asthma, diabetes, obsessive-compulsive disorder), tic disorders have a biological basis. Like these other conditions, tics are impacted by emotions, activities, and environments. This research on the biology of tics has helped us understand some of the things that can cause tic disorders.

Current Understanding of the Role of Genetics

Research has shown that tic disorders have a strong genetic basis. For example, many people with tics have relatives in their family who also have tics or other conditions that involve repetitive behaviors, such as Obsessive Compulsive Disorder (OCD). However, researchers are still working to understand how this happens.

Current Understanding of the Neurological Basis

Research shows that our brain is set up into circuits or “networks,” such that different areas of the brain work together to help us function in different ways. Each circuit is responsible for doing a particular task.

A group of circuits called the “Cortico-Striatal-Thalamo-Cortical” or CSTC circuits are responsible for tics (see picture below), particularly the motor circuit, associative circuit, and limbic circuit.

It can help to think of these circuits as different train tracks that travel through the brain. Using our train analogy, the basal ganglia is like a train yard—the place where all the tracks come very close together so that trains can be loaded and unloaded with information about movement.

Each CSTC circuit, or “train track,” carries different information. The motor circuit carries information about movements to do (“go”), the associative circuit carries information about movements to control (“stop”), and the limbic circuit carries emotional information about movement, like sensory urges.

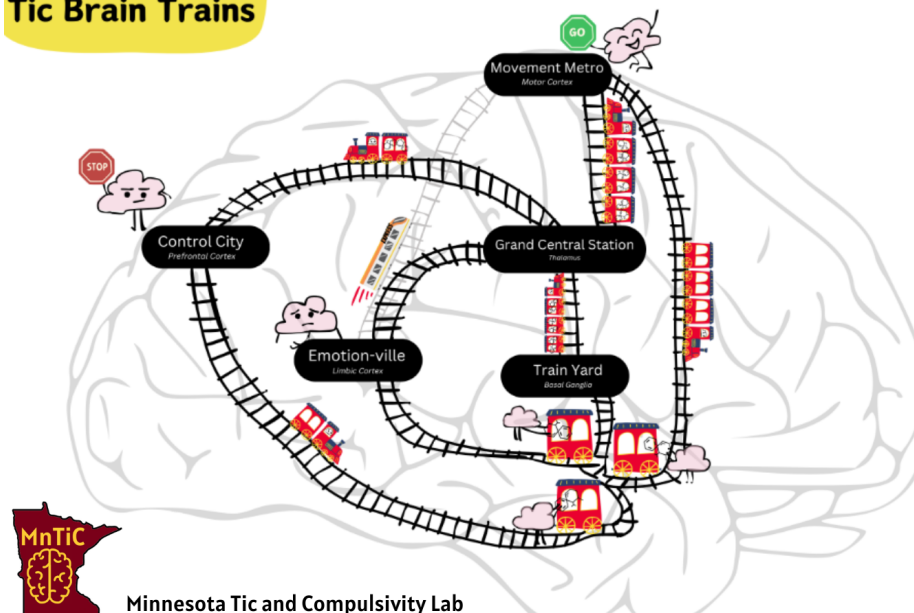
These circuits then travel through the thalamus, which is like the brain’s “Grand Central Station,” or the place where the tracks start to split off in different directions.

Next, each circuit travels out to a different “destination” in the cortex, which is the top layer of the brain. Finally, each circuit loops back to the basal ganglia with information about “what happened” when you did or didn’t do a movement.

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Tic Brain Trains



Current Understanding of the Way These Circuits Work in People with Tics

Research shows that:

1. The motor circuit is overactive in people with tics, such that their brain sends more messages telling their body to move and make sounds. You can think of it as “too much gas.”
2. The associative circuit is underactive in people with tics, such that their brain has a harder time controlling movements and sounds they don’t need to do or want to do. You can think of it as a “squeaky brake.”
3. The limbic circuit is more strongly connected to the motor circuit in people with tics, meaning that emotions like stress can more easily impact movements.

Research also shows that some neurotransmitters are involved in tics, especially dopamine. “Neurotransmitters” are the chemical messengers in brain circuits. They help different parts of the circuit and the brain communicate with each other. Medication can be helpful for tics because it can help these messenger signals perform better.

We also know that situational factors can impact tics. We think this is because of how different situational factors impact the CSTC circuits. For example, information about movement, such as watching someone else tic, can increase the “gas” in the motor circuit. Rewarding things that happen after a tic, like getting special attention or getting out of a test, increases dopamine in the motor circuit, making it *more likely* for the tic to happen in a similar situation in the future.

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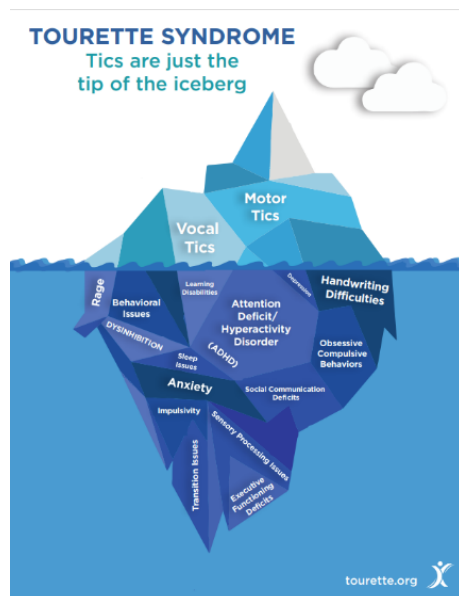


Stress and fatigue can weaken the associative circuit or make the brake more “squeaky,” such that tics are harder to control.

What are Other Common Conditions That Go Along with Tics?

It is common for people with TS to also experience other neurodevelopmental or neuropsychiatric conditions. These conditions can cause more impairment than the tics themselves. Some of these co-occurring conditions are related to the neurocircuitry of TS. The underactive associative circuit or “squeaky brake” is the same brain process that underlies ADHD, executive functioning and impulse control challenges, and behavioral issues. The overactive motor circuit can lead to hyperactivity and other repetitive behaviors.

Other co-occurring psychiatric conditions can occur as a result of the challenges people with tics can face, such as social anxiety and depression. Researchers think that people who are in unsupportive environments, who experience bullying or discrimination due to tics, or avoid important life activities are at a higher risk of developing these additional symptoms.



Additional Resources

Please note that this represents an update of what is included in Chapters 1-2 in the [Managing Tourette Syndrome: A Behavioral Intervention Workbook, Parent Workbook](#) by Dr. Doug Woods and several other tic experts. Additional information comes from the [Tourette Association of America](#) website.

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