

Tourette Syndrome

Making a Difference Today

Tourette syndrome (TS) is a neurological disorder characterized by involuntary, sudden, repetitive movements or vocalizations called tics. Symptoms typically first appear in childhood and range from simple tics, such as blinking, throat-clearing and shoulder shrugging, to complex and more disabling tics, such as jumping, touching objects and hitting oneself. Although coprolalia, the uncontrolled use of offensive language, has received considerable media attention, fewer than 15 percent of people with TS have this particularly embarrassing symptom. Such involuntary utterances seldom reflect the thoughts or opinions of the person with the disorder.

The exact cause of TS is unknown, but scientists believe it involves a malfunction in the basal ganglia, an area of the brain that helps control movements and more complex behaviors. The abnormal activity of dopamine and other brain chemicals that help transmit messages between neurons in the basal ganglia and other areas of the brain also appears to be implicated.

An estimated 200,000 Americans have full-blown TS, and as many as 300,000 more may have milder forms of the disorder. There is no cure, although people typically see their symptoms decrease as they reach their late teens and early 20s. Few, however, experience a complete remission. Most people with TS lead full, productive lives, but many also struggle with the symptoms of obsessive-compulsive disorder, attention deficit hyperactivity disorder (ADHD), sleep disorders, and learning disabilities. Some are prone to anxiety and depression, especially when they have endured teasing and stigmatization by their peers.

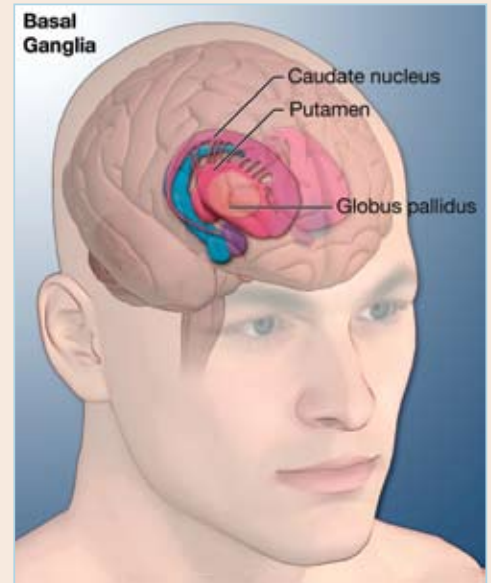
Research Advances Understanding

TS was thought to be a psychological disorder until the 1960s when scientists discovered that certain drugs could reduce tics by blocking the effect of dopamine on neurons. Subsequently, genetic research has revealed TS to be an inherited neurological disorder. In fact, a parent with TS has a 50-50 chance of passing on the gene(s)—and the clinical manifestations—to his or her child. A recent study funded by the National Institutes of Health (NIH) identified one potential TS-related gene, *SLTRK1*, on chromosome 13. Although *SLTRK1* is the first TS-related gene mutation to be identified, it is unlikely to account for more than a small percentage of TS cases. Many other genes, scattered throughout the human genome, are likely involved in causing this syndrome.

Other NIH-funded research—along with advances in brain imaging—have enabled scientists to unravel the mystery of what goes on in the brain that triggers the tics and vocalizations associated with TS. Of particular interest is an area of the basal ganglia known as the ventral striatum, where an excessive number of dopamine-containing nerve terminals have been found in people with TS. The striatum also tends to be slightly smaller in people with TS, particularly in children who develop severe tics and obsessive-compulsive disorder.

Treatment Advances

Backed by resources of the NIH, scientists continue to search aggressively for effective ways to reduce the symptoms of TS. A wide variety of drugs are used to suppress tics and make life more manageable for people with the disorder. However, all cause side effects that can be particularly problematic for both children and adults. One of the more promising non-drug treatments is habit reversal therapy, which involves helping an individual with TS become aware of when a tic is about to occur and then training that person to replace the tic with a less bothersome physical response. Studies have shown that this therapy—which was developed as a direct result of basic science research into modifying neural circuitry—can reduce tic severity by up to 30 percent.



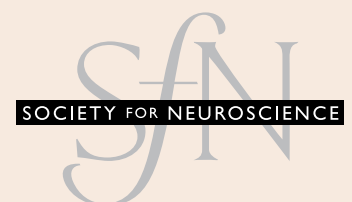
Symptoms of Tourette syndrome probably arise from a malfunction in the basal ganglia, an area of the brain associated with the coordination of body movement. Its separate components include the caudate nucleus, the putamen and globus pallidus.

Continued funding for research could lead to:

- A better understanding of the genetic and environmental factors that play a role in the development of tics and TS
- The discovery of new drug treatments that produce fewer side effects than current medications
- The continued development of effective non-drug treatments for managing tics and other TS symptoms

For more information please email brss@sfn.org.

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Tourette Syndrome

Making a Difference Tomorrow

Thanks to basic science research, neuroscientists have deepened their knowledge of what happens in the brain to cause Tourette syndrome. Yet despite such advances, a cure remains elusive, leaving thousands of American children and adults to struggle with the disorder's often disabling symptoms. Did you know that:

- TS symptoms usually first appear in children between the ages of 7 and 10 years.
- Boys are three to four times more likely than girls to develop symptoms of TS.
- All races and ethnic groups are equally affected by TS.
- A parent with TS has about a 50 percent chance of passing on the disorder to his or her child.

Research Brings Hope for the Future

With funding from the National Institutes of Health, scientists are making remarkable progress in understanding the basic neurobiology behind TS and related disorders. Genome scanning, an advanced method for finding genes for various diseases, is helping scientists track down TS genes (such as *SLITRK1*) that appear to be involved in the development of the disorder. Currently, a large multi-site consortium of researchers is scanning the entire human genome in an attempt to pinpoint the chromosomal location of all the genes that are closely associated with the various expressions of TS. Such a discovery would help shed light on how TS develops, which, in turn, would provide clues for the development of far more effective therapies.

Genes do not tell the entire TS story, however. Scientists are actively searching for environmental factors, such as exposure early in childhood to an exceptional stressor, medications or an infectious agent. Using advanced brain imaging technology, researchers are also attempting to determine which environmental factors might affect the emergence and severity of tics.

New technologies are also enabling scientists to focus on the subtle differences between the brains of people with TS and those without the disorder. For example, scientists are searching for the precise sub-regions within the striatum of the brain that are smaller in individuals with TS—and are determining how changes in those regions may predict the future course of the disorder. Such studies may one day enable scientists to design more individualized and thus more effective treatments for TS.

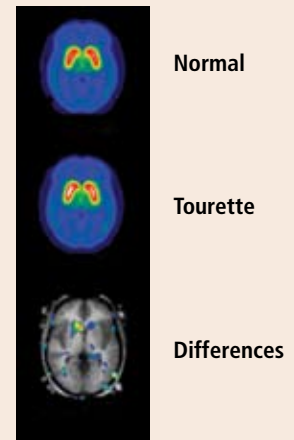
Research also continues into habit reversal therapy, a promising alternative to drug treatment for TS symptoms. NIH-funded studies are currently underway to determine exactly how this therapy works and to train clinicians around the United States in its practice.

For the treatment of very severe TS, scientists are also testing deep brain stimulation, a surgical procedure that involves implanting battery-powered electrodes into the brain to control unwanted movements. Individual reports of clinical benefit from this treatment have generated tremendous excitement among people with TS and their families, but the procedure remains experimental for this disorder. Much more research is needed.

Hope for Other Diseases

Research on one brain disease often promotes a better understanding of others. Consequently, funding for basic neuroscience research often produces knowledge and results that may benefit patients across multiple diseases. As scientists search for new treatments and a possible cure for TS, they are also unlocking the biological secrets of other closely related neurobehavioral disorders, such as obsessive compulsive disorder, attention deficit hyperactivity disorder, sleep disorders, and learning problems. In addition, continued funding for TS research promises to add to scientists' growing understanding of other dopamine-related illnesses, such as depression, schizophrenia and Parkinson's disease—disorders that disable millions of Americans annually.

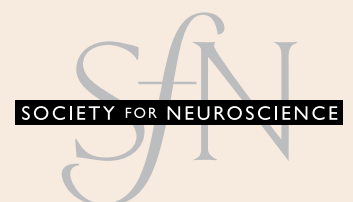
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The development of more sophisticated technology for carrying out and analyzing brain imaging has made it possible for scientists to observe subtle differences in the brains of people with Tourette syndrome. In order to discern the difference in activity between the brains of normal (top) and TS patients (middle), the magnitude of activity in various areas of the brain can be compared by subtracting the areas of greatest difference. The bottom “difference” image demonstrates parts of the basal ganglia and other areas that are more active in the TS patient.

Already research has led to:

- The understanding that TS is an inherited neurological disorder rather than a psychological one, lessening the social stigma that has been associated with it.
- The development of drugs that can help reduce severe tics and other TS-related symptoms
- The discovery of a single gene mutation that may play a role in at least some cases of the disorder
- Improvements in alternatives to drug treatments for TS, including habit reversal therapy



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