Brain images illuminate Tourette syndrome

A strange array of head jerks, facial grimaces, eye blinks, vocal outbursts, and other compulsive tics and behaviors characterize Tourette syndrome, a condition that affects roughly 200,000 people in the United States.

Drugs that block the action of the chemical messenger dopamine in the brain often quell the symptoms. But now researchers have obtained anatomical evidence linking the syndrome to supersensitivity of a certain class of dopamine receptors in the caudate nucleus, a brain structure implicated in the control of intentional actions.

Five pairs of identical twins in which one has moderate symptoms and the other severe symptoms of Tourette syndrome were studied with brain scans by a team at the National Institute of Mental Health Neuroscience Center in Washington, D.C. In each twin with severe symptoms, at the front of the caudate nucleus the researchers found heightened sensitivity of the dopamine receptors called D2.

The team, directed by Daniel R. Weinberger, recruited identical twins to control for genetic variations in brain function that make it difficult to compare brain scans of unrelated people. Each twin received an injection of a radioactively labeled drug, iodobenzamide, that binds to D2 dopamine receptors. A single-photon emission computed tomography scanner then measured how much of the substance attached to receptors throughout the brain. That measure reflects the sensitivity of the receptors to naturally occurring dopamine.

"Strikingly, the degree to which twins differed in caudate D2 binding predicted almost totally their differences in [Tourette syndrome] severity," asserts Weinberger. The team's results appear in the Aug. 30 SCIENCE.

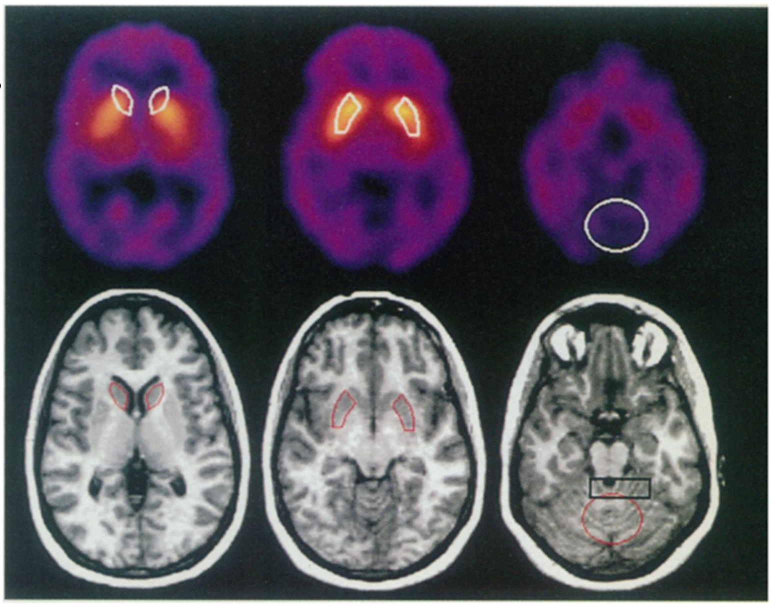
Although prior work supports a genetic basis for Tourette syndrome (SN: 7/21/90, p. 42), the differences in symptom severity between identical twins suggest that environmental factors, such as prenatal damage, also play a role, theorizes David E. Comings of City of Hope Medical Center in Duarte, Calif.

Brain-imaging studies of obsessive-compulsive disorder, which often occurs in conjunction with Tourette syndrome, also implicate the caudate nucleus. These findings support the theory that the underlying brain mechanisms in these two disorders overlap, Weinberger contends.

The "intriguing" new findings point to the need for research on the possible roles of other receptors in Tourette syndrome, holds Anne B. Young of Massachusetts General Hospital in Boston.

— *B. Bower*

Images in top row show greater drug binding in caudate nucleus, left, than in putamen, center, or cerebellum, right. Corresponding views of brain anatomy appear in bottom row.



Weinberger/SCIENCE

Hubble finds stormy weather above Jupiter

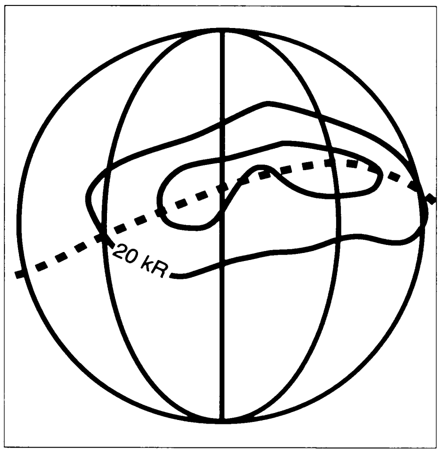
More than twice as massive as all the other planets combined, Jupiter is nonetheless too small to pass muster as a star. But in one respect, this heavyweight could still be a stellar contender. A new study suggests that Jupiter's atmosphere is just as turbulent and stormy as that of a bona fide star.

Using a Hubble Space Telescope spectrograph, researchers have deduced that hydrogen atoms in Jupiter's upper atmosphere are moving at supersonic speeds. Moreover, the velocities fluctuate wildly on a timescale shorter than 10 minutes, note Claude Emerich of the Institute of Spatial Astrophysics in Orsay, France, and the Institute of Astrophysics in Paris, John T. Clarke of the University of Michigan in Ann Arbor, and their colleagues.

"This behavior, unexpected in a planetary atmosphere, is evidence of the particularly stormy Jovian upper atmosphere, not unlike a star's atmosphere," the team writes in the Aug. 23 SCIENCE.

"To find velocities that high is really very surprising," agrees Donald E. Shemansky of the University of Southern California in Los Angeles.

The light analyzed by Hubble, known as Lyman-alpha emission, originates



A. J. Dessler et al./PLANETARY AND SPACE SCIENCE

Yellow region depicts Jupiter's Lyman-alpha bulge, which girdles the planet's magnetic equator (dashed curve).

from hydrogen atoms well above Jupiter's cloud tops. The spectrograph revealed that the emission forms an unusually wide spectral line, indicating that the atoms have velocities as high as 100 kilometers per second. Although another craft, the International Ultraviolet Explorer, had already hinted at such velocities, Hubble's higher sensitivity provides more compelling evidence, notes Clarke.

The hydrogen radiation forms part of the Lyman-alpha bulge, a ring of ultraviolet light that girdles Jupiter's magnetic equator. First observed by a short-flight rocket 18 years ago and seen by the Voyager spacecraft a few months later, the ring has eluded explanation.

The Hubble data can't identify what powers the ring or produces the high velocities. One explanation points to Jupiter's auroras, oval-shaped regions above the planet's north and south magnetic poles where charged particles crash and emit light. Jets of gas emanating from each magnetic pole might meet and collide near the magnetic equator, accounting for the Lyman-alpha bulge and the turbulent, high-speed motion of the hydrogen atoms.

Fast-moving hydrogen represents only one percent of the hydrogen in Jupiter's upper atmosphere. It's too soon to say whether the mechanism behind these high velocities could also be the solution to another mystery. The Voyager craft found that Jupiter—like Saturn, Uranus, and Neptune—has upper atmospheric temperatures too high to be accounted for by the sun's heat. The same force might power the hydrogen and heat the atmosphere.

— *R. Cowen*