

serves in the National Guard, says the case has already caused his name to be added to an immigration watch list: When his military unit reentered the United States after training in the Caribbean, he notes, he was delayed for hours while FBI officials checked out his story. "It's gotten Kafkaesque," he says.

University officials, meanwhile, have watched with concern as Foral's case has unfolded. Some schools, such as the Massachusetts Institute of Technology in Cambridge, had already hinted that the criminal sanctions and security requirements imposed by the Patriot Act and the more recent bioterrorism law (*Science*, 31 May, p. 1585) might force them to end research on regulated agents such as anthrax. "Many researchers are still unaware of these laws," says Atlas. "Deans are terrified," he adds, that one of their students could be next.

—DAVID MALAKOFF

PSYCHOLOGY

Violent Effects of Abuse Tied to Gene

Some children who suffer physical, sexual, or emotional abuse become violent adults. But many do not. Now a new study of both genetics and social surroundings points to the influence of a particular genotype on aggressive behavior in young adults from a troubled background.

On page 851, a team led by clinical psychologists Terrie Moffitt and Avshalom Caspi, both of King's College London and the University of Wisconsin, Madison, reports that a certain form of a gene that breaks down neurotransmitters makes men more likely to be violent, but only if they were maltreated as children. "This is a very important piece of work," says geneticist Greg Carey of the University of Colorado, Boulder. "It's pretty convincing for just a single study."

The gene codes for an enzyme called monoamine oxidase A (MAOA), which metabolizes several kinds of neurotransmitters in the brain. By getting rid of excess neurotransmitters, MAOA helps keep communication between neurons functioning smoothly. Studies of lab animals show that knocking out the MAOA gene makes adult mice more aggressive. The first suggested evidence in humans came from a 1993 report of a Dutch family (*Science*, 18 June 1993, p. 1722). Several men in this family had a defective MAOA gene—none of

the enzyme was found in their cerebrospinal fluid—and were prone to impulsive bouts of aggression. But because the mutation is extremely rare, no one has replicated the finding in other families.

To see whether the MAOA gene influences aggressive behavior in the broader population, Moffitt and Caspi's team turned to New Zealand's Dunedin Multidisciplinary Health and Development Study. The study, begun in 1972, has followed 1037 children since birth. Hoping to get as homogeneous a genetic background as possible, Moffitt and Caspi selected 442 subjects with four white grandparents. "It's about as refined as it can be," Moffitt says.

As expected, the team discovered that severely maltreated boys were more likely to exhibit so-called antisocial behavior than boys who had suffered little or no abuse. But the researchers also found that antisocial behavior was more likely in males with the genotype for low MAOA activity who had been mistreated. The 55 boys in this group were about twice as likely to have been diagnosed with conduct disorder in adolescence as the 99 mistreated boys with the high-activity genotype. And they were three times more likely to be convicted of a violent crime by age 26. Although the 55 males who had experienced moderate or severe maltreatment and also had the low-activity genotype made up only 12% of the study group, they committed 44% of the crimes. "They're doing four times their share of rape, robbery, and assault," Moffitt says.

But environmental influences were critical, Moffitt found. In the absence of abuse, having the low-activity genotype didn't make boys any more likely to be antisocial. Jon Beckwith of Harvard Medical School in Boston agrees, although he'd like to see the finding replicated: "I would use this as a wonderful class example of how social factors can play an enormous role in expression of behavioral traits." Moffitt views the results as an example of how accounting for

environmental factors can help reveal a gene: "Finding the stressor can be a magic key."

There are caveats. The link between the MAOA alleles and the activity of the enzyme in these males is only inferred, Beckwith points out. Also potentially confounding the study is that antisocial behaviors might depend on social situations, not just genes, adds sociologist Troy Duster of New York University.

Replicating the results will be important, researchers say, although this might be easier than in previous studies because the sample was drawn from the general population. Confirmation could also lead to better intervention strategies. Social workers and therapists would benefit from knowing which abused kids are most at risk, notes criminologist Alfred Blumstein of Carnegie Mellon University in Pittsburgh.

Legal implications are less clear. Although some attorneys might argue that the MAOA genetic defect results in diminished capacity, Hal Edgar of Columbia Law School in New York City doesn't think judges will buy it. "This particular study in and of itself is not going to shape the [legal] culture," he says. And experts warn that it's much too early to discuss whether drugs might counter the effects of low MAOA activity.

Experts also say that it's important to remember that many genes probably influence violence and other antisocial behaviors. Or as Carey says, the strongest genetic marker for violence is still the presence of a Y (male) chromosome.

—ERIK STOKSTAD

NEUROSCIENCE

Long-Awaited Technique Spots Alzheimer's Toxin

STOCKHOLM—Alzheimer's disease is notoriously difficult to diagnose, particularly as it begins to take hold. Researchers suspect that therapies, when they become available, will work best if given early, however, raising the need for a test that spots the first signs of this dementia-causing disease. On 24 July at the International Conference of Alzheimer's Disease and Related Disorders here, a team revealed the first images from a positron emission tomography (PET) technique that picks up one of the defining—and first—features of Alzheimer's disease.

"People are going to point to this particular presentation and say, 'This is when we started making progress'" on visualizing Alzheimer's disease, says Mark Mintun of Washington University Medical Center in St. Louis, Missouri. This putative marker, as well as others reported at the meeting, could be invaluable not only for diagnosis but also in clinical research, conference attendees say.

Clinicians settle on a diagnosis of



Two strikes. Men who have a certain genotype for a brain enzyme—and were abused—tend to be more prone to violence.

CREDIT: JAY DICKMAN/CORBIS