CRIME Times

Linking Brain Dysfunction to Disordered/Criminal/Psychopathic Behavior

Volume 11, Number 2, 2005

FEATURE ISSUE: AGGRESSION
(see pages 1-5)

Could altered levels of fatty acids make us more aggressive?

Omega-3 fatty acids, which are not manufactured by the body and must be obtained from the diet, are essential to brain development and function. Modern Western diets contain a lower amount of these fats than the diets of earlier generations, while containing a higher level of omega-6 fatty acids such as linoleic acid. Growing research tentatively links this dietary alteration to increases in depression, learning disabilities, and attention deficit disorder (see *Crime Times* Volume 5, Number 1, 1999, page 1), and now clinical and epidemiological studies also hint at a link to increases in aggressive or violent behavior.

Joseph Hibbeln et al. have conducted a series of studies examining the effects of omega-3 and omega-6 fatty acid levels on aggression, hostility, and rates of homicide. In one study, the researchers analyzed economic measures of omega-6 consumption across time and countries to see if these were related to trends in homicide rates. They report finding evidence of "a

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Adolescent killers exhibit marked neurological deficits

A study of juveniles condemned to death reports compelling evidence that they exhibited serious neurological impairment at the time they committed their crimes.

Dorothy Otnow Lewis and colleagues evaluated 18 males who had received the death penalty in Texas. All had been 17 years old at the time they committed murder. At the time of the evaluations, the subjects were in their mid-20s. Each subject underwent neurological, neuropsychological, psychiatric, and educational evaluations.

The researchers report that:

• Three subjects had been born prematurely (one weighing only 3 pounds), a fourth was delivered by Cesarean section because the umbilical cord was wrapped around his neck, and the mother of a fifth had attempted to abort him. Overall, the researchers report, "six (33 percent) of the group began life with potentially compromised central nervous system functioning, and a seventh reportedly was the product of a difficult delivery."

• All but one of the subjects had a history of multiple head injuries, often resulting in loss of consciousness.

• Neurological evaluation revealed that five of 17 subjects (one did not undergo neurological testing) exhibited one abnormal finding on testing of prefrontal lobe functioning, three had two abnormal findings, two had three abnormal findings, and three had four or more abnormal findings. "It should be noted," the researchers say, "that most normal individuals have no signs of frontal lobe impairment on neurological examination." In addition, three subjects exhibited significantly impaired motor function.

• Neuropsychological testing revealed impairment on at least two traditional structured tests of "executive functions" (brain functions including planning and organization) in 10 of the subjects. On the unstructured Iowa Gambling Task, which also measures executive functions, 84 percent of subjects exhibited marked impairment. Overall, the researchers say, "every subject demonstrated signs of prefrontal cortical dysfunction on neurologic examination, neuropsychological testing, or both."

• Psychiatric evaluation revealed that eight subjects had histories and signs and symptoms consistent with early-onset bipolar spectrum disorder, while another four had histories and signs and symptoms consistent with early-onset schizoaffective disorder. Of the remaining six subjects, the researchers say, "three were clearly hypomanic" and one exhibited paranoia. Another subject apparently had committed his crime while sleepwalking, and his father had also exhibited parasomnia (unusual behavior during sleeping). Many subjects reported experiencing dissociative symptoms ("spacing out" or "out-of-body" episodes). Six had started abusing alcohol or drugs before their 13th birthdays.

• All but one of the subjects came from very violent or abusive families, "in which mental illness was prevalent in multiple generations."

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Editorial

WHY CRIME TIMES?

In its ten-year history, *Crime Times* has published hundreds of articles—many of which aren't specifically about crime. A single issue, for instance, may contain stories on malnutrition-linked learning problems, Fetal Alcohol Syndrome, genes linked to attention deficit hyperactivity disorder (ADHD), and the role of low serotonin in impulsive behavior. Most likely, our readers sometimes wonder: "What does this article have to do with delinquents or criminals?"

The answer is that *Crime Times* is about biological influences on disordered behavior—and disordered behavior is one of the chief risk factors for criminality.

Obviously, not all biologically vulnerable children become delinquents or criminals. The majority, in fact, do not. Most children with ADHD or dyslexia, for instance, do not become criminals—but research shows that most criminals have one or both of these disorders. Similarly, studies show that a high percentage of criminal offenders have brains compromised by prenatal alcohol or drug exposure, heavy metal toxicity, head injuries, or malnutrition. Research also reveals that impulsivity, aggression, and violence, all of which are key risk factors for criminality, are powerfully influenced by genes.

Little of this research, however, reaches the hands of the people who can make the best use of it: law enforcement officers, judges, pediatricians, psychologists, psychiatrists, neurologists, educators, and parents. This is a dangerous knowledge gap, because the fact that behavior problems often have biological roots means that *we can treat them through biological means*. When we do so, vulnerable children, teens, or even adults can be helped while there is still time to prevent a tragedy. We can, in many cases, stop the troubled child from growing up to be the rapist, robber, drug dealer, or cop-killer.

Crime Times is a plea for prevention and treatment of disordered behavior *before* the people it affects can do harm to society. By addressing the biological factors that contribute to crime, we can dramatically reduce the odds that at-risk children will become delinquents or criminals, reduce our burgeoning prison population, and protect the lives and property of millions of potential crime victims.

To do this, a revolution in thinking is needed. For decades we've been taught that regardless of animal studies linking aggression and other aberrant behavior to genetic flaws or head injuries or toxins or malnutrition, we humans were somehow exempt. In our case, experts told us, behavior problems stemmed solely from poor parenting, poor teaching, poverty, or other societal evils. Now, however, we know better—or at least we should.

Current research tells us that genes that lower brain levels of serotonin can contribute to impulsive aggression, and that genes that alter dopamine levels can contribute to ADHD. It tells us that childhood deficiencies of iron, omega-3 fatty acids, zinc, or other nutrients can lead to hyperactivity, learning disabilities, and aggressive behavior. It tells us that lead toxicity elevates the risk for delinquency, and that prenatal alcohol or drug exposure can make a child more impulsive, less empathetic, and far less able to resist the lure of criminal behavior. Research now underway at UCLA is even revealing that all the way down to the level of the fruit fly brain, genetically acquired aggression can be reduced simply by altering the diet.

As science continues to unravel the many biological threads that can lead to delinquency or criminality, it is time for this knowledge to lead to new and effective treatments. How many of the 18 boys discussed in the article on page 1 of this issue would be on death row if their biological impairments had been detected and treated? How many of their victims would still be alive today? And how many future lives can we save by recognizing that changing the brains of potential offenders is far more effective than merely changing their environments?

Insofar as we know, *Crime Times* is the only publication entirely devoted to reporting current research involving the diagnosis, prevention, and treatment of brain disorders that result in disordered and criminal behavior. The remarkable number of U.S. and foreign websites that now link to *Crime Times'* website reinforces our belief that this information is sorely needed by people all over the world who are seeking alternatives to failed policies for addressing crime and violence.

It is our hope that by providing information on the brain impairments that contribute to violent or criminal behavior, we will encourage more research into how we can prevent or treat these problems. And it is our belief that such prevention and treatment will lead today's and tomorrow's troubled children and adults to a better future, and protect the people who would otherwise be their prey.

Adolescent killers exhibit marked neurological deficits

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• Only one subject was mentally retarded, with one other diagnosed as "borderline." However, six had lower reading scores than would be predicted by their IQ scores. The majority showed significant impairment in math, with 12 subjects exhibiting at least a 20-point discrepancy between overall IQ and mathematical reasoning ability scores. Eight subjects repeated grades in school, and the other 10 had been placed in special education classes or transferred to alternate schools. By second grade, more than one-third were having serious problems in school; by sixth grade, 78 percent had been identified as needing special assistance (primarily for emotional rather than intellectual reasons).

The researchers note that despite the clear neurological impairments of their subjects, it appeared that only four had undergone pretrial psychiatric evaluations, and none had received pretrial neurologic or neuropsychological testing. Also, none had received neuropsychiatric evaluations prior to sentencing.

The researchers note that despite the clear neurological impairments of their subjects, it appeared that only four had undergone pretrial psychiatric evaluations, and none had received pretrial neurologic or neuropsychological testing. Also, none had received neuropsychiatric evaluations prior to sentencing. "Unfortunately," they say, "in cases like these, a clinician's failure to investigate thoroughly the psychiatric, neurologic, and environmental factors influencing behavior can literally mean the difference between life and death."

The researchers cite current evidence showing that the prefrontal cortex and temporal lobes (both critical to reasoning and self-control) do not mature until late adolescence. Teens with brain dysfunction and/or mental illness, they note, would be even more vulnerable to impairments in judgment and impulse control. Thus, they say, "Our data... raise a question of ethics: to what degree does it behoove our justice system to modify its criteria for mitigation and culpability and adopt rules consistent with the findings of early 21st century neuroscience?"

In earlier research involving adult murderers (see *Crime Times* Vol. 1, Number 4, 1995, page 1), study co-author Pamela Blake and colleagues reported that "specific neurologic diagnoses could be established in 20 of the 31 subjects."

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"Ethics questions raised by the neuropsychiatric, neuropsychological, educational, developmental, and family characteristics of 18 juveniles awaiting execution in Texas," Dorothy Otnow Lewis, Catherine A. Yeager, Pamela Blake, Barbara Bard, and Maren Strenziok, *Journal of the American Academy of Psychiatry and the Law*, Vol. 32, 2004, 408-29. Address: Dorothy Otnow Lewis, 10 St. Ronan Terrace, New Haven, CT 06510, dorothy.lewis@yale.edu.

Crime Times is interested in hearing from readers conducting research pertaining to biological influences on criminality and psychopathology. Reprints of research papers are appreciated.

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Dietary changes in omega-3 and omega-6 fatty acids: one cause of aggressive behavior?

(continued from page 1)

striking correlation between greater apparent consumption of linoleic acid from seed oils and greater risk of homicide mortality across time, from 1961 to 2000, among five Western countries [the United States, the United Kingdom, Australia, Canada, and Argentina]." Hibbeln et al. say that this finding, and earlier research by the same authors showing that greater intakes of omega-3 rich seafood correlate with lower rates of homicide mortality across 36 countries, "are consistent with animal studies and controlled intervention trials in humans [*see Gesch et al.,* Crime Times *Volume 8, Number 3, 2002, page 1*] that reported decreased measures of aggression or violence by increasing intakes of long chain omega-3 fatty acids relative to omega-6 intake."

Hibbeln et al. say, "One mechanism that may link excessive linoleic acid intake or deficient EPA and DHA status is a deficit in serotonergic neurotransmission in the frontal cortex, which has been repeatedly implicated in the pathophysiology of lifelong impulsive and violent behaviors." They cite animal research showing that dietary deficiencies of omega-3 fatty acids during fetal development and early postnatal life are linked to residual deficits in serotonergic neurotransmission.

The researchers conclude that while multiple factors contribute to aggression and violence across cultures, and the possible associations between omega-3 and omega-6 fatty acids and homicide rates need to be further investigated, "dietary interventions that reduce linoleate intake and improve the tissue status of omega-3 fatty acids and other basic nutrients can potentially become relatively cost-effective measures for reducing the pandemic of violence in Western societies, just as dietary interventions are reducing cardiovascular mortality."

Hibbeln et al. say their findings suggest that "dietary interventions that reduce linoleate intake and improve the tissue status of omega-3 fatty acids and other basic nutrients can potentially become relatively cost-effective measures for reducing the pandemic of violence in Western societies, just as dietary interventions are reducing cardiovascular mortality."

In a separate study, Hibbeln and colleagues note that elevated levels of corticotrophin-releasing hormone (CRH) in the cortical-hippocampal-amygdala pathway increase fear and anxiety, emotions that play a strong role in violent behavior. Levels of two prostaglandins that increase CRH activity in this pathway are reduced by omega-3 fatty acids. Thus, the researchers theorize, a diet low in omega-3 fatty acids could lead, indirectly, to increased expression of CRH and thus to elevated levels of violence-provoking fear and anxiety.

To test this theory, the researchers measured plasma levels of fatty acids in 21 perpetrators of domestic violence. They found that lower levels of DHA predicted greater cerebrospinal fluid levels of CRH.

"Randomized, placebo-controlled trials are needed to determine if supplementation with DHA and EPA can decrease elevated levels of CRH and improve behavioral outcomes among subjects with aggressive and violent behaviors," they say.

Hibbeln and colleagues note that additional findings support the link between low omega-3 fatty acids and behavioral disorders. These findings include:

- Another study by Hibbeln et al. showing an association between high consumption of DHA and seafood and reduced levels of hostility in young adults (see *Crime Times* Volume 10, Number 2, 2004, page 3).
- A study by M. C. Zanarini and colleagues showing that supplementation with EPA reduced aggressive behavior as well as the severity of depressive symptoms in women with borderline personality disorder.
- A study by Tomohito Hamazaki et al., who found that DHA supplements prevented stress-linked increases in aggression in students (see *Crime Times* Volume 5, Number 1, 1999, page 1).

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"Increasing homicide rates and linoleic acid consumption among five Western countries, 1961-2000," Joseph R. Hibbeln, Levi R. C. Nieminen, and William E. M. Lands, *Lipids*, Vol. 39, No. 12, 2004, 1207-13. Address: Joseph R. Hibbeln, Section on Nutritional Neurochemistry, LMBB, NIAAA, 31 Center Drive, Building 31/1B 58, Bethesda, MD 20892, jhibbeln@mail.nih.gov.

—and—

"Omega-3 status and cerebrospinal fluid corticotrophin releasing hormone in perpetrators of domestic violence," Joseph R. Hibbeln, Garth Bissette, John C. Umhau, and David T. George, *Biological Psychiatry*, Vol. 56, 2004, 895-97. (See address above.)

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Reduced IQ from elevated mercury levels: new study suggests a high toll for society

The neurological impairment caused by children's prenatal exposure to mercury, a powerful neurotoxin, is estimated by a new study to cost the United States billions of dollars annually.

Leonardo Trasande and colleagues used an "environmentally attributable fraction" model—the same methodology previously used to calculate the economic costs of lead toxicity—to calculate the economic effects of mercury exposure. The researchers limited their analysis to the neurodevelopmental effects of mercury, and in particular to reductions in intelligence.

Using data from a 2000 study by the Centers for Disease Control and Prevention, the researchers determined that between 316,000 and 637,000 children each year have umbilical cord blood mercury levels higher than 5.8 micrograms per liter, a level associated with a loss of IQ. The resulting loss of productivity, they note, lasts over the entire lifetimes of affected individuals. "This lost productivity is the major cost of methylmercury toxicity," they say, "and it amounts to $8.7 billion annually (range $2.2-$43.8 billion, 2000 dollars)."

Trasande et al. note that this may be an underestimate, because they did not take into account the costs of mercury exposure to children during the first two years of life, when the blood-brain barrier is vulnerable to penetration by methylmercury. They also point out that their figures do not take into account non-IQ effects of mercury toxicity, such as alterations in behavior. While the effects of mercury on behavior have not been well studied, the researchers note that lead—another neurotoxin—is strongly linked to antisocial behavior and criminality.

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"Public health and economic consequences of methylmercury toxicity to the developing brain," Leonardo Trasande, Philip J. Landrigan, and Clyde Schechter, *Environmental Health Perspectives*, February 2005 (epub in advance of publication).

Low MAO activity again implicated in violence

A new study adds to evidence implicating low activity of platelet monoamine oxidase (MAO) as a risk factor for violent behavior (see *Crime Times* Volume 8, Number 4, 2002, page 1 and Volume 1, Number 3, 1995, page 1).

M. Skondras and colleagues compared 82 male offenders, imprisoned for homicide or other violent acts, to 54 non-violent, non-criminal men. The researchers factored in the effects of smoking, which can affect MAO activity.

"Platelet MAO activity was significantly lower in the offenders group compared to controls," the researchers report, adding that the difference could not be attributed to smoking, and appeared to be related to personality traits and behaviors characteristic of the offenders.

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"Platelet monoamine oxidase activity and psychometric correlates in male violent offenders imprisoned for homicide or other violent acts," M. Skondras, M. Markianos, A. Botsis, E. Bistolaki, and G. Christodoulou, *European Archives of Psychiatry and Clinical Neuroscience*, Vol. 254, No. 6, December 2004, 380-6. Address: M. Skondras, Athens University Medical School, Eginition Hospital, Psychiatric Department, Laboratory of Clinical Neurochemistry, Athens, Greece.

Study hints at effects of prenatal testosterone on female aggression

A new study of twins adds to evidence that prenatal testosterone levels may influence later levels of aggressive behavior in females.

Studying 13-year-old girls, Celina Cohen-Bendahan et al. compared 74 girls with twin brothers (designated as OS, or "opposite sex") to 55 girls with twin sisters (designated as SS, or "same sex"). Animal research shows that females who develop in utero with male siblings tend to exhibit more masculine patterns of behavior than females who develop in utero with female siblings, apparently because of exposure to high levels of testosterone from the males.

Cohen-Bendahan et al. found no differences in testosterone levels between the OS and SS girls. Also, testosterone levels at the time of the study did not correlate with personality traits. "However," they say, "a sex difference in aggression proneness was observed, and opposite-sex girls showed a more masculine pattern of aggression proneness than the same-sex girls." The researchers speculate that this difference could be due to greater exposure of the OS girls to testosterone during prenatal development.

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"Is there an effect of prenatal testosterone on aggression and other behavioral traits? A study comparing same-sex and opposite-sex twin girls," Celina C.C. Cohen-Bendahan, Jan K. Buitelaar, Stephanie H.M. van Goozen, Jacob F. Orlebeke, and Peggy T. Cohen-Kettenis, *Hormones and Behavior*, Vol. 47, 2005, 230-37. Address: Celina C.C. Cohen-Bendahan, Department of Child and Adolescent Psychiatry, A01.468, University Medical Center Utrecht, P.O. Box 85500, 3508 GA Utrecht, The Netherlands, celina_cohen@yahoo.com.

Variant of serotonin gene linked to drug experimentation

Research suggests that the risk for aggression is elevated for individuals with one or two low-activity "short" (S) variants of a region of the serotonin transporter (5-HTTP) gene, which plays a critical role in regulating the reuptake of the neurotransmitter serotonin by nerve cells (see *Crime Times* Volume 11, Number 1, 2005, page 7). A new study indicates that this gene variant may also put teens at greater risk for substance abuse.

> Gerra et al. report that teens with two short variants of the serotonin transporter gene region were significantly more likely to be drug experimenters than those with two long variants.

Gilberto Gerra and colleagues compared 91 adolescents with a history of drug experimentation to 125 teenagers who had never tried illegal drugs. The researchers report that "the short-short (SS) genotype frequency was significantly higher among experimenters compared with abstinent subjects," with subjects with two short variants of the gene region being more than four times more likely to have tried illegal drugs than those with two long variants. Gerra et al. also report, "The SS genotype frequency was significantly higher among aggressive/novelty seeker experimenters with poor school achievement, compared with drug experimenters without aggressiveness and school failure."

The researchers conclude, "Our data suggest that a decreased expression of the gene encoding the 5-HTT transporter, due to "S" promoter polymorphism, may be associated with an increased availability to experiment with illegal drugs among adolescents, particularly in the subjects with more consistent aggressiveness, novelty-seeking temperament, and learning disabilities."

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"Serotonin transporter promoter polymorphism genotype is associated with temperament, personality traits and illegal drug use among adolescents," G. Gerra, L. Garofano, L. Castaldini, F. Rovetto, A. Zaimovic, G. Moi, M. Bussandri, B. Branchi, F. Brambilla, G. Friso, and C. Donnini, *Journal of Neural Transmission*, January 24, 2005 (epub ahead of print publication). Address: G. Gerra, Centro Studi Farmaco-tossico–dipendenze, Ser. T., AUSL, Parma, Italy, ggerra@ausl.pr.it.

QUOTABLE

Our violent behavior bewilders us because we lack crucial information. Countless newspaper articles, books, and television programs chart the social dimensions of violence: poverty, racism, the breakdown of the family, the pervasive influence of television, the ready availability of guns. But the outer world is meaningless until it enters the inner world, the dimension governed by brain and perception, thought and emotion, nerve and tissue. Until we know as much about this inner dimension as we do about the outer one—what goes on inside the heads of aggressors and their victims—we are not prepared to analyze the problem of violence effectively.

Debra Niehoff in
The Biology of Violence
(Free Press, 1999)

Teens who were preemies exhibit reductions in hippocampal gray matter

Teenagers who were born prematurely show reductions in hippocampal volume, according to a recent study by researchers in Spain.

Mónica Giménez and colleagues used optimized voxel-based morphometry (VBM) to compare 22 adolescents with a history of prematurity to 22 control subjects who were born at full term. They report, "VBM analysis showed significant left hippocampal and bilateral thalamic reductions in subjects with a history of prematurity…. We also observed a reduction in hippocampal volume, with left posterior predominance." The researchers say reduction in left hippocampal gray matter correlated with verbal memory deficits in the premature group.

"Our results suggest that left hippocampal tissue loss may be responsible for memory impairment," they say, "and is probably related to the learning disabilities that subjects with a history of prematurity present during schooling."

Last year, a magnetic resonance imaging study by Allan Reiss and colleagues (see *Crime Times* Volume 10, Number 4, 2004, page 2) found reductions of both white and gray matter in the brains of eight-year-old boys born prematurely.

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"Hippocampal gray matter reduction associates with memory deficits in adolescents with history of prematurity," M. Giménez, C. Junque, A. Narberhaus, X. Caldu, P. Salgado-Pineda, N. Bargallo, D. Segarra, and F. Botet, *Neuroimage*, Vol. 23, No. 3, November 2004, 869-77. Address: M. Giménez, Department of Psychiatry and Clinical Psychobiology, Institut d'Investigacions Biomediques August Pi i Sunyer (IDIBAPS), University of Barcelona, 08036 Barcelona, Spain.

Transnationally adopted delinquents exhibit more cognitive, neurolopsychological deficits than nondelinquent peers

Transnationally adopted children who become delinquents are much more likely to exhibit cognitive or neuropsychological deficits than their adopted peers who do not become delinquents, according to a recent Swedish study.

> Elmund et al. found that the mean full-scale IQ of the delinquent transnational adoptees was about 85, while the mean for non-delinquents was nearly 100.

Anna Elmund et al. compared two groups of adopted children. The children, ranging in age from 9 to 21, were originally from other European countries, South America, or Asia. Of the group, 20 were delinquents and 21 were not. In both groups, the majority of subjects were male. The two groups did not differ significantly as to age, sex, or country of origin.

The researchers say the adopted delinquents had significantly lower IQs than the controls and scored more poorly on several other cognitive measures, even when the researchers adjusted for their age when they arrived in their adoptive homes. The mean full-scale IQ of the delinquents was about 85, while the mean for non-delinquents was nearly 100. While both groups had lower-than-average scores for arithmetic skills, the delinquents again did worse than the non-delinquents. Moreover, Elmund et al. say, the delinquents' cognitive profiles were highly irregular, with a higher-than-typical number of subtest scores falling above or below the mean in many cases.

No differences between the two groups were seen on the Wisconsin Card Sorting Test, a measure of abstract thinking and the ability to shift cognitive strategies when required. However, in the Tower of London test, the delinquents needed significantly more time to complete the easiest steps, an indication of impaired planning skills. They were less successful at other steps as well, but this difference did not reach statistical significance.

Parent questionnaires indicated that five of the delinquents, but only one of the non-delinquents, qualified for a diagnosis of attention deficit hyperactivity disorder (ADHD). Also, 30 percent of the delinquents, but only 14 percent of the controls, were left-handed. Left-handedness is typically genetic, but can also indicate subtle brain damage.

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"Cognitive and neuropsychological functioning in transnationally adopted juvenile delinquents," Anna Elmund, Lennart Melin, Anne-Liis von Knorring, Lemm Proos, and Torsten Tuvemo, *Acta Paediatrica*, Vol. 93, No. 11, November 2004, 1507-13. Address: Anna Elmund, Department of Women's and Children's Health, University Hospital, SE-751 85 Uppsala, Sweden, anna.elmund@kbh.uu.se.

FROM OUR EMAIL...

I am an associate professor of Criminal Justice at a state university, and a former correctional psychologist. For the past few years our program has moved from sociological/criminological explanations regarding the etiology of criminal behavior to an interdisciplinary model. Your publications are an invaluable tool for our pedagogical efforts. The changes in our students' understanding of this complex issue are blatant and even more pleasing. Thanks for your wonderful efforts and willingness to share.

Is social responsibility genetically "hard-wired?"

Genes strongly influence an individual's sense of social responsibility, according to a recent study.

J. Philippe Rushton and colleagues compared 174 pairs of identical twins to 148 pairs of fraternal twins (who share only half as many genes), asking them if they agreed or disagreed with 22 statements such as "I am a person people can count on" and "Cheating on income tax is as bad as stealing." Responses to these questions are known to predict socially responsible behavior such as voting or volunteer activity.

Rushton reports that the answers of identical twins were nearly twice as similar as those of fraternal twins. Genes explained 42 percent of the individual differences in attitudes toward social responsibility, while shared home environment accounted for 23 percent and non-shared environment for the remainder. Genes had much more influence on the attitudes of males than on those of females.

The study also found that parents have little effect on children's social behavior once the children reach puberty. "That seems to be when their genes kick in," Rushton says, "and the influence of peers and other outside sources is much stronger in their social development."

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"Genetic and environmental contributions to pro-social attitudes: a twin study of social responsibility," J. P. Rushton, *Proceedings of the Royal Society of London: Biological Sciences*, Vol. 271, No. 1557, Dec. 22, 2004, 2583-5. Address: J. Philippe Rushton, Department of Psychology, University of Western Ontario, London, Ontario N6A 5C2, Canada.

—and—

"Humans wired to be good," Jim Anderson, *Western News*, Univeristy of Western Ontario, January 20, 2005.

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"The 1999 Annual Report of the United States Department of Juvenile Justice and Delinquency Prevention states that 52 percent of chronic violent offenders have their first referral to the justice system by the age of 13. Moreover, the recidivism rate for violent juveniles is 57 percent. Clearly, a better understanding of the causes and mechanisms of aggressive behavior would greatly enhance the development of preventive and treatment programs. The result of this lack of recognition of biological mechanisms for aggression is profound in more than one respect. Not only are possible treatment options being neglected, resulting in the loss of many individuals to a life of crime, incarceration, and injury to the community, but it is also possible that the current handling of juveniles may unwittingly aggravate their behavior. For example, if certain unrecognized environmental conditions contribute to prefrontal cortical impairment in aggressive individuals, then allowing ongoing exposure to these conditions will further aggravate prefrontal dysfunction, lowering the threshold for committing future acts of aggression."

Pamela Blake, M.D.

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