CRIME Times

Linking Brain Dysfunction to Disordered/Criminal/Psychopathic Behavior

Volume 12, Number 2, 2006

Epigenetics: Can your actions today affect your grandchildren's genes and behavior?

Drugs given to pregnant animals can affect the brains and behavior of at least two generations of offspring, Toronto researchers say. The finding adds to evidence that dietary intake, drug use, toxic exposure, and other environmental factors can cause "epigenetic" effects—that is, changes in gene function that occur in the absence of changes in DNA sequencing and that can be inherited by future generations.

Stephen Matthews and colleagues studied the effects of betamethasone, a synthetic glucocorticoid drug, on the offspring of guinea pigs. Doctors frequently give betamethasone to pregnant women at risk of delivering very prematurely, because a single dose can markedly reduce the death rate of their babies. However, babies who do not arrive as prematurely as expected can be exposed to many courses of the drug.

The researchers used guinea pigs because the animals' placentas are similar to humans' and they give birth to similarly mature offspring. The animals were divided into three groups, with one group receiving three injections of betamethasone, a second group receiving three injec-

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Long-term study finds childhood ADHD is a major risk for young adult antisocial, addictive, mood and anxiety disorders

A new study reinforces earlier findings that attention deficit hyperactivity disorder (ADHD), once considered a childhood disorder, has damaging effects that last well into early adulthood.

Joseph Biederman and colleagues conducted a 10-year prospective study of more than 100 boys with ADHD, comparing them to controls without the disorder. The researchers identified both ADHD and non-ADHD children from two sources, an academic medical center and a health maintenance organization. When the study began, the children were between the ages of 6 and 18, and each underwent a three-stage diagnostic process to ensure the validity of their ADHD or non-ADHD categorization. The follow-up assessment involved interviews with both the study subjects and their mothers.

> Biederman et al. say their findings confirm "a wide range of psychopathology among ADHD children grown up."

Biederman and colleagues report, "This 10-year follow-up found that, by a mean age of 21, ADHD youth were at high risk for markedly elevated lifetime prevalences of antisocial, addictive, mood and anxiety disorders.... These longitudinal results into young adult years confirm and extend our previous follow-up findings by mid-adolescence documenting a wide range of psychopathology among ADHD children grown up."

ADHD subjects had higher levels of psychopathology despite the fact that 93% had received treatment for the disorder at some point during their lives. Of those, 86% had received both medication and counseling, while 6% received medication alone and 1% received counseling alone.

The study supports earlier research by Salvatore Mannuzza and Rachel Klein, whose investigation of the outcomes of adults diagnosed in childhood as hyperactive found that, compared to controls, the ADHD subjects "complete less schooling, hold lower-ranking occupations, and continue to suffer from poor self-esteem and social skills deficits." Mannuzza and Klein also found that significantly more ADHD subjects than controls exhibited antisocial behaviors. Similarly, a 1997 study by Eric Taylor and colleagues (see *Crime Times* Volume 3, Number 3, 1997, page 1) found that childhood hyperactivity, even when not combined with conduct problems, strongly predicted later violence, social problems, academic underachievement, and defiant and disruptive behaviors.

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"Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study," Joseph Biederman, Michael Monuteaux, Eric Mick, Thomas Spencer, Timothy Wilens, Julie Silva, Lindsey Snyder, and Stephen Faraone, *Psychological Medicine*, Vol. 36, 2006, 167-79. Address: Joseph Biederman, Massachusetts General Hospital, Yawkey Center for Outpatient Care, YAW-6A-6900, 32 Fruit Street, Boston, MA 02114.

Diet rich in essential fatty acids, before or after birth, linked to cognitive, behavior benefits

Expectant mothers who eat a diet high in omega-3 fatty acids may enhance the IQs of their children and reduce those children's risk of antisocial behavior, according to data from a large, long-term study. A separate study, using data from the same group of mothers and children, concludes that a maternal diet high in omega-3-rich fish during pregnancy can lead to better social, language, and communication skills—all of which are strongly linked to adult success and prosocial behavior. And a third study replicates findings from recent British research showing that essential fatty acids can dramatically improve the learning and behavior of children with attention deficit hyperactivity disorder (ADHD).

Hibbeln and Golding: higher IQs, less antisocial behavior

Joseph Hibbeln analyzed data from 14,000 women and children, all involved in the Avon Longitudinal Study of Parents and Children. The study measured food consumption in mothers during pregnancy and then tested their children at regular intervals.

Hibbeln and colleague Jean Golding, the originator of the Avon study, found that children of women who consumed the lowest amounts of omega-3 fatty acids during pregnancy had verbal IQs six points lower than average. In addition, by age seven, children whose mothers consumed very little of these nutrients were more prone to exhibit pathological social interactions—a risk factor for later antisocial behavior. These children also exhibited poorer fine-motor control than the children whose mothers had the highest omega-3 fatty acid intakes during pregnancy.

> Hibbeln et al. found that children whose mothers consumed very little omega-3 fatty acids during pregnancy were more prone to exhibit pathological social interactions—a strong risk factor for later antisocial behavior.

Unlike Emily Oken and colleagues (see *Crime Times* Volume 11, Number 4, 2005, page 1), who found that that the mercury levels in seafood partially offset the benefits of its high omega-3 content, Hibbeln and Golding say they did not detect any deleterious effects from mercury.

Daniels et al.: better language

In a separate study, Julie Daniels and colleagues used data on more than 7,400 mothers from the Avon project to determine the women's prenatal seafood intake and evaluate their children's cognitive outcomes. The researchers report finding a subtle but consistent link between higher fish intake and scores on developmental tests.

The most notable effect was on a test of the children's understanding of words at 15 months of age. Children whose mothers ate fish once a week or more scored 7% higher on this test than those whose mothers did not eat fish. The children whose mothers ate seafood also scored somewhat higher on tests of social activity and language development, and a similar pattern was seen for children who ate fish at least once a week before their first birthday.

Daniels notes, however, that her team detected a threshold effect. "The relationship with neurodevelopment was strongest for [mothers] eating fish between one and three times per week," she said, "with no additional benefit in eating fish more often." This is consistent, she noted, with the U.S. Food and Drug Administration's recommendation to limit fish consumption to 12 ounces of low-mercury fish per week during pregnancy.

> Sinn reports, "The parents of children who spent 15 weeks on a course of capsules containing a combination of fish oil and primrose oil reported increased attention and reduced hyperactivity, restlessness and impulsivity." Scores on tests of attention and vocabulary also improved.

Daniels and her colleagues conclude, "When fish is not contaminated, moderate fish intake during pregnancy and infancy may benefit development," but caution that "the balance between the benefits of fish and the adverse effects of mercury contamination in relation to neurodevelopment remain unclear for populations where mercury levels are higher."

Sinn: improvement in children with ADHD

Recently (see *Crime Times* Volume 11, Number 3, 2005, page 1), British researchers reported that children with developmental coordination disorder improved dramatically when given supplements containing fish oil and evening primrose oil and providing high levels of the omega-3 fatty acids EPA and DHA and the omega-6 fatty acid linoleic acid. The children made remarkable advances in learning and exhibited fewer symptoms of ADHD.

A separate study, by Natalie Sinn, has replicated these findings in children with ADHD-related symptoms.

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Vitamin reduces neuron damage, behavior abnormalities in prenatally alcohol-exposed mice

Nicotinamide, a form of vitamin B3, protects against alcohol damage in unborn rats and may help to prevent symptoms of Fetal Alcohol Syndrome (FAS) if administered soon after alcohol exposure, a new study reports. The researchers caution, however, that their results are preliminary and that efforts to prevent FAS must focus on discouraging pregnant women from drinking.

Alessandro Ieraci and Daniel Herrera injected seven-day-old mice (whose developmental level resembles that of human fetuses during the third trimester of pregnancy) with amounts of ethanol sufficient to create blood ethanol levels comparable to those generated by a session of binge drinking by a human mother. The researchers found that the alcohol caused apoptosis (a form of cell death) by activating a cell-killing enzyme called caspase-3. This resulted in damage to the anterior cingulate cortex, which is involved in cognition; to the hippocampus, which plays a key role in learning and memory; and to the thalamus, a relay station that sends messages from the outside world to various brain regions.

When the researchers gave the mice nicotinamide after alcohol exposure, the nutrient significantly reduced damage to these brain regions. The strongest protective effect occurred when the mice received nicotinamide within two hours after alcohol exposure, but the nutrient had beneficial effects even when given eight hours after alcohol exposure.

Studying the behavior of alcohol-exposed mice, the researchers found that those that did not receive nicotinamide exhibited hyperactivity, a reduced sense of fear, and impairments in learning and memory—all abnormalities consistent with alcohol-induced damage. Nicotinamide-treated mice, however, showed none of these abnormalities.

Nicotinamide has antioxidant properties and currently is drawing interest due to its role as a neuroprotective agent. It is also being used as a treatment for type 1 diabetes and an autoimmune skin disorder called bullous pemphigoid. The researchers say, "Although there are other studies showing a possible protective effect of antioxidants in preventing ethanol-induced apoptotic neuronal death, to our knowledge this is the first treatment that has been shown to work at the molecular, cellular, and behavioral levels."

> The researchers say that "this is the first treatment that has been shown to work at the molecular, cellular, and behavioral levels."

Experts stress that the only good method for preventing FAS is for mothers to avoid alcohol, and especially binge drinking, during pregnancy. However, despite warnings, one in twelve pregnant women admits to drinking during pregnancy, and one in thirty admits to binge drinking. Thus, the researchers note, nicotinamide treatment could prove valuable in preventing FAS in children of mothers who are unable or unwilling to discontinue drinking during pregnancy.

FAS affects about one in every thousand children in the United States, with a milder form, Fetal Alcohol Effects (FAE) affecting many more. FAS and FAE can cause severe problems including learning disabilities or mental retardation, hyperactivity, low impulse control, and sexually inappropriate or antisocial behavior, and FAE in particular is a major risk factor for delinquency and criminality.

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"Nicotinamide protects against ethanol-induced apoptotic neurodegeneration in the developing mouse brain," Alessandro Ieraci and Daniel Herrera, *PLoS [Public Library of Science] Medicine*, Vol. 3, No. 4, April 2006 (online). Address: either author at the Department of Psychiatry, Weill Medical College of Cornell University, 525 E. 68th Street, New York, NY 10021.

—and—

Nicotinamide: A way to prevent Fetal Alcohol Syndrome?," commentary, *PLoS Magazine*, Vol. 3, No. 4, April 2006.

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Scans reveal how MAOA gene variant affects brain structure, increases risk for aggression

A variant of a gene linked to aggression appears to affect behavior by weakening impulse control circuits in the brain, according to a new study.

The enzyme monoamine oxidase-A (MAOA) breaks down serotonin and several other neurotransmitters in the brain. Growing research links the low-activity (L) variant of the gene that codes for MAOA—a variant that results in higher levels of serotonin circulating in the brain—to aggressive behavior. While low levels of serotonin in adulthood are associated with depression and aggression, researchers suspect that high levels of serotonin during early development cause the brain to compensate, leading to alterations that make people more susceptible to violence and anxiety later in life.

Andreas Meyer-Lindenberg and colleagues used magnetic resonance imaging (MRI) to investigate how the L version of the MAOA gene translates into altered brain structure and function. Comparing people with the L variant to people with the high-activity H variant, the researchers found that:

—Individuals with the L variant had an 8% reduction in gray matter in the cingulate cortex and amygdala, both of which play a role in mood regulation. Conversely, males exhibited a 14% increase in volume in the orbital frontal cortex, a region key to motivation and impulse control. The researchers suspect that this increased volume reflects deficient pruning of neurons during development, resulting in impaired orbital frontal function.

—When asked to perform a task involving pictures of angry and fearful faces, individuals with the L variant showed higher activity in the amygdala (an area of the brain that responds to fear), while showing decreased activity in the orbital frontal cortex and other higher-brain regions that regulate fear responses.

—Men, but not women, with the L variant also showed increased reactivity in the amygdala and hippocampus when remembering emotionally negative information.

—Men with the L variant were impaired at a task requiring them to inhibit a simple motor response. They failed to activate the cingulate cortex, which typically helps to inhibit impulsive movements.

Overall, the findings indicate that individuals (and particularly men) with the L variant have smaller emotion-related brain structures, poor impulse control circuitry, and brain alterations that make them hypersensitive to threats. The gender difference appears to stem from the fact that the gene is on the X chromosome, and women have a second X chromosome that often carries the H variant.

"By itself," Meyer-Lindenberg says, "this gene is likely to contribute only a small amount of risk in interaction with other genetic and psychosocial influences; it won't make people violent. But by studying its effects in a large sample of normal people, we were able to see how this gene variant biases the brain toward impulsive, aggressive behavior."

The findings are consistent with earlier research (see *Crime Times* Volume 8, Number 4, 2002, page 1) showing that abused children are vastly more likely to develop antisocial behavior if they possess the L variant of the MAOA gene.

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"Aggression-related gene weakens brain's impulse control circuits," news release, National Institute of Mental Health, March 20, 2006.

—and—

"Neural mechanisms of genetic risk for impulsivity and violence in humans," Andreas Meyer-Lindenberg et al., *Proceedings of the National Academy of Sciences*, March 29, 2006 (epub before print publication). Address: Andreas Meyer-Lindenberg, andreasml@nih.gov.

Can your actions today change another generation's genes?

(continued from page 1)

tions of saline, and the third group receiving no injections at all.

As expected, offspring of the drug-exposed guinea pigs were hyperactive—an effect also documented in human infants of women given multiple doses of betamethasone. However, the researchers discovered that when affected female offspring mated with normal male guinea pigs, their offspring—the grandchildren of the original drug-exposed animals—also exhibited behavioral abnormalities. Males showed little interest in exploring new surroundings, while females were hyperactive and made odd vocalizations.

The study's results are consistent with other research showing that dietary changes or exposure to toxins can cause epigenetic changes affecting future generations. One study, for instance, found that when pregnant rats were exposed to a high dose of a particular pesticide, 90% of male offspring in the next four generations exhibited reproductive problems.

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"Pregnancy drugs can affect grandkids too," *New Scientist*, December 3, 2005, www.newscientist.com. Address: Stephen Matthews, Dept. of Physiology, Medical Sciences Bldg. Room 3240B, 1 King's College Circle, University of Toronto, Toronto, Ontario, Canada M5S 1A8, stephen.matthews@utoronto.ca.

Evil minds or broken brains? High rate of brain anomalies detected in sexual murderers

A recent study reveals a high percentage of brain abnormalities in sexual murderers, and suggests "the importance of a comprehensive neurological and psychological examination of this special offender group."

Peer Briken and colleagues evaluated psychiatric court reports of 166 men who committed sexual homicides between 1945 and 1991, and found that 31% of the men showed evidence of brain abnormalities. Abnormalities included epilepsy, traumatic brain injury, childhood encephalitis or meningitis causing brain damage, genetic disorders (including three cases of XYY), and unspecified brain damage. Sixty patients had undergone neuroimaging, and in 34% of these the results revealed pathology. A number of men had multiple signs of brain abnormalities, with 14 exhibiting two signs and six exhibiting three or more.

The sexual murderers with brain abnormalities had a history of more childhood behavior problems than the sexual murderers who did not exhibit brain abnormalities. They also had a higher rate of transvestic fetishism and paraphilias, and there was a trend for sexual sadism to be more frequent in this group. In addition, the subjects with brain abnormalities were significantly more likely to commit multiple murders. Conversely, the men with brain abnormalities were less likely to have alcohol problems or to have offended while under the influence of alcohol, which the researchers say "could indicate that these individuals need less disinhibiting factors to commit a homicide."

The researchers say, "Our findings of a substantial frequency of brain abnormalities and paraphilic psychopathology are… consistent with the hypothesis involving the importance of neurodevelopmental contributions in the genesis of serial sexual homicide."

Sexual murderers with brain abnormalities were significantly more likely to commit multiple murders, and there was a trend for sexual sadism to be more frequent in this group.

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"The influence of brain abnormalities on psychosocial development, criminal history and paraphilias in sexual murderers," Peer Briken, Niels Habermann, Wolfgang Berner, and Andreas Hill, *Journal of Forensic Sciences*, Vol. 50, No. 5, September 2005, 1-5. Address: Peer Briken, University Hospital Hamburg-Eppendorf, Martinistrasse 52, D-20246 Hamburg, Germany, briken@uke.uni-hamburg.de.

In psychopaths, higher IQ correlates with greater severity

In 1941, Hervey Cleckley published *The Mask of Sanity*, the first psychiatric description of psychopaths—dangerous people, many of them violent or white-collar criminals, who exhibit shallowness and narcissism, callousness and lack of empathy, impulsiveness, a lack of remorse, and egocentricity.

Cleckley's description has stood the test of time, except for one observation: that psychopaths, unlike other criminals, tend to be highly intelligent. Later studies revealed that in general, psychopaths have IQs similar to those of non-psychopathic lawbreakers.

A new study, however, suggests that the *severity* of criminality increases in psychopaths who are more intelligent—a pattern opposite to that seen in criminals who are not psychopathic.

Peter Johansson and Margaret Kerr studied 370 men sent to a Swedish nationwide assessment center for violent offenders. Forty percent of the men were convicted of murder, attempted murder, or manslaughter.

The researchers report, "The key finding in this study is that psychopathic and non-psychopathic criminals, although not different in overall levels of intelligence, did differ in how high intelligence was related to the seriousness of misbehavior. For non-psychopaths, higher intelligence, particularly verbal intelligence, meant a later start in violent crime. For those diagnosed as psychopaths, however, high intelligence meant an early start in violent offending and more problematic behavior in and outside of institutions."

The researchers say that while psychopaths are not more intelligent than non-psychopaths as Cleckley suggested, high intelligence appears to "enhance the destructive potential" of a psychopath. They speculate, "[P]erhaps an explanation lies in the experience of having high intellectual abilities together with characteristics such as impulsivity and irresponsibility that do not allow one to succeed in the ways that people with high intellectual abilities normally do."

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"Psychopathy and intelligence: a second look," Peter Johansson and Margaret Kerr, *Journal of Personality Disorders*, Vol. 19, No. 4, 2005, 357-69. Address: Peter Johansson, Center for Developmental Research, Department of Behavioral, Social and Legal Sciences, Örebro University, SE-701 82 Örebro, Sweden, peter.johansson@bsr.oru.se.

Essential fatty acids benefit IQ, learning, behavior

(continued from page 2)

Sinn gave 145 Australian children with ADHD either a placebo or fatty acid supplements, without letting their parents know which children were taking the active supplements. She reports, "The parents of children who spent 15 weeks on a course of capsules containing a combination of fish oil and primrose oil reported increased attention and reduced hyperactivity, restlessness and impulsivity." The children also improved their scores on tests of attention and vocabulary.

When the children taking the placebo switched to the fatty acids, they showed similar improvements, while the supplemented group—which continued to take the fatty acids—made additional strides.

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Presentation by Joseph Hibbeln to the Institute of Brain Chemistry and Human Nutrition, January 2006. See "Diet and the unborn child: the omega point," *The Economist*, January 19, 2006.

—and—

J. L. Daniels, M. P. Longnecker, A. S. Rowland, and J. Golding, "Fish intake during pregnancy and early cognitive development of offspring," *Epidemiology*, Vol. 15, No. 4, July 2004, 394-402.

—and—

"Children with ADHD benefited from 15-week course of fish oil and primrose oil," *Medical News Today*, September 21, 2005.

QUOTABLE

"The evidence is getting ever stronger that children who have diets poor in omega-3 are not achieving their natural potential."

—Professor Robert Winston, Institute of Reproductive and Developmental Biology, Imperial College, London

From the CRIME TIMES mailbox:

Our thanks to the many readers who have written or emailed us from the U.S. and around the world. Lately, we've heard from readers in countries including the U.K., Europe, Canada, Nigeria, Turkey, and Mauritius. We're delighted to hear your comments (positive or negative), and we're pleased that so many parents and so many professionals in the fields of medicine, education, justice, and criminology find our publication helpful. Here's a quick sampling of our recent mail.

"I would like two copies of Crime Times mailed to my clinic for use in the waiting room. We see many individuals whose problems are likely to bring them into conflict with legal agencies. We emphasize the importance of nutritional supplementation and the articles in your journal are wonderful to help with this task."

"Thank you for your wonderful website. I am a mom of a special-needs child and a typical child, and I look around on the Internet a lot. Finding your site was a welcome relief from the many commercial sites and the personal sites with useless or even wrong information."

"I would very much appreciate if you could send me information on how to get further issues as I found your publication very interesting and relevant to my research."

"It seems to me that studying rats to 'learn about human behavior' is very much like studying an alarm clock to find out how automobile engines work. Very much off target. The brain is the source of human behavior? Hardly. Funding for such 'research' is a CRIME."

"I just wanted to drop you a note and tell you how much I appreciate Crime Times. GREAT stuff! Consistently! Inspired coverage of this crucial and neglected area. Thank you, ever so much, for your work."

"I am working on my Ph.D. in Criminology, and teach criminology at the local Junior College. It [Crime Times] is a great tool for me during my research."

"I totally agree [with the concept that crime has biological roots] and as an ER physician, now with moderately severe environmental illness, I was thinking about why the homeless are the way they are as well. Between toxic load, hormonal insufficiency, nutritional inadequacy there is hardly anything that traditional medicine even touches on that helps these people at all!"

"Your magazine is highly interesting to us [and] your work is of the utmost importance to us. Your editorial [Vol. 11, No. 2] is excellent." (France)

"Keep up the good work you are doing with *Crime Times*." (England)

"I'm studying your reports. They make me very surprised with the many important news [items] I didn't know before." (Austria)

Parenting approaches: cause or effect of teen misbehavior?

A cornerstone of sociological theories about adolescent behavior problems is that they stem from poor parenting. A new study, however, indicates that parenting styles typically are a response to, rather than a cause of, teenage girls' misbehavior.

David Huh and colleagues questioned 496 adolescent girls from eight different schools to determine their perceived parental support, parental control, and the presence or absence of externalizing behavior problems (lying, stealing, running away, etc.) or substance abuse. The researchers say their findings did not support either the "social mold" model (which posits that poor parenting causes children's behavior problems) or the "reciprocal" model (which holds that children's behavior affects parenting, which in turn affects children's behavior). Rather, they say, "Results suggest that problem behavior is a more consistent predictor of parenting than parenting is of problem behavior, at least for girls during middle adolescence."

Huh and colleagues say that increases in adolescent behavior problems predicted decreases in parental control and support, and that increases in adolescent substance abuse predicted decreases in parental control. Conversely, low parental control—while it influenced the development of substance abuse—played no role in escalating behavior problems. Deficits in parental support did not cause escalation of either behavior problems or substance abuse.

"In theory, increases in adolescent problem behavior raise parental tolerance of deviant behavior resulting in decreased parental control attempts," the researchers say. "As an adolescent's behavior becomes increasingly threatening, parents may respond by becoming less supportive and controlling. Eventually, parents may come to emotionally reject adolescents exhibiting problem behavior. In this fashion, early child characteristics may dynamically shape later parenting behaviors."

Editor's note: The entrenched belief that poor parenting is the primary or sole cause of children "going bad"—a belief that, as this study shows, is grossly inaccurate—has long prevented us from looking at the real (and largely biological) reasons for these children's problems.

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"Does problem behavior elicit poor parenting? A prospective study of adolescent girls," David Huh, Jennifer Tristan, Emily Wade, and Eric Stice, *Journal of Adolescent Research,* Vol. 21, No. 2, March 2006, 185-204. Address: David Huh, Oregon Research Institute, 1715 Franklin Blvd., Eugene, OR 97403.

QUOTABLE

"…(G)enes and environment cannot be viewed as totally separate and independent."

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"Much of the writing on environmental risk factors tends to imply that risk effects operate across the population as a whole. However, the evidence is clear-cut that this is rarely the case. In particular,… genetic influences play a major role in moderating environmental effects."

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"…(V)irtually all major environmental effects involve genetic mechanisms of one sort or another. Psychosocial researchers ignore these genetic effects at their peril."

Michael Rutter, in *Genes and Behavior: Nature-Nurture Interplay Explained,* Blackwell Publishing, 2006

QUOTABLE

"Even if a lead poisoned child is found to have a normal IQ and behavior, the reality is that this normal IQ is likely 10-15 points below what the child was born with and the child will still be struggling with inner demons due to impulsivity unleashed by lead. A child born with a 115 IQ has a right to a 115 IQ, and if the child now has an IQ of 100, that is NOT normal. If the lead is there, the child is brain damaged. Ignoring the damage is easy, but it does not mean it does not exist."

Michael T. Martin, Arizona School Boards Association, in "A Strange Ignorance: The Role of Lead Poisoning in 'Failing Schools,'" 2002

Why Crime Times?

The more we learn about the brain dysfunction that underlies much delinquency and criminal behavior, the more successful we will be in truly rehabilitating offenders and preventing at-risk children from turning to lives of crime. The purpose of *Crime Times*, a free publication sponsored by the Wacker Foundation, is to foster this effort by reporting state-of-the-art worldwide research on biological causes and treatment of aberrant behavior. It is our hope that physicians, researchers, educators, law enforcement professionals, and parents can use the information in *Crime Times* to build a better, safer future for at-risk children and for the communities in which they live.

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QUOTABLE "Individuals with neuropsychological impairment as the result of a head injury are considered to be among those at greatest risk for developing violent and aggressive behavior. Sustaining a TBI [traumatic brain injury] has been found to be a significant predictor of becoming a batterer. In a comparison study, prior history of TBI was found to be more highly correlated with domestic battering than any other medical, psychosocial, and psychiatric variables measured (Cohen et al., 1999). Men with a history of brain injury are six times more likely to engage in spousal aggression, and in 93.1% of a group of batterers who sustained TBIs, the injury occurred prior to the first episode of domestic violence (Westby & Ferraro, 1999)."

Deborah Bryon, "Domestic aggression and traumatic brain injury," 4therapy.com

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