culture to eating habits.

"No single brand-name food has clogged more heart arteries," said Phil Sokolof of the National Heart-Savers Assn. "It has made many lawyers surgeons and morticians independently wealthy."

But today, as Americans who can't remember life before the Big Mac threaten to outnumber those who can, its cultural significance has far surpassed its gastronomic value (500 calories, including 26 grams of fat and 100 milligrams of cholesterol).

So what if some people think the Big Mac is yucky? It is also intrinsically American. And because of that, it has a loyal following of grease junkies, gourmands and scholars.

"No one buys a Big Mac for the simple reason of eating it," said Michael R. Steele, whose anthropological essay about McDonald's

Please see BIG MAC, A18

assure that rape or incest actually occurred, but only if the requirements do not "deny or impede coverage."

To assure that these safeguards against fraud do not prevent rape or incest victims from receiving abortions, the directive said, any reporting requirement "must be waived and the procedure considered to be reimbursable if the treating physician certifies that in his or her professional opinion, the patient was unable, for physical or psychological reasons, to comply with the requirement."

Abortion foes said the directive confirmed their worst fears.

"It's basically telling the states they cannot have any enforceable type of review mechanism," said Douglas Johnson of the National Right to Life Committee, the nation's largest anti-abortion group.

Johnson warned that some doc-

Please see ABORTION, A16

By ELIZABETH
TIMES STAFF WRIT

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Fears Cloud Search for Genetic Roots of Violence

■ **Sociology:** Many say studies could open the door to abuses and racism. Scientists are sharply divided.

By SHERYL STOLBERG
TIMES MEDICAL WRITER

As gun detectors become standard furniture in schools and some children learn to fire automatic weapons before they learn to drive, Dr. Markku Linnoila is struggling to unravel a great mystery of human behavior. What transforms innocent little children into brutal teen-agers and adults?

Across America, hundreds of other scholars are on a similar quest, frantically searching for the roots of modern violence. Most are pursuing the obvious leads: poverty, parental neglect, lack of education, drugs, guns and TV violence.

Not Linnoila. He is hunting for clues in genes—and triggering great controversy while he is at it.

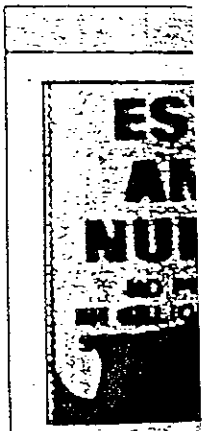
In his laboratory at the National Institutes of Health, the soft-spoken native of Finland has spent 13 years immersing himself in the intricacies of the brain chemical serotonin. By examining the spinal fluid and blood of more than 1,000 Finnish prisoners—including 300

■ FIRST OF TWO PARTS

violent offenders—he says he has proved over and over again that people with low levels of this neurotransmitter are prone to impulsive, violent acts, especially when they abuse alcohol.

Now, Linnoila is searching for "vulnerability genes" that create

—Please see VIOLENCE, A14



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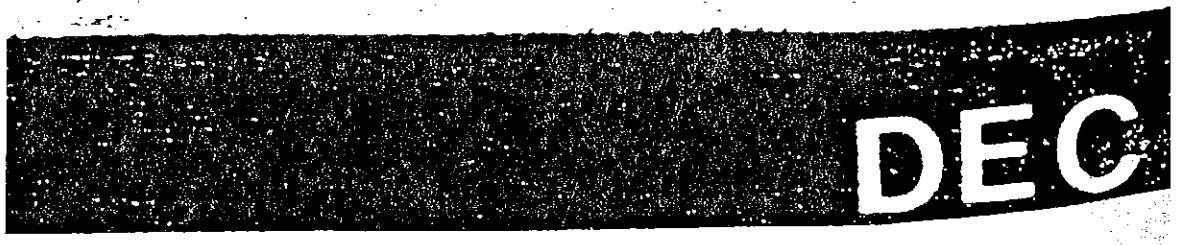

VIOLENCE: Fears Cloud Search for Genetic Causes

Continued from A1

this serotonin deficit. His goal: to be able to predict who might become violent, and then to prevent it—either with programs to help these people change their behavior or, if that doesn't work, new drugs.

At a time when the U.S Centers for Disease Control has declared that violence is America's most pressing public health threat, Linnoila's work raises some of the most intriguing—and politically volatile—questions in medical research today. Are some people biologically or genetically predisposed to violence? Could traditional medicine hold clues, even tiny ones, to making streets safe again?

"We are trying," Linnoila explains simply, "to address this public health problem with an open mind."

But not everyone's mind is so open.

His work challenges long-held assumptions that social and environmental factors—poverty, joblessness, discrimination, lack of education—are the sole causes of crime and violence. And there is bitter controversy over whether science should even attempt to answer the questions raised by his research.

Critics say research like Linnoila's is dangerous, that it holds too much potential for abuse. The biggest fear is that the studies will be used to discriminate against people of color, particularly African Americans. This is because blacks are disproportionately represented in arrest statistics; the federal government reports that African Americans, who make up about 12% of the population, account for 46% of all arrests for violent crimes such as homicide, rape and robbery.

Thus, scientific pursuits have become entangled in delicate discussions of race. Social tensions are spilling over into the laboratory. Not surprisingly, the debate sometimes gets emotional.

"We know what causes violence in our society: poverty, discrimination, the failure of our educational system," said Dr. Paul Billings, a clinical geneticist at Stanford University who has spoken out against such research. "It's not the genes that cause violence in our society. It's our social system."

Counters Adrian Raine, a USC psychologist who has reviewed all published research that attempts to

The High Cost

Violence is one of the United States' most pressing public health threats, according to the U.S. Centers for Disease Control and Prevention. Some of the sobering figures:

■ **THE TOLL:** Homicide is the nation's 11th leading cause of death, and the leading cause of death for young black men. It is the second leading cause of death for people ages 15 to 24.

■ **TEEN-AGERS:** Firearms are responsible for the deaths of more U.S. teen-agers than are all diseases combined.

■ **THE GUN'S ROLE:** More than 60% of all murders are committed with guns. At least 80% of the cost of treating firearms injuries is paid by taxpayers.

■ **THE HOSPITAL SCENE:** Each year, more than 2 million Americans suffer injuries as a result of violence, and more than 500,000 are treated in emergency rooms.

■ **THE COST:** By some estimates, the nation spends as much as $18 billion each year caring for victims of violence; by comparison, $10 billion was spent last year to treat people infected with the AIDS virus.

academics to explore every aspect of the nation's violence problem.

In a massive 464-page report titled "Understanding and Preventing Violence," the scientists recommended that along with traditional research into the social causes of violence, biomedical research into violence should be increased.

The language was cautious, noting that "evidence of a genetic influence specific to violent behavior is mixed." But the message was clear: The human body may hold clues to what makes people violent. And scientists ought to pursue them.

Aside from genetics, the NRC cited other important biological leads, including studies that show certain brain abnormalities are linked to violent behavior. And it

Yet over the years, science has developed a significant—if scattered—body of evidence that indicates some people are indeed biologically prone to violence. For instance, studies have shown that a disproportionate number of murderers have suffered from head injuries. Hypoglycemia—low blood sugar levels—has been linked to violent and aggressive behavior. So has the male hormone testosterone, in high concentrations.

Sophisticated brain imaging has pinpointed differences in the prefrontal cortex—the region of the brain believed to control social behavior—of violent criminals. Other studies have suggested that people with low levels of "arousal"—heart rate, sweat rate and electrical activity of the brain—are more likely to commit violent crimes.

Controversial History

Not all of these biological differences have their roots in genes, and so far, research into the links between genetics and violence has been limited.

But recent advances in molecular biology are opening up vast—and as yet largely untapped—possibilities for studies into how genes affect behavior, including violence. This field, "behavioral genetics," has been fraught with controversy; claims of genes for schizophrenia, manic depression and alcoholism have all either been disproved or come under severe criticism. Some say the same will undoubtedly be true of any attempt to find a gene for violence.

Others worry about how the research will be used.

"Let's just assume we find a genetic link [to violence]," said Ronald Walters, a political scientist at Howard University in Washington. "The question I have always raised is how will this finding be used? There is a good case, on the basis of history, that it could be used in a racially oppressive way, which is to say you could mount drug programs in inner-city communities based upon this identification of so-called genetic markers."

So far, just one study has made a connection between a specific gene and violence. In October, a team of Dutch scientists reported that they had found a genetic mutation in a family whose men had a high

Violence: a

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Sources: World Book Encyclopedia, Thomas

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Counters Adrian Raine, a USC psychologist who has reviewed all published research that attempts to link biology to violence: "It is irrefutably the case that biologic and genetic factors play a role. That is beyond scientific question. If we ignore that over the next few decades, then we will never ever rid society [of violence]."

Many Factors at Work

It is a classic nature-versus-nurture debate—one that might be confined to the ivory tower, if it were not for the dreadful toll that violence is taking on America.

The United States leads the industrialized world in murder, with an annual rate of homicide four times that of Scotland, the country with the next-highest rate. Murder is responsible for more deaths among young black men in America than any other cause, and Latino men are three times as likely to be killed as whites. According to the CDC, homicide is the nation's 11th-leading cause of death.

Theories abound concerning the reasons for this upsurge: Poor parenting. Television violence. Poverty. Discrimination. Substandard housing. Inadequate education. Easy access to guns. Drug abuse. Genetics and biology. The truth is, all these factors are at work, but no one really knows how they play in combination with one another. There are many questions. Answers are scarce.

"There are lots of things that we don't know," Yale University sociologist Albert Reiss said. "What is it that accounts for the fact that we have more interpersonal violence [than other nations] and that it is disproportionately among blacks? That's a puzzle. And why is it that women have so much less homicide, but suicide ranks higher? If you think we know the answers to all those questions, then there is no reason to do research."

Although rational voices agree that biology and genetics probably play a role in causing violence, what they cannot agree on is this: How much of a role? Or is this intellectual territory better left unexplored?

Last year, the National Research Council stepped into the fray and gingerly sided with the argument made by Raine of USC. As the research branch of the National Academy of Sciences, the most prestigious scientific group in the nation, the NRC brought together 19 of America's most prominent [illegible] that the message was clear. The human body may hold clues to what makes people violent. And scientists ought to pursue them.

Aside from genetics, the NRC cited other important biological leads, including studies that show certain brain abnormalities are linked to violent behavior. And it suggested new drugs might be developed to prevent violent behavior "without undesirable side effects."

Yet using medicine to "cure" violence is precisely what opponents find so abhorrent.

Among the most vocal critics is Dr. Peter Breggin. As founder of the Center for the Study of Psychiatry in Bethesda, Md., Breggin has made a career of fighting medical approaches to social problems. He envisions a frightening scenario in which government-funded genetic screening programs will label inner-city youngsters at risk for becoming violent, and then dope them up in what he calls "a massive drugging of America's children."

Not one to mince words, Breggin compares attempts to find genes for violence to the horrifying genetic experiments that took place during the Nazi Holocaust. "It's like if you go into the concentration camps and see how bad the Jews are doing, to look for genetic factors for it!" he exclaims. "This is biomedical social control."

If history is any guide, Breggin may have reason to be fearful. Americans have long been fascinated with biological explanations for violence, and the research cannot escape its own sordid history, a legacy of one debunked theory after another.

During the early 20th Century, advocates of eugenics—a movement that asserted society should encourage breeding by those with "good traits"—claimed that certain immigrant groups had higher crime rates because they came from genetically flawed stock. Advocates of eugenics believed that criminal tendencies were linked to what was then called feebleminded-ness. While eugenics was in vogue, more than 30 states passed laws providing for the sterilization of the feebleminded or insane.

More recently, in the late 1960s and early 1970s, there was a flurry of interest around scientific reports that boys born with an extra Y chromosome were destined to become violent. The studies were ultimately discredited, but not before researchers in Boston began screening newborn boys—a program that was canceled amid public outrage. Jonathan Beckwith, a Harvard University geneticist, said: "The whole premise of the study was based on terribly faulty science."

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So far, just one study has made a connection between a specific gene and violence. In October, a team of Dutch scientists reported that they had found a genetic mutation in a family whose men had a long history of violence—including a rape that occurred 50 years ago, two arsons and an incident in which a man tried to run down his boss with a car after receiving a negative performance evaluation.

These men, the researchers found, had abnormal genes that code for enzymes that help break down the brain chemical monoamine oxidase, which could cause someone to respond violently to stress if allowed to build up in high concentrations. But the study's authors—well aware of the controversy their work might engender—were quick to caution that their discovery of the so-called aggression gene applied only to the one family they studied, and that the genetic defect was probably not widespread.

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The Debate

As academics across the nation struggle to understand the causes of violence and how to prevent it, some scientists are looking to the human body for clues. There is scientific evidence that biology and genetics play some role in violent behavior. But biomedical research into violence is highly controversial, and some critics would like to see it quashed.

"It's like if you go into the [Nazi] concentration camps and see how bad the Jews are doing, to look for genetic factors for it! This is biomedical social control."

—Dr. Peter Breggin, who opposes attempts to find genes for violence.

"Our critics paint these nightmare scenarios . . . that somewhere there is a bogyman who wants to start drugging people. . . . I think we have a very significant problem with interpersonal violent behavior. It behooves us, if we are serious about this, to try to understand how to prevent it."

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Uproar Over Research

No scientist has suggested that there is a single gene for violence, or that biology alone can explain the broad swath of crime cutting through American society. But Linnoila and others do say these studies could provide science with clues about why people become violent in certain situations—and how to prevent it. Even if the research applies to only a small number of people, advocates argue, it will still be worthwhile.

"Violent behavior is a problem for society," said Kenneth K. Kidd, a geneticist at Yale University. "And there is growing evidence that some small component—I have no idea how big yet—of violent behavior has a genetic basis. So I think it is worth trying to understand what causes that and trying to understand how we can minimize it."

Dr. Frederick Goodwin thought search.

But Goodwin sprinkled his speech with several remarks that were later interpreted as racist, including one that suggested studies involving monkeys might prove useful in understanding violence in humans. The comments sparked a huge uproar, the violence initiative was scuttled and amid the fury, the NIH convened a special panel to review all its violence-related research.

The panel has not yet made its recommendations, but members say it is likely to suggest the NIH expand its research into the social causes of violence. Goodwin, meanwhile, was forced to resign his post with the alcohol and drug abuse agency and now serves as director of the National Institute of Mental Health. He declined to be interviewed.

But the controversy has failed to subside.

Among those it has snagged is David Wasserman, a 40-year-old lawyer and research scholar at a University of Maryland think tank. Wasserman organized and scheduled a conference on genetics and crime for October, 1992—eight months after Goodwin made his ill-fated remarks.

Although the NIH had agreed to foot the $78,000 bill for the conference, it yanked the funding after Breggin and others complained about the conference. Wasserman was forced to cancel the meeting, but the university appealed and the money has since been reinstated. The conference will be held, Wasserman says, but its agenda will be nowhere near as broad as the one he first envisioned.

That is because the researchers he invited are now afraid to discuss their work.

"I had scientists who were invited to the conference telling me that they were going to tone down what they were going to say because they didn't want [their funding] to be placed in jeopardy," he said.

For scientists interested in the biology of violence, any public pronouncements are fraught with danger. Sarnoff Mednick learned that lesson long ago.

Mednick is a USC psychologist who in the late 1970s conducted a landmark study of genetics and crime. His was a classic genetics study. It relied not on the sophisticated techniques of molecular biology but on a painstaking analysis of the criminal records of more than 14,427 adopted children in Denmark between 1927 and 1947. (Scandinavian nations are particularly suited to genetic studies because their populations are homogeneous and because they keep excellent records.) He compared these records with the criminal records of the children's biological and adoptive parents.

...y as the American Assn. for the Advancement of Science, there was a mob scene, with the press running after me and me running away. I was amazed."

A Public Health Issue

In 1983, Mednick proposed a large-scale study that would have measured arousal—sweat rate, heart rate and brain electrical activity—in juvenile delinquents. The object was to predict who would become repeat offenders. He says his plan received initial approval from the U.S. Department of Justice, which was to fund the study, and that he had the cooperation of judges in San Diego, where the research was to have been conducted.

But the funding was withdrawn, Mednick said, after a Washington newspaper columnist published an article comparing his proposal to "something cooked up by the Nazis' Dr. Mengele." Now, 10 years later, Mednick is about to embark on the same study—in Australia, where the political opposition is not as great.

Mednick is morose about the future of this biomedical research into violence. "It's kind of hopeless," he said. "Nobody permits the studies to be done. Nobody permits the conferences to be held."

And like most others in the field, Mednick tries to shield his work from publicity. "I think most of the people who are doing serious work on this try to avoid it," he said in a recent telephone interview. "Like I was trying to avoid this phone call for some time."

Linnoila, too, worries that anything he says will be misconstrued. He fears he will be branded as "one of these crazies," and he chooses his words with caution. He is careful to say that, in his vision, drugs would be used to control violent behavior only as a last resort, after other programs had been tried and failed. And he offers—without being asked—that he does not consider his research "an ethnic issue."

But he believes fiercely that science may hold at least some clues to curing America's violence epidemic, and that his own research is crucial to the public health of a nation at risk.

"Our critics paint these nightmare scenarios based on their own imaginations . . . that somewhere there is a bogyman who wants to immediately start drugging people, and I don't see that," he said. "I think that we have a very significant problem with interpersonal violent behavior. And it behooves us, if we are serious about this, to try to understand how to prevent it."

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Violence and the Brain

Dr. Markku Linnoila of the National Institutes of Health has spent the past 13 years researching serotonin, a neurotransmitter—or brain chemical—that modulates emotion. Linnoila's research has repeatedly shown that people with low levels of serotonin (pronounced SER-uh-TOE-nin) are prone to impulsive, violent acts. Linnoila is now looking for genes that create this serotonin imbalance. Finding these genes could help scientists predict who might become violent—and give them preventive treatment.

Background

The brain has 10 billion to 100 billion nerve cells. Messages between cells are communicated by both electrical and chemical processes. Here is a look at how the chemical process works:

The Messengers

A. Nerve cells, called neurons, contain tentacle-like structures known as axons that carry messages. Others, known as dendrites, receive messages.

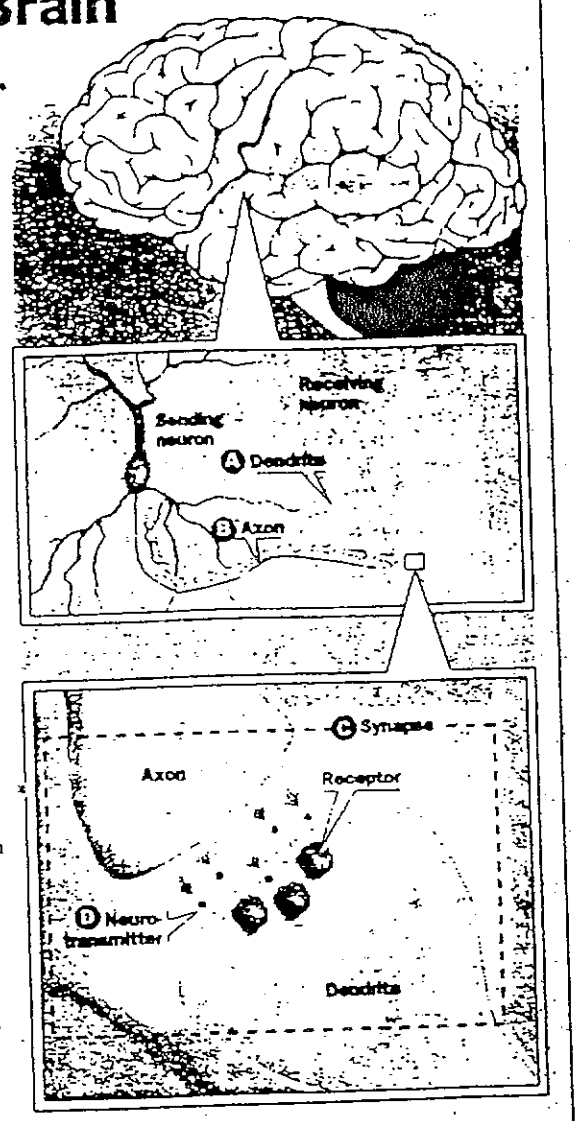
B. The axons of one nerve cell are separated from the dendrites of another by a tiny gap called a synaptic cleft or synapse.

C. Messages are transmitted across the synapse by the various neurochemical transmitters.

D. Many researchers believe that the neurotransmitter known as serotonin plays a key role in a number of emotions. Imbalances in serotonin levels have various effects; low levels have been tied to depression, suicidal behavior and aggression while large amounts can bring on emotional highs, including mania.

What Is Serotonin?

Serotonin, which is converted from an amino acid called tryptophan, is a naturally occurring chemical found in the brain, blood and other parts of the body. It can also be produced synthetically. In the brain, it is one of at least 40 chemicals that serve as messengers between nerve cells.



Research by NORA YATES/Los Angeles Times
Sources: World Book Encyclopedia, Times files

DENNIS LOWE/ Los Angeles Times

noila is investigating is far more commonplace; he estimates it may be present in as many as one out of every 20 men. But, Linnoila adds, there are more than 20 genes that could control the manufacture of this brain chemical. And it will be at least another decade before he understands how they work together—in connection with other factors, such as alcohol abuse or poor parenting—to make people violent.

"The low serotonin turnover as such does not make anybody a violent criminal," Linnoila said. "It is simply a predisposing factor. . . . The challenge is really to understand how the genes and environment interact."

Uproar Over Research

No scientist has suggested that there is a single gene for violence.

so too, but he was not nearly so careful in his choice of words as Kidd, and it got him into trouble.

In the 1970s and 1980s, Goodwin, a respected psychiatrist, conducted studies into the connection between serotonin and violence. Goodwin later became director of the now-defunct federal Alcohol, Drug Abuse and Mental Health Administration. Two years ago, while still in that job, he called for government scientists to embark on a large-scale violence initiative that would include biomedical research.

But Goodwin sprinkled his speech with several remarks that were later interpreted as racist, including one that suggested studies involving monkeys might prove useful in understanding violence in humans. The comments sparked a huge uproar, the violence initiative was scuttled and amid the fury, the NIH convened a special panel to

Mednick found no evidence that children inherited a tendency toward violence. But he did find that youngsters were more likely to commit property crimes, such as theft, if their biological parents had also committed property crimes. And, like Linnoila, he found himself caught up in a heated political debate.

"People were out of their minds trying to deny that this could possibly exist . . . ," he said. "When I presented the paper orally at the American Assn. for the Advancement of Science, there was a mob scene, with the press running after me and me running away. I was amazed."

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Dr. Frederick Goodwin thought search.

But Goodwin sprinkled his speech with several remarks that were later interpreted as racist, including one that suggested studies involving monkeys might prove useful in understanding violence in humans. The comments sparked a huge uproar, the violence initiative was scuttled and amid the fury, the NIH convened a special panel to review all its violence-related research.

The panel has not yet made its recommendations, but members say it is likely to suggest the NIH expand its research into the social causes of violence. Goodwin, meanwhile, was forced to resign his post with the alcohol and drug abuse agency and now serves as director of the National Institute of Mental Health. He declined to be interviewed.

But the controversy has failed to subside.

Among those it has snagged is David Wasserman, a 40-year-old lawyer and research scholar at a University of Maryland think tank. Wasserman organized and scheduled a conference on genetics and crime for October, 1992—eight months after Goodwin made his ill-fated remarks.

Although the NIH had agreed to foot the $78,000 bill for the conference, it yanked the funding after Breggin and others complained about the conference. Wasserman was forced to cancel the meeting, but the university appealed and the money has since been reinstated. The conference will be held, Wasserman says, but its agenda will be nowhere near as broad as the one he first envisioned.

That is because the researchers he invited are now afraid to discuss their work.

"I had scientists who were invited to the conference telling me that they were going to tone down what they were going to say because they didn't want [their funding] to be placed in jeopardy," he said.

For scientists interested in the biology of violence, any public pronouncements are fraught with danger. Sarnoff Mednick learned that lesson long ago.

Mednick is a USC psychologist who in the late 1970s conducted a landmark study of genetics and crime. His was a classic genetics study. It relied not on the sophisticated techniques of molecular biology but on a painstaking analysis of the criminal records of more than 14,427 adopted children in Denmark between 1927 and 1947. (Scandinavian nations are particularly suited to genetic studies because their populations are homogeneous and because they keep excellent records.) He compared these records with the criminal records of the children's biological and adoptive parents.

...y at the American Assn. for the Advancement of Science, there was a mob scene, with the press running after me and me running away, I was amazed."

A Public Health Issue

In 1983, Mednick proposed a large-scale study that would have measured arousal—sweat rate, heart rate and brain electrical activity—in juvenile delinquents. The object was to predict who would become repeat offenders. He says his plan received initial approval from the U.S. Department of Justice, which was to fund the study, and that he had the cooperation of judges in San Diego, where the research was to have been conducted.

But the funding was withdrawn, Mednick said, after a Washington newspaper columnist published an article comparing his proposal to "something cooked up by the Nazis' Dr. Mengele." Now, 10 years later, Mednick is about to embark on the same study—in Australia, where the political opposition is not as great.

Mednick is morose about the future of this biomedical research into violence. "It's kind of hopeless," he said. "Nobody permits the studies to be done. Nobody permits the conferences to be held."

And like most others in the field, Mednick tries to shield his work from publicity. "I think most of the people who are doing serious work on this try to avoid it," he said in a recent telephone interview. "Like I was trying to avoid this phone call for some time."

Linnoila, too, worries that anything he says will be misconstrued. He fears he will be branded as "one of these crazies," and he chooses his words with [illegible] careful to say that, in his vision, drugs would be used to control violent behavior only as a last resort, after other programs had been tried and failed. And he offers—without being asked—that he does not consider his research "an ethnic issue."

But he believes fiercely that science may hold at least some clues to curing America's violence epidemic, and that his own research is crucial to the public health of a nation at risk.

"Our critics paint these nightmare scenarios based on their own imaginations . . . that somewhere there is a bogyman who wants to immediately start drugging people, and I don't see that," he said. "I think that we have a very significant problem with interpersonal violent behavior. And it behooves us, if we are serious about this, to try to understand how to prevent it."

The Debate

As academics across the nation struggle to understand the causes violence and how to prevent it, some scientists are looking to the man body for clues. There is scientific evidence that biology and netics play some role in violent behavior. But biomedical research to violence is highly controversial, and some critics would like to e it quashed.

"It's like if you go into the [Nazi] concentration mps and see how bad e Jews are doing, to look r genetic factors for it! is is biomedical social ntrol."

Dr. Peter Breggin, who poses attempts to find nes for violence.

"Our critics paint these nightmare scenarios . . . that somewhere there is a bogyman who wants to start drugging people. . . . I think we have a very significant problem with interpersonal violent behavior. It behooves us, if we are serious about this, to try to understand how to prevent it."

—Dr. Maricka Linnoila, who believes that science may be able to find some clues to violence.

disillusioned, impover-ed Russian voters turned to right-wing extremists and old-time Communists to rescue them from Yeltsin's shock-therapy reforms.

They boosted Vladimir Zhirinovsky, a demagogic extreme nationalist leader who wants to resurrect the Soviet Union, to a leading role in Russia's new parliament.

Suddenly not just the economic reforms, vowed to press ahead even faster with the wrenching transformation—and berated his fellow Russians for preferring "to hear sweet lies rather than boring truth."

Others, though, were deeply alarmed.

"I wonder if we have finally hit the wall here," said a Moscow-based official of the World

SEE RUSSIA, PAGE 6

The Illinois Appellate Court w consider the case Tuesday in emergency hearing that is expe ed to provide new guidelines f doctors, hospitals and prosecuto in situations where a woman r fuses treatment deemed necessa for the health of her fetus.

The case, the first of its kind Illinois, raises a host of difficu legal and moral issues. The st and the Cook County public gu dian will argue that a 22-year-c

Why some kids turn violent

Abuse and neglect can reset brain's chemistry

By Ronald Kotulak
TRIBUNE STAFF WRITER

Unlocking the mind

Roots of violence

This is the third in a series of articles exploring new links between brain chemistry and violent aggression.

In probing the biology of violence, scientists have found it useful to take an age-old question—Why do some kids turn out bad?—and pose it this way:

What happens inside a developing brain to turn a child into a killer?

Their discoveries are shedding new light on the epidemic of violence that is being inflicted on children and that they are inflicting on others.

Consider the infant brain: Its main job is to figure out the kind of world it will have to live in and what it will have to do to survive.

For millions of American children, the world they encounter is relentlessly menacing and hostile. So, with astounding speed and efficiency, their brains adapt and prepare for battle. Cells form trillions of new connections that create the chemical pathways of aggression; some chemicals are produced in overabundance, some are repressed.

What researchers now can tell us with increasing certainty is just how the brain adapts physically to this threatening environment—how abuse, poverty, neglect or sensory deprivation can reset the brain's chemistry in ways that make some genetically vulnerable children more prone to violence.

The research also has produced an unexpected and ominous revelation: Environmentally induced brain changes can become permanent, encoding into genes a propensity for aggression and violence that can last a lifetime.

Scientists also have found that aggression genes, those that raise a person's propensity for violence, may be passed on to new generations. Some researchers believe that the increase in female criminal violence since the 1950s may be an early sign of how the genes of violence already are building up in the population.

"Aggressive or violent behavior has to be explained in part by biology," said Dr. Burr Eichelman, chief of psychiatry at Temple University in Philadelphia.

"Even though there are all kinds of social and learned issues that get played out [in violent behavior], they are all superimposed on a biological substrate."

Using sophisticated imaging devices that can peer inside the brain, scientists have observed how a threatening environment influences the brain's production of two key chemicals implicated in violent aggression—serotonin and noradrenaline.

Serotonin is the brain's key chemical modu-

SEE VIOLENCE, PAGE 8

Dr. Mar
ning to
ments |

Violence

(Continued From Page 1)

lator of primitive drives and emotions, including sex, appetite, mood, sleep and aggression.

Noradrenaline is the brain's master alarm switch. It gets turned on when the brain perceives a threat, preparing the mind to deal with impending crises and preparing the body to fight or flee.

When serotonin is low, all of the basic drives that it regulates can burst out of control. But such impulsivity is especially noticeable in aggression and it is made worse by high noradrenaline, which sets firecrackers under the primitive drives.

At the University of Illinois Medical School on Chicago's West Side, researchers are examining the blood of children for low serotonin levels. They know from an earlier study that these children are likely to grow up to be troublemakers and they want to find out why.

The study is designed to find out at what point in childhood serotonin levels plummet and what things in a child's early experiences cause serotonin to fall, said Dr. Markus J. Kruesi, chief of child and adolescent psychiatry at the U. of I.'s Institute for Juvenile Research.

He already has done a study of 29 children and adolescents with disruptive behavior disorders. It found that a low serotonin level was the single most accurate predictor of which youngsters would go on to commit more violent crimes or suicide.

"What we are all beginning to conclude is that the bad environments that more and more children are being exposed to are, indeed, creating an epidemic of violence," Kruesi said.

"Environmental events are really causing molecular changes in the brain ... [so that] people are more impulsive," he said. "It is frightening to think that we may be doing some very dreadful things to our children."

'We have a very naive belief that families are providing children with all their needs in these early years, despite the fact that families are functioning less and less well all the time.'

Dr. Felton Earls of Harvard

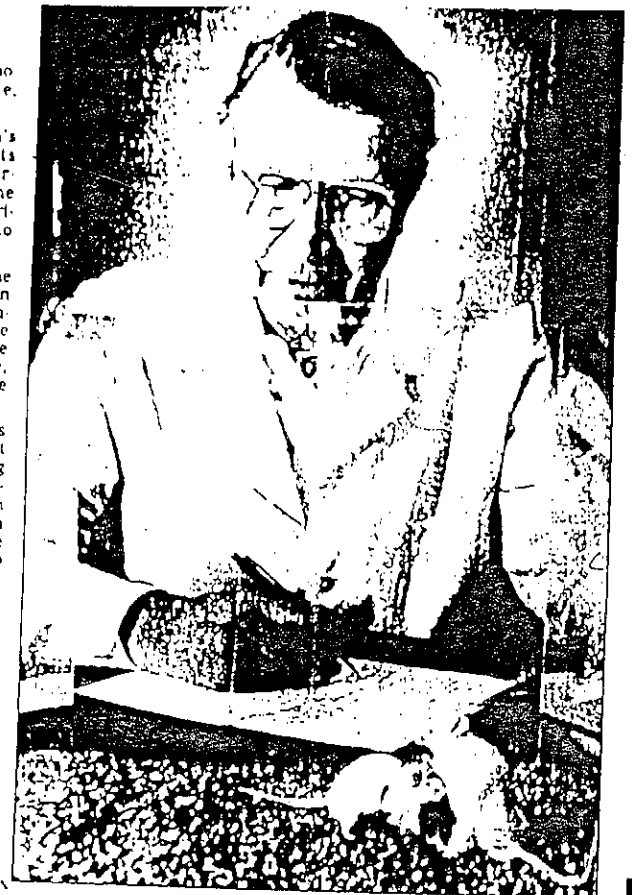


Photo by Dan Seers/University of North Carolina

Psychobiologist Robert Cairns of the University of North Carolina said his experiments in breeding aggressive mice showed that certain genes could change behavior and be passed on to male and female offspring.

tute of Mental Health's child and adolescent disorders research branch.

He said the collapse of the two-parent family, poverty, teenage pregnancies and violence are exposing many of these children to enormous stress.

Indeed, for an increasing number of children, all the things that used to be taken for granted—family, home, adequate food, good schools, social services, decent neighborhoods, health care—are rapidly decaying.

"We have earned the dubious distinction of doing less for our families and children than any other industrialized nation," said Cornell University developmental psychologist Urie Bronfenbrenner, who helped bring Head Start into existence.

Dr. Burt Eichelman, at Temple University: Aggressive behavior can be explained in part by biology.

Threatening environment and aggression

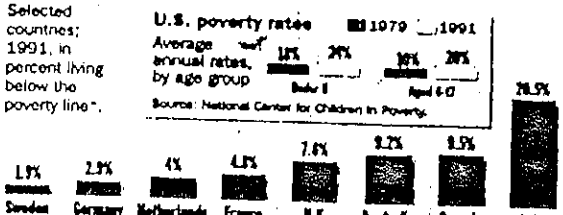
The brain adapts physically to a threatening environment. Violence, poverty, neglect, harsh discipline, poor schooling, or sensory deprivation can influence the brain's production of two key chemicals implicated in violent aggression and make some genetically vulnerable children more prone to criminal violence. The following selected charts highlight some of the environmental events that may contribute to the high rates of aggression in children:

- Between 1960 and 1990 the homicide rate for white males aged 15-24 increased 4 times and that for black males 2.2 times.
- In that same period the suicide rate for white males increased 3.6 times and for black males 3 times.
- Every day an estimated 270,000 students bring guns to school.
- Nearly one out of three children is born to an unmarried mother.
- One of every five children lives in poverty.
- One of every 50 children has a parent in prison.
- Alcohol is involved in 65 percent of all fights and assaults in the home.

Sources: Government and private child agency groups

Children living in poverty

Selected countries; 1991, in percent living below the poverty line*.



*In 1991, the U.S. poverty line for a family of three was $10,860. For a family of four, it was $13,924.

Sources: Timothy M. Smeeding, The War on Poverty: What Worked?, Testimony prepared for the Joint Economic Committee U.S. Congress, September 1991, National Commission on Children, UNICEF.

Murder rates

Deaths by homicide per 100,000; 1987-90, average annual rates, age 15-24

Key: Deaths by homicide / Average anual rate

U.S.	5,718	13.9	Sweden	13	1.6
Canada	121	2.1	Denmark	8	1.0
Italy	179	1.5	Netherlands	21	1.5
Norway	9	1.4	U.K.	80	1.4
Spain	93	1.4	France	59	1.1
Switzerland	12	1.3	Japan	73	.8

Source: World Health Organization, World Health statistics Annual 1991

Suicide rates

Deaths by suicide per 100,000; 1987-90, average annual rates, age 15-24

Key: Average annual rates 1970 1987-90

Australia	8.8	15.9	France	20	10.1
Norway	6.2	15.9	W. Ger.	11.0	9.6
Canada	10.2	15.6	Denmark	8.0	13
Switzerland	13.7	15.7	U.K.	4.1	7.7
U.S.	12.0	13.4	Japan	13.6	7.0
Sweden	13.1	12.7	Netherlands	4.9	6.7

Source: World Health Organization

University of Southern California photo

Using a PET imaging device to scan for brain chemistry, psychologist Adrian Raine tracked hot- and cold-blooded types of murderers.

One study using a PET imaging

72 Researchers have recently demonstrated that defects in two genes are linked to abnormal levels of serotonin and noradrenaline and that threatening environments can trigger these genes.

73 Now they suspect that bad experiences can change genes and that those changes can quickly become permanent.

74 "Sociologists have called me an idiot for saying this, because they think genes can't change in one generation, but regrettably they can," said Linnoila of the National Institute on Alcohol Abuse and Alcoholism.

75 One of the common, everyday environmental influences that can directly affect genes is alcohol. It does so through demethylation, a process that cells use to upgrade or downgrade the activity of genes in response to environmental changes.

76 "There truly are novel mechanisms by which the environment can change genetic expression within a generation," he said. "What role it plays in our current

be doing some very dreadful things to our children."

Other researchers are documenting the effects of bad childhood experiences on the brain's production of noradrenaline.

Children who were raised in the Branch Davidian cult provide a vivid example.

Released during the siege of cult headquarters in Waco, Texas, earlier this year, the children were found to have such high noradrenaline levels that their hearts roared in their chests, even at rest. While seated, the children had heart rates of 100 to 170 beats a minute. The average for children that age is 84.

Their brains, too, were racing, pumping out noradrenaline and other stress hormones that researchers said were in response to the children's violent and abusive lives with cult leader David Koresh.

Dr. Bruce Perry, of the Baylor College of Medicine in Houston, who examined 11 of the Branch Davidian children after their release from the Waco compound, had seen the phenomenon before in inner-city Chicago children.

The high levels of noradrenaline were the chemical signature of post traumatic stress disorder, or PTSD, which first came to prominence among battle-scarred Vietnam veterans.

In children, the disorder resets the brain's chemistry to an alarm response. They are hot-blooded, more quick to react, more impulsive, more aggressive and more likely to commit violent criminal acts.

"It is adaptive to be impulsive in that [abusive] setting," Perry said, referring to the cult. "If you wait, very frequently you will be victimized. So it's highly adaptive to be hypervigilant, to be overly reactive and impulsive, to actually act before you're acted upon."

While both high noradrenaline and low serotonin can increase a child's susceptibility to impulsive aggression, low serotonin can cause other changes, such as depression.

Scientists now believe that along with the nation's increase in violence, low serotonin may be responsible for a steady increase in depression, especially among children. Since World War II each succeeding generation has had higher rates of depression, particularly among adolescents and young adults.

"Children born in later years are more likely to become depressed and to become depressed at earlier ages," said Dr. Peter Jensen, chief of the National Insti-

existence.

Reported cases of physical abuse, sexual abuse, neglect and emotional maltreatment of children jumped from 416,033 cases in 1976 to 1.7 million in 1990, according to a study released in June by the National Academy of Sciences' National Research Council.

The rising tide of abuse and neglect of children occurs during the critical period when children are developing what Harvard's Dr. Felton Earls calls "moral emotions."

These are emotions that are rooted in brain chemistry and are established in the first three years of life, he said. The development of impulse control occurs at a time when sensitivity toward others is also being rooted in the child's personality.

The chemical patterns that are established tell a child how to react to his or her environment, whether the child sees the world as a hostile place that has to be fought, or a more peaceful one where social cooperation wins the day.

"We have a very naive belief that families are providing children with all their needs in these early years, despite the fact that families are functioning less and less well all the time," Earls said.

Last year, for instance, of the nearly 66 million U.S. children under the age of 18, nearly 20 million lived with one parent. Among African-American children, 64 percent lived with a single parent, as did 35 percent of Hispanic children and 23 percent of whites.

For many children, a single-parent family is a war zone. Analyzing national child-abuse surveys, Dr. Richard Gelles of the University of Rhode Island found that severe violence toward children increased 71 percent among single mothers compared to mothers in two parent homes.

Several trends contribute to the pattern of neglect and violence, said Markku Linnoila, scientific director of the National Institute on Alcohol Abuse and Alcoholism.

First of all parents are pushed to the limit to procure livelihoods that will support their families, reducing the amount of time they have for their children, he said.

"We don't invest very heavily in child rearing as a society, especially in preschool enrichment," he said. "The family is dissolving. Male role models are all too scarce."

Large groups of disadvantaged people are thrown together in public housing complexes, where the physical layout and social patterns can make behavioral con-

University. Aggressive behavior can be explained in part by biology.

trol over children difficult, he said.

"Then we have perhaps the most violent TV anywhere in the world," Linnoila continued. "TV becomes the baby-sitter and the conflict-resolution patterns seen by the kids are blowing away the other guy. Then we provide the easiest availability of handguns, even automatic guns, in the world."

An estimated 4 million American children are victimized each year by physical abuse, sexual abuse, domestic violence, community violence and other traumatic events.

Taking all of this in is the *locus coeruleus*, the brain's alarm network. Sitting at the base of the brain, it sends out noradrenaline highways to other brain centers that control heart rate, breathing, blood pressure, emotions and motivation.

When the *locus coeruleus* finds itself in an uncontrollable, threatening environment, it sets its noradrenaline gauge on high. Over the highways come surges of the stress hormone that keeps the body in a constant state of readiness—heart racing, blood pressure high, easy to startle, quick to blow up. These are the PTSD children.

They're in double trouble, said Baylor's Perry. They're at risk because they don't have the opportunities to learn the traditional ways that enable people to get along in society, and they are at risk because the brain systems involved in impulsivity are poorly regulated.

The increased tendency to act before thinking, combined with language handicaps and poor problem-solving skills, predisposes these children to use aggressive and violent strategies to deal with life's daily challenges, he said.

Setting the noradrenaline gauge on high is surprisingly easy to do. University of Wisconsin psychologist Mary Schneider found that noradrenaline levels can be turned up in a fetus if its mother is exposed to significant stresses during pregnancy.

Monkeys born to mothers who listened to 10 minutes of random noise each day during mid and late pregnancy had higher noradrenaline levels than normal monkeys. The hyped-up monkeys were impulsive, overresponsive and had fewer social skills as infants.

When the prenatally stressed monkeys got to be the equivalent

University of Wisconsin photo

Pyschologist Susan Clarke says high-stressed pregnant women tend to have hyperactive babies.

of pre-teens, their noradrenaline was still high and their behavior still abnormally hostile and aggressive, said University of Wisconsin psychologist Susan Clarke, who studied the monkeys as they grew up.

Although human studies are sketchy, they suggest that mothers who report high levels of stress during pregnancy, such as divorce, poverty or violence, tend to have babies who are hyperactive and developmentally delayed, Clarke said.

"If you think about the fact that the inner-city population is chronically stressed, and there's a lot of that population that is chronically pregnant, then we can begin to see some of the biology that may be responsible for high rates of aggression in the children," she said.

While high noradrenaline and low serotonin appear to be behind the huge rise of impulsive, hot-blooded crime in the U.S., scientists are also starting to study the effects of low noradrenaline, which is linked to cold-blooded, premeditated crime.

Researchers are finding that the difference between high and low noradrenaline may be two sides of the same coin. Low arousers tend to be sensation-seekers. They try sky diving, auto racing or other exciting activities to get their kicks in a socially acceptable way.

But some of them turn out to be more like Hannibal the Cannibal in the movie "Silence of the Lambs," remorseless serial killers. More typically they are the kind of criminals who coolly look for vulnerable victims they can stalk to rape, rob or kill.

Researchers have identified two broad types of murderers.

One study, using a PET imaging device to scan the brains of 22 convicted California murderers, tended to confirm the idea that brain chemistry determines whether a criminal will be a cold-blooded or a hot-blooded killer, said University of Southern California psychologist Adrian Raine.

"We broke the murderers down into those whose murderous acts were impulsive, where there was a lot of rage going on, and those who planned their acts, who were predatory," he said.

PET scans were used to measure chemical activity in the prefrontal cortex, the part of their brains which controls the expression of emotions.

The scans revealed that the brains of the cold-blooded murderers were underaroused, suggesting low emotional activity, while the brains of the hot-blooded murderers were overaroused, indicating impulsive behavior, Raine said.

Where do the cold-blooded killers come from?

Baylor's Perry is studying children who start off in the alarm state with high noradrenaline and impulsive behavior, and then around puberty convert to low noradrenaline, low arousal and predatory behavior.

One explanation for the change may be that brain cells exposed to constant stress burn out, dropping to a lower level of activity to save themselves. Animal studies show that overexposure to stress can kill brain cells.

"It's really scary to watch the transition from high arousal to low arousal," he said. "They change from being victims to being victimizers and they develop this incredible icy quality of being emotionless."

When they are arrested the only thing they are sorry about is being caught, he said.

If you ask them if there is anything they would do differently, the only things they would change are things that would prevent them from being caught, not the things that would prevent them from engaging in criminal behavior again," he said.

Psychologist David Magnusson of the Karolinska Institute in Stockholm has studied all the boys in a small Swedish town over a 20-year period starting at the age of 10. He found that the few who go on to become career criminals have low noradrenaline levels.

"The two most important characteristics of these persistent criminals are their lack of emo-

tion and lack of

by which the environment can change genetic expression within a generation," he said. "What role it plays in our current epidemic of violence is not known right now, but the possibility that it does play a role cannot be ignored."

In his experiment to breed increasingly assaultive male mice, developmental psychobiologist Robert Cairns of the University of North Carolina in Chapel Hill noticed that their sisters were also becoming increasingly aggressive.

Until that point, Cairns said, "I was a total disbeliever in [that] genes could change behavior."

It was amazing to see how genes for increased aggression could be transmitted to male and female offspring of parents who had been exposed to aggression-promoting environments, Cairns said. The most aggressive offspring were successively bred to enhance the genetically aggressive line.

To find out if the same thing happens in humans, Cairns looked at the arrest records for teenage girls from 1900 to 1960 in Los Angeles County, and then compared them with female arrest records in North Carolina during the '80s.

Up until the 1960s, girls were arrested chiefly for sex offenses. In the '80s their reasons for getting into trouble with the law increasingly involved violent crimes.

Like the generational increase in depression after World War II, every generation since the '60s also has seen an increase in young female aggression, Cairns said.

The pattern that is emerging is of girls, who are increasingly victims of child abuse, who grow up angry and have children with men who are likely to also be aggressive, Cairns said. As a result, succeeding generations of children are being born to aggressive parents and into aggression-inducing environments.

"It really suggests that if there are red signals that [our] society has to be wary of [they] should be those temporal increases in female violence," he said. "It has been ignored, but it may be the most important of all."

Scientists hope the new research on aggression and violence will open the doors to prevention and treatment.

"If we don't invest in the early rearing environment of our children, we're going to be paying the bills for the rest of [their] lifetimes," said University of Wisconsin psychologist Christopher Coe. "The bills will be for mental disorders and physical diseases and putting many of these kids in jail."

'Natural born killers' may be n

By Deborah Blum
Bee Science Writer

For most of us, the word "death" comes loaded. It calls up memories of friends lost, family members we long, futilely, to see again. We respond even to the deaths of strangers, weeping for the children killed in the Oklahoma City bombing. If ever a word was tangled with grief or pain, this would seem the one.

Except for those, of course, to whom it means nothing.

And it's those people, the ones who read "death" as a collection of letters, who fascinate Robert Hare. Hare is a psychologist at the University of British Columbia in Vancouver. For years now, he's specialized in the science of psychopathy, trying to understand how a person loses the ability to care for others.

He's still not sure. But in a recent series of experiments, he came up with some chilling evidence of exactly how cold psychopaths are, functioning as if a surgeon had cleanly sliced away their ability to feel emotion.

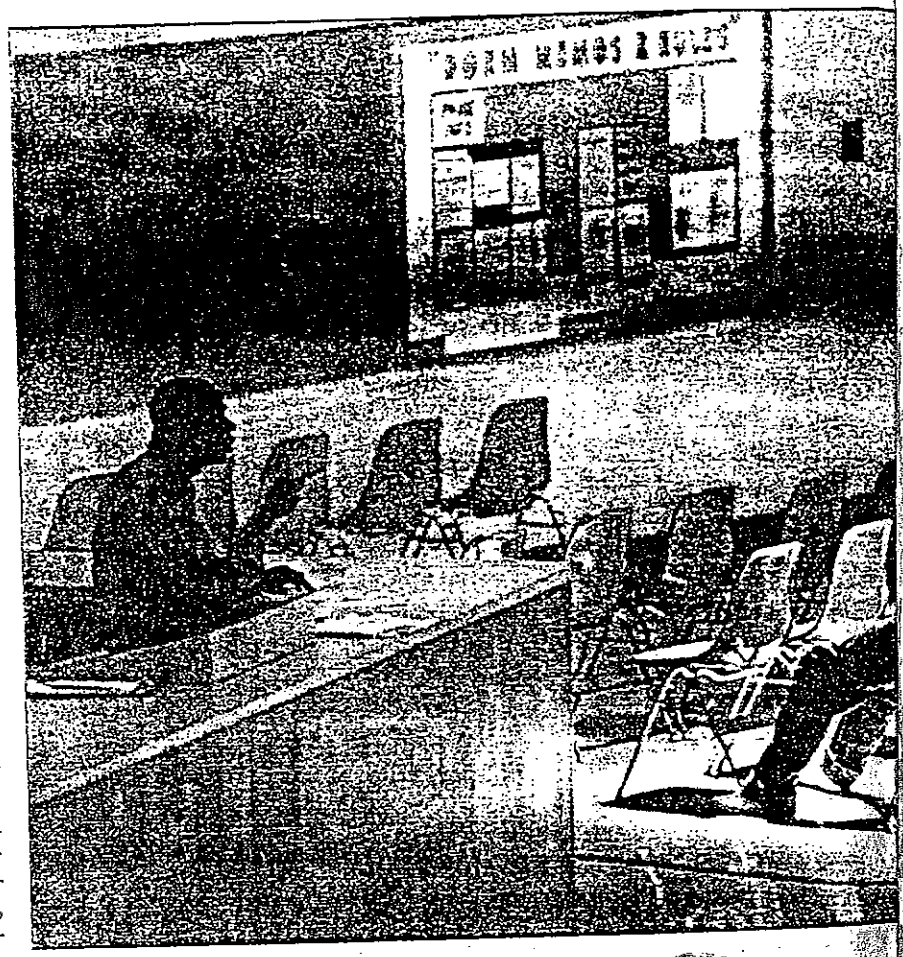
Hare devised an experiment in which combinations of letters flashed on a computer screen. Some were nonsense — "xybbtrw." Some were neutral words, such as "table." Some were emotion-loaded, such as "death."

He asked test subjects to watch the screen, to filter out real words from garble. His watchers were divided into known psychopaths, diagnosed by a detailed psychological test, and what Hare calls "nonpsychopaths," basically your everyday citizen.

While they watched, scientists made real-time pictures of their brains. They measured brain wave activity, looking for where it was most intense. And they used high-tech scanners, which pick up energy release, creating an image of those parts of the brain where metabolism is highest. The average group reacted most quickly to loaded words. They didn't just pick them out faster, they felt them. They would see the word "death," and suddenly regions of the brain linked to grief or anger would light the screen.

But to psychopaths, "death" was five letters. A companion word to t-a-b-l-e. They didn't — or couldn't — pick out loaded words faster. The rear of the brain, where basic processing occurs, stirred into action. Toward the front, where emotion plays, Hare's pictures went dark.

"You show these pictures to neurologists and their first reaction is that the machine wasn't working," Hare said. "And the next is, are these people from



Inmates of the California Youth Authority in Stockton relax in a recreat... criminal behavior are caused by a certain mix of brain chemistry. Othe...

tle enough to be downright invisible.

Second, he noted, being a psychopath doesn't always equal being a killer. The classic definition includes lacking remorse or shame, total disregard of the feelings of others, and an incandescent ego, a sense of being the sun around which all planets — and all others — revolve. Levinson notes, somewhat sarcastically, that this typifies the basic operating principle of many American corporations.

In fact, Levinson argues, the basic premise of American society today — "Let's look out for No. 1" — tends to encourage psychopathic traits. People could simply learn to shun emotional reactions and that could explain Hare's chilling images.

But could that mean that we are breeding for coldbloodedness?

"People who believe in pure biology would say that we are selecting for survival traits," Levinson said.

That idea is borne out by the work of Bruce Perry, a neurobiologist at the Baylor School of Medicine in Houston. It is precisely survival that Perry has in

Noradrenaline, by contrast, is ... mal scream, all reaction and actio... been in a near-miss car accident, ... your heart speed up, had your foo... brake before you consciously t... about it? That's noradrenaline, ... you into hyperfast reaction.

The two neurotransmitters ... flow in the brain, almost in synch... that a person with higher seroto... tend to be lower in noradrenaline ... the opposite. Biologists suspect ... that shifting balance that helps ... violent behavior.

Women, generally milder in ... than men, average about 30 perce... er serotonin levels. By contrast, ... els of noradrenaline have been ... Finnish men imprisoned for ... offenses, U.S. Marines discha... abusive behavior and people w... attempted suicide in the bloodie... ble ways.

Some scientists suggest that g... here, that each of us may inherit ... tings" for influential neurotra... levels. Others, such as Perr... against such simplicity. "I w...

"You show these pictures to neurologists and their first reaction is that the machine wasn't working," Hare said. "... The next is, are these people from Mars, or what? It's not what we think of as a human reaction.

11 "I think of it sometimes as a continuum, from water to ice. Water and ice have the same components, but they are very different. And these guys, they're the ice."

12 The question for scientists, such as Hare, becomes this: What is the biology of human ice? This is no academic question. These are times when Americans increasingly harm strangers, a time of random murder.

13 The anti-government militants who are accused of blowing up the federal building in Oklahoma had no personal vendetta against small children; the Sacramento teenagers who shot an ice cream vendor to death last year didn't know his name. And there are too many other examples — the now-infamous Unabomber; the K Street Mall robbers who killed a musician after they already had his money; the daily, deadly routine of drive-by shootings.

14 In 1993, for the first time since record-keeping began, the FBI's Uniform Crime Report announced that more Americans had been killed by unknown assailants than by friends, acquaintances or family members.

15 Hare firmly believes that the ability to kill without remorse is based in biology. But within his own specialty, that remains a raging debate — whether one is born without compassion or simply learns to do without it.

16 At the University of California, Davis, sociology professor Michael R. Levinson stands firmly against the notion that some inborn kink in the brain causes cold-blooded behavior.

17 First of all, Levinson said, Hare and his colleagues have spent years picking at the brains of psychopaths. They've created some flashy images. But they haven't found an actual kink, a brain structure to explain it all. If that exists, it seems subvirtually, Levinson said.

18 That idea is borne out by the work of Bruce Perry, a neurobiologist at the Baylor School of Medicine in Houston. It is precisely survival that Perry has in mind, and bear in mind that many children in this country do not survive childhood.

19 The latest government report indicates that 2,000 American children die every year from abuse and neglect. The main reason that children under 4 die is that adults kill them. And there's another statistic concerning the survivors: Crimes by children, especially teenagers, are increasing faster than in any other age group.

20 Perry concentrates on children raised in fear. He has studied the children who survived the Branch Davidian fiasco in Waco, Texas, and children in Chicago's high-rise and high-crime inner-city housing projects.

21 As he has learned, the heart is not a liar.

22 In following 11 children from the Branch Davidian cult, released during negotiations before fire consumed the rest of David Koresh's followers, he found that their hearts thudded uncontrollably, up to 170 beats a minute, even as they sat still. The average heart rate for a child is 94 beats a minute.

23 Those heartbeats provide clues to changing biology. A heart does not stutter out of control on its own. The regulating switches are set within the brain. And it is the response of the brain that alters the normal heart rate and may, indeed, alter behavior as well.

24 Chemically, the brain is a noisy place, nerve cells chattering constantly to each other via hormones and neurotransmitters. In studying violence, biologists have concentrated on two such messengers — serotonin and noradrenaline.

25 Serotonin, essentially, is the soft voice of reason: calming, controlling impulses, regulating against aggression. In an argument with a child, however irritating, most of us do not fall back on fists. That's, in part, the pull-back effect of serotonin, cooling us off.

26 Some scientists suggest that genes r here, that each of us may inherit the "s tings" for influential neurotransmitt levels. Others, such as Perry, arg against such simplicity. True, we may predisposed to a certain brain chemistr but there's nothing permanent about it.

27 Alcohol lowers serotonin levels in t brain, possibly increasing the likelihoo of violence. Drugs, such as the popul anti-depressant Prozac, work by increa ing serotonin circulation in the brain. In parallel way, drugs that inhibit noradre aline calm people. So does decent huma contact. University of Minnesota studi show that jittery children, born with hig noradrenaline levels, relax in the securit of a loving home.

28 And Perry's work suggests that wretched childhood may also alter the critical balance. He suspects the brain i so responsive to experience that whatever the genetic settings, they may be reset What happens in the home, in the neigh borhood, in the school can literally be a experiment in brain chemistry.

29 If a child grows up in a danger zone the brain naturally puts the body o alert. Noradrenaline levels charge up depressing serotonin, keeping the hear pounding, the nerves twitchy. The ques tion becomes one of endurance. How lon can a child live in that hypervigilan state?

30 "We get some children who just stay overanxious, some who withdraw, becom depressed," Perry said. "There are other whose heart rate normalizes. If you look at their behaviors, they begin to identify vulnerable people in their group and t act out. They start to manipulate the vul nerable people around them; they stalk them. They become predatory.

31 "And then they're no longer anxious. Their heart rates go down."

32 Scientists know that the body makes some natural opiate compounds in response to release from stress; they help produce the cheerful mood that often fol lows vigorous exercise.

33 Perry speculated that these children begin to get a similar release from attacking others: "It's almost as the stalking

Biologist's hotly debated idea: Most men

By Deborah Blum
Knee Science Writer

It began with an ugly question. If rape is rare — as it appears to be among animals — why are humans among the few that practice it?

Forced sex is so unusual that you can count the known rape-committing species on your fingers. Among all primates — humans, orangutans and, sometimes, baboons. Among other mammals, the enormous elephant seals. Among birds, mallard ducks, whose males have attacked resistant females so fiercely that they've drowned them. Among insects, scorpion flies and light-footed water striders. The short list, a bare seven species worldwide, led Randy Thornhill from the politically safe study of insects into the risky territory of human behavior. It is from that vulnerable platform that he now proposes that rape is built into human evolution, that even today "essentially, almost all men will respond to the idea of forced sex" in the right circumstances.

Thornhill's theory remains widely — even furiously — debated in his field of evolutionary psychology. It illustrates vividly the minefield-aspect of the science. Sooner or later, anyone who decides to explore the human mind is likely to propose an idea that someone else will either hate, take personally, or both.

Thornhill, at the University of New Mexico, began his work quietly enough with scorpion flies. He was intrigued because t forced sex. The mal arms — something gling female in place

From there, he tu sive species — his insects explain hum offer insight into the

What he does argu ly — rape belongs species, a predisposi tion to generation. voked the wrath of many offended men.

To all critics, Th

ONLY HUMAN

The New Biology of Our Behavior

' may be more than a movie titl

Bee/Anne Chadwick Williams

:hority in Stockton relax in a recreation area. Some scientists believe violence and :ertain mix of brain chemistry. Others say environment definitely plays a part.

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Noradrenaline, by contrast, is the primal scream, all reaction and action. Ever been in a near-miss car accident — felt your heart speed up, had your foot on the brake before you consciously thought about it? That's noradrenaline, pushing you into hyperfast reaction.

The two neurotransmitters ebb and flow in the brain, almost in synchrony, so that a person with higher serotonin will tend to be lower in noradrenaline. Or just the opposite. Biologists suspect that it's that shifting balance that helps regulate violent behavior.

Women, generally milder in behavior than men, average about 30 percent higher serotonin levels. By contrast, high levels of noradrenaline have been found in Finnish men imprisoned for violent offenses, U.S. Marines discharged for abusive behavior and people who have attempted suicide in the bloodiest possible ways.

Some scientists suggest that genes rule here, that each of us may inherit the "settings" for influential neurotransmitter

40 begins giving them an opiate kind of pleasure release. You know, the way serial killers sometimes talk about the rush they get from the killing."

41 At the University of Southern California, psychologist Adrian Raine thinks that violent tendencies may start in biology but, essentially, need a bad environment to fully develop. Raine has specialized in thrill-seeker crime, killers who seem to find pleasure in the deaths of others.

42 Some researchers speculate that such people have under-aroused nervous systems, that they need the kick of violent behavior to bring them to normal activity levels. Raine and his colleagues scanned the brains of California murderers, looking for clues. They did find unusually sluggish brain activity, especially in the regions of the brain that regulate emotion.

43 But like Perry, Raine has become convinced that internal biology alone does not explain this. For a while, he speculated that simple injury might derail the

49 of fear, then you make that a tra
that state of fear is built in to the
your brain operates. And then it's h
make that go away."

50 His young stalkers, actually, re
him of some violent adults, of a stu
wife-beaters in Seattle. That resear
the University of Washington, was
by psychology professor Larry Jacc
who was exploring anger between
bands and wives.

51 Jacobsen and a partner, psycho
John Gottman, gathered together co
ed spouse-abusers and asked the
restage arguments while they mon
their hearts. Even in the re-enact
most of the men went hot with angei

52 But the most aggressive wife-be
went cold. As they began the argu
their pulses steadied. Their skin c
The more they attacked, even with v
the calmer they became. Jacobsen, c
founded, ended up comparing the
pythons ready to strike.

53 "There's nothing out of control
these guys," he said. "It's like targ
prey."

54 Jacobsen suspects, as Perry does
this kind of response may be rooted
troubled childhood. In a world of fea
chaos, a child might best survive by
ing very cool under threat.

55 Robert Hare's studies show that
30 percent of all wife-beaters can b
mally classified as psychopaths. T
itself makes them stand out. As
likes to emphasize, total self-absorpt
rare.

56 "All of us have some of these trait
that doesn't make us a psychopath,"
said. "A psychopath exists abov
rules, the laws, the rest of us." Such
ple go to prison for anything from st
to murder. Studies show that when
get out, they are six to eight times
likely than other prisoners to co
another crime.

57 Hare does not believe this is all le
behavior. He said he can pick up si
psychopathy in children as young
there are certainly remorseless k
who come out of loving homes.

58 "I think we are talking about h
genetic control," he said. "There's
be something in your biology tha
you on this path or it just doesn't
pen."

59 He doesn't argue, though, that b
alone explains crime statistics. T
been no selective breeding of psycho
to explain a 371 percent increase in
killings since 1980.

60 Neurobiologists such as Perry and
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not explain this. For a while, he specula-
ed that simple injury might derail the
brain, might even help explain such
lethargic brains.

"Kids fall out of trees, are hit by cars,
it's hard to get through childhood without
some kind of trauma," he said. "There's
lot of evidence tying brain injury to crime.
But there's plenty of us who got hit in the
head and didn't become criminals."

His most recent work suggests a risky
combination. In a broad survey in
Europe, he decided to look at children
who suffered birth complications, as a
possible screen for brain injury. He found
them slightly more aggressive than their
peers.

But if they also grew up in a hostile
home, rejected their parents, then they
turned truly dangerous. The children
with both factors accounted for 3.9 per-
cent of the population studied, and 22
percent of the violent crimes committed
by the group.

What Perry fears is that a hostile
environment acts like an acid on
the brain, etching the changes in
permanently. Particularly if one is talk-
ing about resetting the nervous system,
right down to the body's baseline heart-
beat. Perry said that parts of the brain
change easily in response to experience:
One can learn a phone number, store it
in the brain's memory system and lose it
without effort.

But, for obvious reasons, the brain
keeps a tight grip on the way it manages
basic life functions. It wants to hold a
heartbeat steady. Even with the Branch
Davidian children, given several months,
their heart rates returned to the regular,
everyday thump. It takes a long, vicious
push to change those settings — or budge
them once reset.

"Some parts of the brain are less plastic
than others and they are supposed to be,"
Perry said. "The brain stem, where you
handle very important functions like
heart rate, locomotion, you don't want to
change that much. But you can do it. If
the brain is organizing in a constant state

Neurobiologists such as Perry and so-
ologists such as Levinson at UC Davis
emphasize that in this era of worsening
poverty and eroding social services, the
fastest increase is in environments that
can stress human biology into violence.
That, combined with an expanding drug
culture and easy access to guns, makes
murder seem almost inevitable.

Perry will even put a number on it. He
argues that 95 percent of this country's
violence is caused by squeezing human
biology into its most dangerous potential.

"In London, in 1340, the murder rate
was 120 per 100,000," he said. "Four gen-
erations later, in 1500, the rate was down
to 10 per 100,000. Now that's too fast for
evolution to have changed people. That's
environment."

Hare agrees that an abusive or threat-
ening childhood could create people indif-
ferent to others, even create predators.
For him, that also falls short as an expla-
nation.

"It's not a nature vs. nurture conflict,"
Hare says. "There's always both. But to
say that if we had a social utopia, all peo-
ple would behave well, that's not reality."

He recalls having his car repaired once
in a prison shop, where the chief mechan-
ic was a diagnosed psychopath. The man
had asked him for help getting a different
job. Hare had been unable to help. The
day he retrieved his car from the shop,
the brakes failed. The brake line had
been carefully nicked, causing a slow
bleed of fluid.

In Hare's mind, being human has come
to mean being emotional. People who can-
not summon compassion, guilt, fear or
even heart-thumping fury have taken a
step out of that realm. He evoked the
image again of those oddly quiet brains.

"It's easy for the psychopath to engage
in violent behaviors because, for him or
her, it's not upsetting. All behavior
becomes neutral. People will ask me,
'Don't they feel anything when they kill?'
And the answer is no, they don't. To them
it's like playing a chess game.

"And they're the winner."

a: Most men are born disposed to rape

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rpion flies. He was
intrigued because they were so clearly designed for forced sex. The males come equipped with clasping arms — something like tongs — to clamp a strug-gling female in place.

From there, he turned to another sexually aggres-sive species — his own. He does not argue that insects explain human behavior. Or that humans offer insight into the social relationships of flies.

What he does argue is that — almost coincidental-ly — rape belongs to the sexual design of both species, a predisposition handed down from genera-tion to generation. It's an argument that has pro-voked the wrath of feminists, other biologists and many offended men.

To all critics, Thornhill has this reply: We can never hope to control rape without acknowledging all its origins.

His theory begins with female choice. Rape seems to occur only in species where females are choosy about their mates.

"You get the evolution of female resistance to mates they don't want," Thornhill says. "And you get males who are selected to mate regardless of what the female wants. It becomes an arms race on an evolutionary scale."

In Thornhill's view, if males dominate the power structure, that predicts the use of force in sex. It also predicts that almost any man will commit rape,

Please see RAPE, next page