



Why is it that some people just seem to be bad to the bone?

In 1982, American blues-rocker George Thorogood even wrote a hit song about it:

*"On the day I was born, the nurses all
gathered 'round
And they gazed in wide wonder, at the
joy they had found
The head nurse spoke up, and she
said leave this one alone
She could tell right away, that I was
bad to the bone...."*

Funny how it falls to poets and pundits to put the human predicament into finest relief, and often in few words, while the most learned men and women of science spin out whole careers searching for some of the same truths about what it means to be human.

Is it natural for us to be aggressive, to be murderously violent, to be criminals? Judging by humankind's bloody, criminally inclined history, the answer should be obvious. But it's anything but.

Serious scientific debate on the origins of criminal behavior, for example, began well before Darwin, and more than a century before the discovery of genes. For most of their modern histories, the intertwined fields of sociology and psychology have been in lock-step in condemning the idea that criminal

dispositions are something we're born with instead of something we learn.

The academic tradition has been to look to the environment—societal factors, or what sort of upbringing a person has had—to explain pretty much everything about crime. And although for some years there has been a small contingent of "biocriminologists" (see box, page 33) speculating about how genetic factors might influence crime, there has been little direct evidence showing that genes actually do play a role.

But that's changing, and the findings pose profound implications for research in a host of fields including psychology, medicine, criminology, molecular biology, sociology, social work, education, philosophy and even religion.

IGNORING GENES

Kevin Beaver is an assistant professor in Florida State's College of Criminology and Criminal Justice whose prolific research over the past decade counts as some of the most compelling evidence yet compiled on the influence of genes on crime. He's convinced that the jury is in on the subject. When it comes to having

either a criminal bent or, most interestingly, even being a victim of a crime, genes play a powerful, if still poorly defined role, he said.

"Criminology has generally ignored the role of genes," he says. "We're seeing all that changing now. Whether we like it or not, genes matter."

Beaver's studies of adolescents, for example, have shown a strong genetic component not just in crime victimization, but in such behaviors as gang membership, use of weapons and the lack of self-control that criminologists believe lies at the root of most criminal behavior.

Some of Beaver's harshest critics have been his fellow criminologists. A recent article in the *Chronicle of Higher Education*, for example, quotes Simon A. Cole, an associate professor of criminology, law, and society at the University of California as saying that "he and other mainstream criminologists are likelier simply to ignore the articles that are published by biocriminologists."

A second criminologist quoted in the article, Jeff Ferrell from Texas Christian University, said that trying to understand the genetic component of crime "strikes me as misguided at a minimum, if not morally and politically questionable."





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Still, by producing work that is meticulously researched and supported by reams of evidence, Beaver is slowly winning converts to his point of view. Although there are still just a handful of researchers in criminology who are looking to genes for explanations, Beaver's work may well be opening up a new front in our understanding of crime.

The power of Beaver's approach is on display, for example, in his victimization study, which is the first to find a genetic component to the likelihood of being a crime victim. Just this summer, in the journal *Youth Violence and Juvenile Justice*, Beaver published the results of his study of more than 500 pairs of identical and fraternal twins. He analyzed the various factors, genetic and environmental, related to an adolescent's chances of being a victim of some crime or violent act. He found that genes could explain about 45 percent of the variation in adolescent victimization.

That paper is just one of more than 40 papers Beaver has authored or co-authored over the past five years, including three that appeared in *Criminology*, the field's premier journal. He has another 20 or so forthcoming in various journals and lists yet another 20 in his vita as being under review.

Although many of the papers are co-written with his graduate students, the sheer

numbers tell you two things about Beaver: First, he has seemingly endless energy and curiosity, and, second, he has found an area with a huge number of questions waiting to be answered and studies waiting to be performed.

MOLECULES THAT MATTER

Beaver says he has always been interested in human behavior as it relates to crime, and, in the beginning, he followed a relatively traditional path in the areas of criminology and criminal justice. As an undergraduate at Ohio University he majored in sociology with an emphasis on criminology.

After graduation he enrolled in the masters program in criminal justice at the University of Cincinnati, where his thesis looked at the effects of marriage, employment and education on a person's ability to stop smoking marijuana. For his doctoral work, which he began in 2001, he stayed at Cincinnati but moved back to sociology. And it was there in the UC sociology department where he first found himself, quite inadvertently, stepping on other peoples' toes.

As Beaver took classes and began doing the reading and research necessary for deciding the direction he would take in his

own research, he found himself increasingly drawn to the question of what causes violence and criminal behavior—why one person commits crimes and another doesn't—but the traditional sociological approach seemed insufficient to answer that question.

"People exposed to the same environment can turn out very differently," he says, "and when you look at this from a purely sociological perspective that doesn't make sense. I began to realize that there was a lot about crime that sociological theories couldn't address." So he began looking for another tool to apply to questions about crime.

Well before the 2003 publication of a complete draft of the human genome and the identification of a growing number of individual genes and their functions, molecular biology had become a powerful tool for investigating human behavior. Suddenly, researchers had new insight into studying why some people are more vulnerable to cancer than others, for example, and the roots of mental illness. Why not apply this tool to the study of those behaviors of interest to criminologists, Beaver asked?

He quickly discovered, however, that his enthusiasm for this new tool was not shared by others in his program. "I was interested in crime, genes, and the environment, and the

Not only do genes influence criminal behavior, but it is possible to link specific genes to specific crimes.

people in sociology didn't really like what I was doing," he said.

BREAKING THE PC BARRIER

In its quest to understand how humans behave as members of groups, sociology traditionally has focused on factors shaping human behavior that arise from groups, e.g. family upbringing, socialization in schools and peer groups, the more diffuse effects of the broader society, and so on.

Many sociologists have resisted—sometimes quite adamantly—the idea that genes have a significant influence on human behavior. Indeed, sociobiology, a field of inquiry legitimized by Harvard biologist E.O. Wilson in the mid-1970s, uses evolutionary—and thus genetic—insights to explain human behavior. The term “sociobiology” is still a dirty word in many academic departments, an affront to a mindset that critics charge is steeped in political correctness.

At Cincinnati, Beaver grew increasingly aware that the entire topic of gene-related crime was taboo within the sociology department. After two years, he decided to pursue his dissertation elsewhere. Fortunately, he had met a young criminal justice professor at Cincinnati, John Paul Wright, who was becoming interested in many of the same questions that were tugging at Beaver.

“John was just starting to get into it,” Beaver says. “He was moving that way.”

So Beaver moved to the criminal justice program to become one of Wright's graduate students, and the two of them began applying the lens of genetics to some of the most interesting questions in criminology.

One of the first projects that Beaver took on with Wright was a re-examination of one of the classic theories in the field of

criminology. In 1990, Michael Gottfredson and Travis Hirschi, both then at the University of Arizona, published *A General Theory of Crime* (Stanford), whose core claim was that the essential element of criminality—the one characteristic that is common to most criminals and others who act in anti-social ways—is a lack of self-control. They went on to claim that this lack of self-control among criminals has its roots not in any genetic factors but rather in how these people were raised as children. In short, criminals are made, not born, and they are made mainly by parents who fail to instill self-control in their offspring.

Since that book appeared, a number of researchers have tested Gottfredson and Hirschi's claims about the link between lack of self-control and criminal behavior, and the claim has stood up well. Today criminologists take it for granted that lack of self-control is a major part of why some people break the law. But, Beaver notes, no studies had examined whether the lack of self-control had anything to do with genes—or in other words, whether the criminal behavior could be blamed on the parents.

Beaver had his doubts, though. In part they had been stirred by the work of Judith Rich Harris, an independent psychologist, who had challenged the importance of parenting in a well-known 1995 article in *Psychological Review*, for which she won the George A. Miller Award for an Outstanding Recent Article in *General Psychology* from the American Psychological Association, and in a book called *The Nurture Assumption* (1998, Free Press). Parents actually have very little to do with what sorts of adults their children become, Harris contended. Instead, most of how a child turns out is due either to influence from the child's peers or from the genes.

So Beaver and Wright set out to test just how large a role parents play in the development of self-control. Did they play the major role that Gottfredson and Hirschi claimed, or were they mainly just bystanders, as Harris said?

Beaver and Wright looked for answers by reanalyzing the results of a survey of children called the *Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999*. The study, conducted by the U.S. Department of Education, examined a nationally representative sample of more than 21,000 children from across the United States. The project assessed the behavior of the children in kindergarten and then again in first grade while also getting answers about the behavior of those children from their teachers and parents along with details about the children's home life and how they were being raised. The survey included information about the children's self-control as well as about such parenting characteristics as parenting involvement, parental affection, and family rules.

What allowed Beaver and Wright to compare parenting influences with genetics was the presence of 155 pairs of twins in this study. By examining these twin pairs along with another 1,000 children without twin pairs, the two researchers had enough data to calculate how large a role genetics was playing versus how large a role parenting was playing.

Beaver and Wright concluded that although the twins in the study were definitely more similar on measures of self-control than were unrelated children, those similarities were caused mainly by their genetic closeness rather than to the fact they grew up in the same household with the same parenting. “As such,” they concluded, “these findings provide tangible evidence in favor of Harris's

“I accept that you have done the work carefully. But shame on you for doing it.”

proposition that...parental socialization techniques minimally influence the individual traits of their children.” Genes, not parenting, made the difference.

A BIOLOGICAL BASIS FOR SELF-CONTROL?

The study was published in 2005 in *Criminology*, the field’s flagship journal and, thanks to that paper plus a flurry of similar work that followed, Beaver quickly became very well known among criminologists—and not necessarily in a good way. When he gave a talk at a professional meeting or conference, he says, “usually there would be at least one person in the audience who had come because they disagreed.”

Some of the attacks were “very scathing,” he recalls. He regularly received e-mails from other criminologists telling him that he should not be performing that sort of research. He remembers one woman in particular who showed up at one of his lectures and stood up to make a comment during the question-and-answer session afterwards. “I believe that your results are true,” she told him. “I accept that you have done the work carefully. But shame on you for doing it.”

As Beaver discovered, the problem was not so much his research results themselves but how other researchers feared they might be interpreted. If criminal behavior came to be seen as genetically imprinted, what might the implications be? Would there be calls to prevent criminals from reproducing and passing on their genes? Would genetic tests be developed to predict the likelihood of criminal behavior so that mothers could abort fetuses that had the potential of turning

into a Charles Manson or a Bernie Madoff? The very idea that genes might play a major role in shaping violent or criminal behavior seemed disconcerting, even offensive, to many of his peers.

But Beaver is making it increasingly hard for his detractors to ignore the evidence. In a study done in 2007, he used data from the federally funded National Longitudinal Study of Adolescent Health, to revisit the question of what causes a lack of self-control. Funded by the National Institutes of Child Health and Development, the study is the largest and most comprehensive of its kind ever done. It tracked adolescents across the country from 1994 to 2002.

Beaver re-analyzed data drawn from a study of nearly 300 pairs of identical twins who had been surveyed when they were in middle school or high school and again about six years later.

That study, which Beaver published in 2008 with Wright and two other colleagues, found that the variation in self-control could

be explained completely by genetics and “non-shared environmental influences,” that is, environmental factors that are not shared by siblings growing up in the same home.

To be sure, these non-shared influences were hard to pin down, Beaver found. “There are a lot of thoughts out there about what they might be,” he said. “Research shows that parents can actually treat their children very differently, even in the case of identical twins. And siblings can have very different peer groups. One twin might hang around one group of friends, while the other has a completely different set.”

What was clear from Beaver’s data, however, was that shared environmental influences—including the shared home environment and the lessons that parents impart to each of their children in pretty much the same way—had basically zero effect on the level of self-control that those children eventually developed.

In the same study, Beaver also examined delinquent behavior, including such things as fighting, drug use, and vandalism, and the tendency to associate with delinquent peers. Genes and non-shared environmental influences together explained both things, he found, and parenting had no discernible influence on whether children associated with delinquent peers or became delinquents themselves. A follow-up study was the first to show a link between the genes and the types

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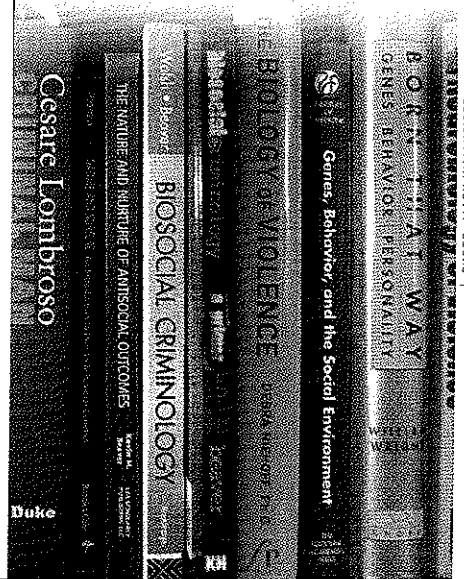


PHOTO: MARK WALLHEISER

BIOLOGY'S CONNECTION WITH CRIME
is a rapidly growing field of inquiry, yet the implications remain difficult for many researchers to reconcile against traditional views that tout environment as playing the dominant role in criminal behavior.

THE RISE OF BIOCRIMINOLOGY

Cesare
Lombroso

Ever since Darwin explained how traits are passed from one generation to the next and how natural selection favors the passing on of certain traits over others, people have speculated about the genetic basis for criminal behavior.

One of the earlier and best-known practitioners of this approach was Cesare Lombroso, who published his theory of the "criminal man" in 1876, 17 years after Darwin's *The Origin of Species* appeared. Lombroso, an Italian criminologist often called the "father of modern criminology," argued that criminals were born, not made, and that they were evolutionary throwbacks to a time when people—and particularly men—were more aggressive and violent and less able to be civilized.

Because criminals were more "primitive," Lombroso said, they

could be identified by certain physical characteristics, e.g. low, sloping foreheads; large jaws; long arms; fleshy lips; shifty eyes. Lombroso's assumption that certain people were more advanced evolutionarily than others tied in with his racist belief that certain groups of people—in particular, those of European ancestry—were more advanced evolutionarily than other groups, such as those from Africa.

The idea that some people are born criminals had obvious—and unpleasant—policy implications. For one thing, it implied that rehabilitation was unlikely. Someone genetically destined to a life of crime was not likely to change, and so the best approach was just to lock him away.

The idea also led directly to the rise of eugenics as a worldwide so-

cial movement by the early 1900s. The central idea was that the human race can—and should—be improved by encouraging people with "desirable" traits to reproduce and discouraging or preventing reproduction among those with "undesirable" traits. For people with criminal genes, the best thing for all concerned was to make sure they didn't have children. After Hitler used eugenics to justify his genocidal bloodbath in WWII, the movement was abandoned.

Not surprisingly, Lombroso's most enduring legacy has been the tendency of progressive-thinking people ever since to reject the idea that criminal behavior has a genetic component, since that belief seemed to lead directly to prison, sterilization, or death for those unfortunates born with the wrong genes.

In the 1970s a very different ap-

proach to understanding the genetic component of criminal behavior arose. It was inspired in large part by the development of sociobiology, a synthesis of biology and sociology that sought to use insights from genetics and evolutionary theory to understand the behavior of individuals in groups.

Termed biosocial criminology, or biocriminology, it was far more nuanced than the genetic determinism of Lombroso, and it recognized that all human behaviors, criminal or not, are shaped by a complex interplay of genetic and environmental factors. Lombroso's claims that heredity determined all behavior were ridiculous, these biocriminologists believed, but equally ridiculous was the idea that heredity had no influence on behavior at all.

In its early years, much of biocriminology was theoretical in nature, as there were few data that spoke directly to the link between genes and criminal behavior. And as such, it was easy for most mainstream criminologists to ignore or deride the young field. This changed, however, with the 13-year, international Human Genome Project (completed in 2003) and the growing number of techniques that allow researchers to explore the relationship between genes and behavior in a very explicit, data-driven way.

In part because of the legacy of Lombroso, criminologists have been slower than researchers in other fields to follow this path. That's changing with the work of FSU criminologist Kevin Beaver and other path-breaking biocriminologists.

In a recent book, *The Criminal Brain: Understanding Biological Theories of Crime* (2008, NYU Press), Northeastern University scholar Nicole Rafter predicted that the tools of genomics and the new capabilities they bring will fundamentally change criminology. The biosocial approach, she wrote, "promises to dominate criminology and other behavioral sciences for decades to come." —R.P.

BIOLOGIC

{ CONTINUED FROM PAGE 32 } CRIME AGAINST NATURE?

of peers—in this case, delinquent peers—that adolescents choose to hang around with.

“CRIMINAL GENES”

Beaver also has investigated the influence of individual genes on specific behaviors. In research that has just been published in *Comprehensive Psychiatry* for example, he focused on a gene that produces an enzyme called monoamine oxidase A, which breaks down various neurotransmitters, such as dopamine, serotonin, and norepinephrine and thus limits their effect in the brain.

Some researchers have dubbed the gene that makes this enzyme the “warrior gene” because it has been linked to aggressive behavior. Researchers have found evidence suggesting that this gene may be more prevalent in cultures with higher than average levels of violence. In particular, certain molecular variations in this gene cause some people to produce a monoamine enzyme that is underactive, which in turn can lead to abnormal levels of various neurotransmitters and thus affect brain functioning and emotions.

For that study, Beaver again used data from the National Longitudinal Study of Adolescent Health, a project that also had accumulated genetic samples from a number of the participants. Working with this subgroup for which genetic data were available, Beaver divided the participants into those genetically wired to produce high activity monoamine oxidase A and those whose bodies produced low-activity monoamine oxidase A. Then he compared the prevalence of gang membership and weapon use in the study sample against the prevalence of the gene.

Among men, Beaver found that individuals with the low activity variants of the

monoamine oxidase A gene were twice as likely to have joined a gang as those with high counts. Among those who were gang members, those with low activity variants were more than four times as likely to have used a weapon in a fight. Interestingly, no correlation of any kind was found in female participants. Still, the study served as an exclamation point to Beaver’s previous work: Not only is it possible to show that genes do indeed influence criminal behavior, but it is possible to link specific genes to specific types of criminal behavior.

Despite the fears of many criminologists that such clear-cut evidence of a gene-behavior link could lead to oppressive policies toward criminals and anyone with “criminal genes,” Beaver sees the situation quite differently.

First, he argues that there is no “criminal gene” here—that is, no gene that causes most or all of the people who possess it become criminals. For example, although his most recent study proved one gene’s role in criminal behavior, it also showed that most men who have the gene don’t join gangs or use weapons. The gene is one small piece of a much bigger picture, most of whose details are still being worked out, he said.

Furthermore, the gene does not exert its influence alone, Beaver believes. It interacts with various environmental factors and other genes to push a person in this direction or that, and there is no way to predict from that single gene how any given individual will turn out.

This hardly means that there’s no practical value to this sort of research into the genetic influences on criminal behavior. Beaver envisions a way that research like his can indeed be quite useful to criminologists—and in a very “progressive” way.

“We can use genetic information not as



a way to decide which people to lock up in order to protect the rest of society but instead to develop different prevention and intervention programs that are tailored to the individual. We can use genetic information as a way of saying, “This person is most likely to benefit from this program, and that person is most likely to benefit from that one.”

BIOLOGY’S DAY IN COURT

One of the major focuses of criminology, Beaver explains, is figuring out how to keep people who have committed crimes and gotten caught from committing more crimes. Criminologists know from

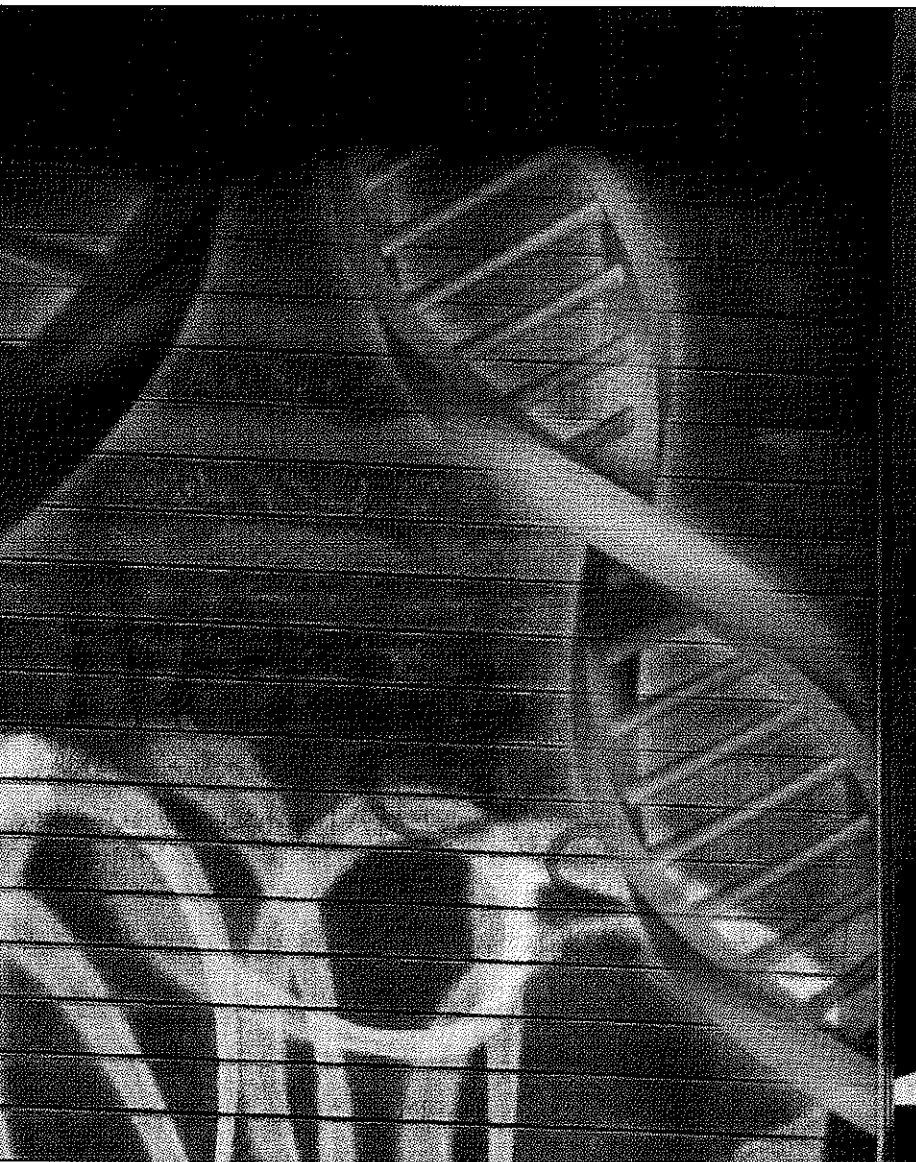


PHOTO MONTAGE: ISTOCK

long experience that recidivism rates are extremely high. Data from the U.S. Bureau of Justice show that nearly 70 percent of people across the country who do jail-time get arrested again after release. This debacle has prompted the rise of various rehab programs, most with dismal results.

Beaver said that such programs' success rates vary according to the type of criminals they're dealing with. Men respond differently to rehab programs than women, for instance. Young people respond differently than older people. People with high IQs respond differently than those with lower IQs. This suggests that if rehab programs are tailored to take such individual differences into account, they can be more effective, Beaver said. One

of his chief goals is to learn to use genetic information to inform the design of rehabilitation programs.

Although no one has yet attempted this sort of genetically targeted program, Beaver notes that several other researchers have been thinking along similar lines. Just this past May, for instance, researchers from the University of Georgia and the University of Iowa, led by Gene Brody from the Institute for Behavioral Research at the University of Georgia reported that participation in a prevention program called Strong African American Families, run by the Center for Family Research at the University of Georgia, was effective in reducing risky behavior among a genetically defined group of adolescents.

A variant gene known as 5HTT has been shown to make adolescents twice as likely to engage in such behaviors as drinking, smoking marijuana and having sex. The new research showed that participation in prevention program canceled out this increased risk. Adolescents who had the gene but who also took part in the program were no more likely than other adolescents to engage in risky behavior. By contrast, the program didn't help the kids who didn't have that particular gene.

BAD TO THE BONE?

The moral, Beaver says, is that genetic information can be useful in targeting interventions to those individuals who can most benefit from them. And this is how he hopes his genetic research will eventually be used—not to stigmatize individuals who have “crime genes” but to learn better how to help them.

Beaver's message, as uncomfortable as it is to so many, is beginning to be heard. In the past year or two, he says he's seeing a more positive, accepting attitude toward his work among his peers in criminology. Ultimately, he says, his goal is to have the genetic approach accepted as one more—very useful—tool in the criminologist's toolkit.

“I would hope that eventually every university will offer classes in which this approach is taught and that every student interested in this approach will be able to pursue it.

“And although it is not something that will likely dominate criminology, I do think it is critically important that everyone in the field should realize the value of genes in understanding why people do what they do.”

