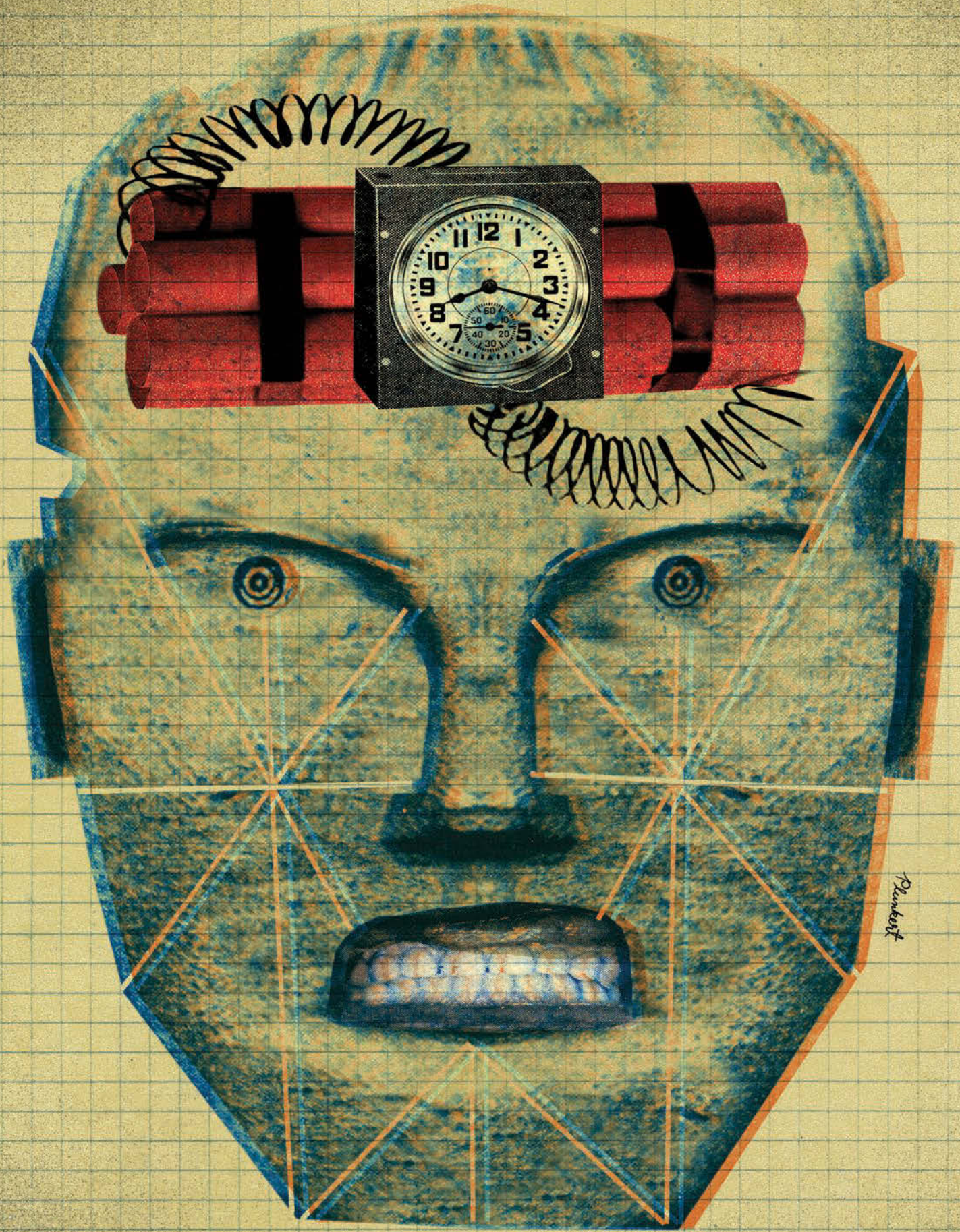
THE ANATOMIST OF CRIME

PIK Professor Adrian Raine is regarded as the world's leading biological criminologist. He didn't get there by playing it safe. BY SAMUEL HUGHES

There was a time when Adrian Raine thought he would never get out of jail. He was in his late 20s, stuck first in the top-security Hull Prison in Yorkshire, then the equally foreboding Frankland Prison. True, he wasn't technically an inmate, but for someone with a PhD from York University, a master's from Oxford, and some prestigious academic awards and published papers on his CV, he often felt like one.

What had landed him behind bars by day was his chosen scholarly interest. Raine, now the Richard Perry University Professor of Criminology, Psychiatry, and Psychology at Penn, was then investigating various biological correlates to crime—not a good career move in the early 1980s, when researchers looking for biological explanations for behavior were shunned, even vilified. As a result, for all his academic credentials, the only organization that would hire him was Her Majesty's Prison Service.

Illustration by David Plunkert


Plunkett

"I worked there for four years," says Raine, now 59. "And it wasn't a research job; it was an applied job, treating prisoners, assessing them, running hostage-training courses for the prison officers.

"I desperately wanted an academic job," he adds. "I made 67 applications in those four years and got 67 straight rejections. I applied everywhere—not just to universities but to what we call 'polytechnics,' which are really teaching institutes in England. I applied for postdoctoral positions; I applied to Australia, New Zealand—even Papua New Guinea—and got rejected. I thought I'd spend the rest of my life in prison. So—a curious wheel of fortune, anyway."

Curious indeed. Today, nearly three decades after his 68th application sprung him from Frankland and into the psychology department of the University of Nottingham, Raine is a high-profile criminologist, one whose interdisciplinary star power brought him to Penn six years ago as a PIK (Penn Integrates Knowledge) professor ["Proof of Concept," Sep|Oct 2008].

"Adrian is probably the most eminent biological criminologist in the world," says Stephen Morse, the Ferdinand Wakeman Hubbell Professor of Law, professor of psychology and law in psychiatry, and associate director of the Center for Neuroscience & Society. "Although it makes a lot of people uncomfortable, I think he makes a very solid case that there are biological factors that are causally implicated in criminal conduct. But why should that surprise anybody? We're biological creatures!"

Raine "holds a unique reputation as *the* neurocriminologist," adds Lawrence Sherman, whose many titles include director of the Institute of Criminology at the University of Cambridge and former director of the Fels Institute at Penn ["A Passion for Evidence," Mar|Apr 2000]. "He has basically invented the field, despite early resistance two decades back, and he has just kept on working, with amazing productivity. Few criminologists are even aware of all he has done, especially since much of his key work on violence is published in psych journals."

This past spring Pantheon published Raine's richly detailed *The Anatomy of Violence: The Biological Roots of Crime* (see excerpt on p. 36), which has not only sold surprisingly well for a work of wonky popular scholarship but also received mostly high marks from his peers and reviewers.

"Adrian is such a good scientist—willing to imagine where the field can go, but still very careful not to overstate where it is now," says Martha Farah, director of the Center for Neuroscience & Society and the Annenberg Professor in the Natural Sciences. "Is the neuroscience in *The Anatomy of Violence* solid? Yes! What Adrian says about brain function and antisocial behavior, you can take it to the bank."

In Sherman's view, "we need a national symposium on neurocriminology, with *Anatomy* as the centerpiece. *Anatomy* is very important for the field, if only because it so accessible and clear."

Violent crime is an understandably explosive subject, and the field, with its search for causes and remedies that go beyond the superficial and punitive, has long been strewn with IEDs. Especially given the emotions churned up in the last century by the eugenics movement and proponents of creating one Master Race or another. While biological explanations of violence and other personality traits are regaining credence, Raine knows that many people would still prefer to keep those ideas locked up for good.

"One of the continuing problems is that this research field borders on the politically incorrect," he writes. "Liberals and center-left parties fear that the research will be used to stigmatize individuals and take attention away from social problems, the true causes of crime. Conservatives and the center-right are concerned that it will be used to let offenders off the hook and take away responsibility and retribution."

Neither side can accuse Raine of conducting his research from an ivory tower. In addition to his years of work with violent offenders in prison, he was attacked and nearly killed during an attempted robbery in Turkey some years ago—an experience that got him in touch with his inner Rambo, even if his prefrontal cortex appears to be keeping those vengeance impulses under control.

"I have got my hands dirty with prisoners, with rapists, psychopaths, murderers, pedophiles," says Raine during a long phone interview from the University of Cambridge, where he is on sabbatical with his wife and twin boys. (Next summer he will return to his house at 41st and Pine streets in University City, which once belonged to legendary criminologists Thorsten Sellin and Marvin Wolfgang Gr'55, and which, he says, has been broken into multiple times since he arrived here in 2007. "I live near my data," he notes wryly.)

"I'd like to think that, more than other scientists in the field, those four years in prison helped in some ways," he adds. "That, and being a victim of violence. It's salutary, and it makes you stop and think."

In a recent *New Yorker* review of new books about neuroscience, Adam Gopnik suggests that those who write about the brain and the mind "tend to divide into Spocks and Kirks, either embracing the idea that consciousness can be located in a web of brain tissue or debunking it." At the moment, he adds, "we have on our hands a sudden and severe Kirkist backlash." Raine is definitely a Spockist by that definition, and Gopnik, who describes *The Anatomy of Violence* as "belligerently pro-neuro," clearly sides with him.

One of Raine's more compelling case studies is that of Michael Oft, a schoolteacher whose previously exemplary behavior began to change around the time he turned 40. First he began going to massage parlors; then he began collecting child pornography; then he began to touch and fondle his stepdaughter when he put her to bed. He became increasingly short-tempered, even violent. After he was arrested for pedophilia and sentenced to prison, he began complaining about severe headaches. A brain scan revealed that he had a large tumor at the base of his orbitofrontal cortex, "compressing the right prefrontal region of his brain." When the tumor was surgically removed, his "emotion, cognition, and sexual activity returned to normal," notes Raine, and the "pangs of guilt and remorse at what he had done to his stepdaughter at last set in." For several months Oft was fine. Then the headaches returned, and so did the child pornography. When his brain was again scanned, it showed that the tumor had grown back. Again it was excised. Since then, "his sexual urges and general behavior have been totally appropriate."

As Gopnik notes, "there is probably no precise connection between the bit of the brain the tumor pressed on and child lust.

The same bit of meat-matter pressing on the same bit of brain in some other head might have produced some other transgression—in the head of a Lubavitcher, say, a mad desire to eat prosciutto." But, he concludes: "You have to respect the power of the meat to change the morals so neatly."

So many things can go wrong in the great mass of soft tissue known as the human brain, and most of them are not so easily pinpointed as Oft's tumors. But some predispose the owner of that brain to violence, Raine and others argue. They might be the result of physical accidents (a flying chunk of metal to the head, say) that change the very personality of the owner. They might stem from insults in the womb (fetal alcohol syndrome) or during delivery. Some are believed to be moderated by genetic factors, though the expression of the relevant genes may be influenced by environmental factors.

Neuropsychology is still a relatively new science, and Raine would be the first to say that brain imaging and other biological indicators cannot, by themselves, be seen as foolproof diagnostic tools. But, he believes, they should be part of the mix.

Every day, for example, prison officials have to make hard decisions about which offenders should be released early, on parole. And those decisions are "based on sometimes-terrible information."

"In California they have, like, 20 indicators," notes the English-born Raine, who migrated to Penn by way of USC. "They're all social and behavioral: being male, having a poor employment history, past criminal behavior. What I'm suggesting is that, if biological variables—which are never added to the prediction equation—give added value to prediction, shouldn't we begin to implement them?"

He points to two brain-imaging studies that appeared after he sent the manuscript of *The Anatomy of Violence* to his publisher. In the first, a team from the nonprofit Mind Research Network scanned the brains of 96 prisoners just before they were released, then followed up on them for several years. The results were published in the *Proceedings of the National Academy of Sciences*.

"What they found is that if the part of the prefrontal cortex called the anterior cingulate is not functioning well, those offenders are twice as likely to [commit a crime] in the next three years," he says, "and that's prediction over and above the usual variables that are used to predict future offending."

ANDREW LAWRENCE RAINE

"IT'S THE SOCIAL HORSE LEADING THE BIOLOGICAL CART THAT DRAGS SOME PEOPLE INTO THE GUTTER AND INTO PRISON."

Another paper, published in the May 6 issue of *Biological Psychiatry* (Raine was a co-author), began with a longitudinal study of 503 first-grade boys in 1986-87. Two decades later, 56 of the boys who had grown into men with "varying histories of violence" were recruited for brain scans.

"We looked at the volume of the amygdala, and we followed up people for four years," says Raine. "And what we found is that people with a small volume to the amygdala, the part of the brain that generates emotions—those individuals were three to four times more likely to commit a violent act in the next three years. And again, that's predicting over and above past violent offending."

"I hope no one would try to assess a person's dangerousness based solely or primarily on a brain scan," says Martha Farah. "But are brain scans the kind of evidence that, with continued research,

might give us a degree of useful predictive information? Absolutely—and Adrian's research is contributing to this progress."

"Prediction methods are improving rapidly," says Larry Sherman. "The question is whether people will prefer less accurate, biased, and racially prejudiced methods of prediction—which are now used daily—to more accurate methods that remain a little unfamiliar. My hope is that we will choose precision, which will probably label many more people as *not* dangerous than we seem to think at present."

Two brain scans: Both have a lot of activity in the prefrontal region at the top of the brain, as well as abundant bilateral thalamic activation in the middle, occipital activation at the bottom, and temporal lobe activation at the sides. There are differences between the two, to be sure, but the similarities are more pronounced, especially compared to those of most violent offenders.

One belongs to a cunning California serial killer and sex offender named Randy Kraft, whose horrific acts were meticulously planned. The other belongs to Adrian Raine. (He also has a low standing heart rate, another feature often found in violent offenders.)

"Might I have a brain predisposition to be a serial killer?" he asks in *The Anatomy of Violence*. "Maybe. Does this similarity in scans demonstrate that brain imaging is *not* diagnostic? I'd like to believe so.

"We cannot use brain imaging as a high-tech tool to tell who's normal, who's a one-off killer, and who's a serial killer," he adds. "It's just not that simple. Yet at the same time we are beginning to gain important clues as to which brain regions—when dysfunctional—could give rise to violence."

"We can't use [neuroimaging] to figure out who was and was not responsible for their conduct, because we can't answer questions about what mental states defendants had when they committed crimes," says Stephen Morse. "Neural indicators don't answer questions about lie-detection sorts of things at present. There's very little that neuro-imaging can do for us about evaluating responsibility. It can't even today answer the question, 'Is the defendant suffering from schizophrenia or another major mental disorder?'

"I think that's going to change in the future," he adds. "In the future we're going to be able to get more reliable indicators. The question is, when might a scan help us?"

The greatest need will be in cases regarding a "gray-area defendant"—one whose mental state, which would determine whether or not someone is legally responsible for his actions, can't be accurately gauged by professional observers. "But, unless the neuro gets really, really precise," cautions Morse, "then where we need it most in the gray-area cases, it's least helpful."

"This is all very promising, and some day it may pay off," says Martin Seligman Gr'67, the Zellerbach Family Professor of Psychology at Penn. "Adrian's stuff is right at the forefront of it. But I'm kind of waiting for interventions."

Seligman, director of the Positive Psychology Center and founder of that movement, describes Raine as the "leading person in the world on the biology of evil," adding that he'd like to see Raine focus more on the "biology of virtue."

Raine himself—whose previous books are *The Psychopathology of Crime*, *Violence and Psychopathy*, and *Crime and Schizophrenia*—views repeated violent offending as a clinical disorder, not evil.

"My concern is that if we begin to think in that almost spiritual way, we have regressed to how crimes were explained in medieval days—by an evil spirit," he writes in *The Anatomy of Violence*. "Surely we have progressed further, scientifically and rationally?

"I would ask you to not only consider violence as a public-health problem, as a disease that affects our society—but also to think about it rationally and clinically, not inflected by ideas of sin and evil."

Oh, Agent Starling—you think you can dissect me with this blunt little tool?
—Hannibal Lecter, *The Silence of the Lambs*

FOR the record, the blunt tool that Agent Clarice Starling was attempting to wield upon Hannibal the Cannibal was a simple questionnaire. Today's brain-imaging tools—functional Magnetic Resonance Imaging (fMRI) and Positron-Emission Tomography (PET) scans—are sharper, though still can hardly be considered foolproof.

Some psychologists are seriously skeptical. As Seligman puts it: "To find that parts of the brain light up when certain behaviors, or certain thoughts, occur—you really don't know what's driving what."

"A big fat 60-ton magnet of the type used in MRI does not sound very sharp, but it's not a blunt tool," writes Raine. "When it comes to discerning truth from fiction, it's as sharp as a razor." He cites the work of several scholars, including Penn's Daniel Langleben, associate professor of psychiatry, who each "independently stumbled onto a sublime truth about lying—the prefrontal cortex is critical."

Before 1994, no one had ever undertaken a brain-imaging study of murderers. Given the challenges of recruiting and testing a significant sample size, they're not the easiest cohort to study. Which is one reason, along with the sunny weather, that Raine emigrated from England to California in 1987: plenty of convicted murderers with time on their hands who could be recruited into his research studies.

Raine and his new colleagues used PET scans to examine the brains of 41 murderers and 41 age- and sex-matched ordinary control subjects. The section of interest was the prefrontal cortex, which is involved in "regulating and controlling our emotions," explains Raine. "It's involved in checking our impulsive behavior. We all get angry. But what stops most of us lashing out is that prefrontal cortex that says, 'Oh, wait a bit—this isn't the right place to get upset. Calm yourself down.'

"We've done brain-imaging research on murderers and other groups showing that this part of the brain is compromised in terms of function and structure," he adds. "It's like the guardian angel on behavior. But if the guardian angel is asleep, well, the devil can come out, and you get impulsive violence."

The PET scans measured glucose metabolism that occurred during a lengthy and "very boring" task in which the subjects had to press a response button every time they saw a certain figure on the computer screen. That 32-minute task required sustained attention—a job for the prefrontal cortex. Compared with the control group, the murderers showed a "significant reduction in prefrontal glucose metabolism."

Among the 41 murderers was Antonio Bustamante, who had been arrested 29 times for a variety of crimes before he brutally beat an elderly man to death during a sloppy, impulsive robbery. Bustamante

was not exactly a born criminal, however. Even through his teenage years he was quite well behaved. But at age 20 he suffered a "very significant" head injury from a crowbar, and not long after that he was in a serious car accident that caused more injuries to his head. From then on he was in constant trouble with the law.

"You don't have to be a Sherlock Holmes to deduce that it was the head injury at 20—well beyond his control—that likely caused his poor prefrontal functioning and the later impulsive, violent offending," writes Raine.

If the idea of using brain scans as biomarkers to predict the next violent offender raises hackles, that's nothing compared to the emotions that will be stirred by investigations into a genetic propensity for violence.

Yet consider the case of Jeffrey Landrigan, who was adopted into a loving family as a baby. Despite being raised in a "safe, nurturing environment," writes Raine, Landrigan showed signs of "emotional dyscontrol" from an early age, and soon drifted into a life of crime. By age 20 he had already stabbed a friend to death, and after escaping from prison he stabbed and strangled to death another young man he had met in a Burger King. While on death row in Arizona, an inmate told him about a convicted murderer named Darrel Hill who looked almost exactly like him. It turned out that Hill was Landrigan's biological father. Furthermore, Hill's father was also an institutionalized criminal who had been shot to death by police after robbing a drug store in 1961. "It don't take anyone too smart to look at three generations of outlaws and see there's a link of some kind, there's a pattern," said Hill. "I believe that when [Landrigan] was conceived, what I was, he became."

Anecdotal evidence, one might say. Small sample size. Fair enough. But extensive studies of identical twins separated at birth and other longitudinal studies support a conclusion that "even the strongest critics of genetic influences in violence are finding harder to resist," notes Raine—"genes give us half the answer to the question of why some of us are criminal, and others are not."

"I think you have to be blinded by political ideology not to recognize that almost everything we care about in psychology has a heritable component," says Seligman. "I don't think there is a respectable psychologist who reads the literature who would stand up and deny genetic components of almost every factor in personality. Twenty-five years ago you could do that and get away with it, but the evidence has just gotten to a point that you have to take biological constraints seriously."

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According to Raine, a recent meta-analysis of 103 studies concluded that "nonaggressive antisocial behavior was 48 percent heritable, while aggressive behavior was 65 percent heritable." Genetic influences are "strongest for criminal careers that start early, occur across many settings, are persistent and severe, and involve callous, unemotional symptoms like lack of remorse," he adds. "This is exactly the form of antisocial behavior that later gives rise to adult violence."

While science is "just beginning to scratch the surface in understanding the specific genes that create violence," he notes, some, like the so-called "warrior gene" (a mutant form of the MAOA gene) have been conclusively identified. Normally that gene produces an enzyme that metabolizes certain neurotransmitters (including dopamine, norepinephrine, and serotonin) involved in impulse control and other cognitive functions. The defective version, first identified in the Netherlands, "gives rise to relatively low levels of this enzyme," notes Raine, and in some cases produces virtually none. One follow-up study found that "low levels of MAOA were associated with later antisocial and violent behavior, particularly when the children had been severely abused."

A related study touched off a firestorm when researchers reported that the Maori of New Zealand had "twice the level of the genotype conferring low levels of MAOA compared with Caucasians." On the other hand, Raine also noted that while the base rate of the low-MAOA gene variant is "about 34 percent in Caucasian males and 56 percent in the Maori, it is 77 percent in Chinese males"—and yet the homicide rate in China is less than that of the United States.

In some instances, such as the genetics of violence and criminality, Morse says he thought that the "evidence was *maybe* less convincing than Adrian did," citing a "quite recent review that's much more pessimistic about what we know genetically." While it "wouldn't surprise me if, in the future, we found some specific predisposing genetic causes," Morse adds, genetics will not provide a complete explanation for violence or almost any other behavior.

"If you want to have a complete explanation of human behavior, for most acting human beings it's going to be a frothy brew of biology, psychology, and sociology," Morse says. "And by the way, Adrian is abso-

lutely clean on that. He is not trying to say that crime is completely explained by biology. Adrian is not a biological reductionist."

"There is no question that we all must be extraordinarily cautious in interpreting any genetic differences between ethnic groups, especially with respect to crime and violence," notes Raine. And yet, he would argue, does that mean that we should not even look at such potentially disquieting information and try to figure out how to use it in a fair, rational way?

Brains don't get "broken," to use Raine's word, by genes alone. "The seeds of sinful violence are sown early ... and not just at the time of conception," he adds. Those seeds "are cultivated in utero, at the time of birth, and also in the early postnatal period to give rise to the framework for violence."

There are many environmental culprits: Birth complications (such as hypoxia, maternal infection, preeclampsia). Rejection by the mother in the first year of life. Drinking during pregnancy. Malnutrition during pregnancy and early life. Lead and other heavy metals in the environment.

Then there's what Raine calls the "biosocial jigsaw puzzle," in which social-environmental factors interact with biological risk factors to create violence.

"What's important about Adrian's work is that it shows how biological factors combine with social factors in the genesis of criminal behavior," says Farah. "That moves us beyond simple-minded dichotomies of 'born bad' versus 'society's fault' to a more realistic understanding of the problem of why people do bad things. We all have our innate strengths and vulnerabilities, our formative childhood experiences, our opportunities to meet our needs and desires in more or less pro-social ways, and these form the incredibly complicated system that Adrian is trying to understand."

Even *The Guardian*, in a review that criticizes Raine's opening chapter on evolutionary biology as "curiously refreshing" in its "crudity," concedes that he does a good job rounding up environmental suspects: "He rows back from his initial 'biology + genes + brains' thesis towards the kind of 'environment (including junk food, toxic metals, maternal rejection, poverty, childhood abuse) + heredity + personal factors' truisms that the rest of us accept."

Raine himself set off an uproar in 1994 when he presented research findings that showed how a combination of birth complications interacted with early maternal rejection in predisposing babies to be violent offenders 18 years later. *Science* magazine reported that his presentation was subjected to a "unified and outspoken assault" by other scientists, who characterized his findings as "racist and ideologically motivated." His sample, incidentally, was all white.

The good news is that by understanding these factors, we can, at least in theory, do something about eliminating them and creating healthier environments for brains. Some experts, for example, believe that the worldwide drop in violent crime is linked to the decrease of environmental lead, which kills neurons and damages the central nervous system. (Around the world and across the board, "lead levels and violence curves match up almost exactly," says Raine.) Better nutrition and consumption of omega-3 fatty acids have led to a significant drop in violence among children, according to studies like the Mauritius Child Health Project, for which Raine served as director. And mindfulness meditation—which "enhances prefrontal functioning, the part of the brain that's involved in self-reflection and self-control"—has been shown to reduce aggression in some prisoners.

"What I really try to emphasize in *Anatomy of Violence* is that the social environment is very important," he says. "I'm not throwing that out—quite the opposite. It's the social horse leading the biological cart that drags some people into the gutter and into prison. A bad home environment can have negative effects on the brain that predispose to crime and violence."

Which raises the question of how responsible someone with a broken brain might be.

"Sociologically, as we learn more and more about the brain, and how the brain influences our behavior, it seems a reasonable speculation that people may start to think of themselves as lesser human beings, less responsible agents, and more like very complicated machines," notes Stephen Morse. "And machines are not responsible; people are. You see a lot of neuroscientists talking that way already.

"My view is that the criteria for responsibility are behavioral, broadly speaking, by which I mean acts and mental states. So it doesn't matter what your brain looks like if your behavior is unproblematic. Your brain may look broken as hell, but if you are a rational person, you're a rational person, and you're going to be responsible." The converse is also true.

Over the past 60 or 70 years, the assumption was that new behavioral disciplines and technological breakthroughs would change the way criminal law views violent criminals. Yet "there hasn't been one hint of a change in doctrine or practice as a result of undoubted scientific breakthroughs," Morse points out. "Neuro and genetics are in exactly the same place. Basically they are mechanistic explanations for behavior, although they're only partial explanations. Whether the cause of behavior is psychological, biological, sociological, or astrological, it doesn't matter. The final pathway is: Were you a responsible agent at the time you committed the crime? And if you were, I don't care what the causal story is; I don't care how causally predisposed you were to commit the crime—you're still a responsible agent."

In a sense, Raine's research was inspired—and haunted—by the ghost of Cesare Lombroso. A 19th-century professor of psychiatry and criminal anthropology at the University of Turin, Lombroso is regarded as the father of criminology. Yet a good deal of his work is now rightly derided as bunkum—somewhere between phrenology and social Darwinism.

In 1871, Lombroso was conducting an autopsy on a notorious Calabrian brigand named Giuseppe Villella when he noticed an unusual indentation at the base of the man's skull—which, he deduced, indicated a smaller cerebellum ("little brain") beneath the two larger hemispheres of the brain. Suddenly, he wrote:

> *I seemed to see all at once, standing out clearly illuminated as in a vast plain under a flaming sky, the problem of the nature of the criminal, who reproduces in civilized times characteristics, not only of primitive savages, but of still lower types as far back as the carnivores.*

The two main parts of Lombroso's theory were "that there was a basis to crime originating in the brain, and that criminals were an evolutionary throw-

back to more primitive species," as Raine puts it. The first part can now be seen as having solid scientific underpinnings, even if the devil is still in the details. The danger lies in the second part.

In a sense, Lombroso's crime was having an important idea a century before the technology existed to do it justice. He believed that criminals could be identified on the basis of "atavistic stigmata," Raine explains, including such "primitive" physical characteristics as a large jaw, a sloping forehead, and a "single palmar crease." Based on his measurements of those traits, Lombroso "created an evolutionary hierarchy that placed Jews and Northern Italians at the top and Southern Italians (including Villella), along with Bolivians and Peruvians, at the bottom." Ironically, Lombroso, whose theories about heritable criminality would be twisted into tools of persecution against Jews, Gypsies, and others, was himself Jewish.

By the time Raine was at Hull Prison, the name *Lombroso* would be flung at him as an insult. A BBC team had come to report on his work with prisoners, who were taken into his specially equipped van to measure biological correlates like EEG, brainwave activity, sweat rate, and heart rate. The BBC's interviewer was not impressed.

"He said, 'Well, isn't this a newfangled *Lombroso*?'" Raine recalls. "It obviously was made to seem derogatory—that this is backward science." More than three decades later, in reviewing *The Anatomy of Violence*, *The Guardian*'s Raymond Tallis sneered that Lombroso was Raine's "hero."

"Lombroso is not my hero," responds Raine, "but he is known, even by sociological criminologists, as the 'father of criminology.' I'm intrigued that, despite some terrible theorizing on evolution, he was right about a brain basis to crime."

Even some of Raine's admirers suggest that it was a risky move to use *Lombroso* as the name for his futuristic crime-prevention program.

"It is a really bad idea, from the standpoint of making neuroscience compelling, to refer back to Lombroso, who was in my view a terrible scientist," says Larry Sherman. "I would rather call the program 'Raine-making,' in honor of a really good scientist."

"I think Adrian does not mind being provocative," says Martin Seligman. "I think he's fully aware of the implications and the controversy around them. And he's done a pretty good tightrope act. Adrian is a lot more Teflon than other people who have farmed this general area of genetic brain constraints on psychological phenomena."

Seligman, it turns out, played a role in inspiring the program's name. After Raine gave a visiting lecture at Penn in 1994, Seligman sent him Philip Kerr's futuristic novel, *A Philosophical Investigation*, in which a serial killer is identified by a "Lombroso" program not unlike the one Raine describes in *The Anatomy of Violence*. The acronym, however—Legal Offensive on Murder: Brain Research Operation for the Screening of Offenders—was Raine's brainchild.

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Raine understands the world's reaction to biological explanations of crime. "The Holocaust, the experiments that were done in Nazi Germany—that certainly made it so that biology and crime is not on anyone's radar screen," he says. "It's a no-go area, or traditionally it's been viewed in that fashion."

Another consequence of those 20th-century science crimes was "a complete abolition of research, basically, on prisoners," he adds. "And for good reason: prisoners are a captive population. But what's been missed in that is that research that could help prisoners has not been done—like treatment programs. Critics would say, how do we know that biological research on criminals will not be used for nefarious purposes? My response is, we have to be very careful, and we have to make sure that the research is being done for the benefit of this class of people, and not to their detriment."

Research can be a double-edged sword, he points out. For one thing, "if these individuals have risk factors early on in life that are beyond their control, should we punish them as much as we do? Now, that's an argument, ethically, which sort of favors—rightly or wrongly—prisoners. But others can argue that if you've got all the boxes checked, all the risk factors are present, maybe we throw away the key. And that may lead to an even harsher perspective on criminals. So you can't entirely ignore critics' concerns about the research."

A lot has changed in the 36 years he's been doing this research, says Raine at the end of our interview. "And as that sea change has occurred in people's mentalizing on 'Can there be a brain basis to crime and violence?'—I suddenly realized, Gosh, this Italian out there in northern Italy, yes, he had some crazy ideas, and yes, some ideas were absurd and even dangerous. And he's always been written off in textbooks. But at some level he was right. He was on to something.'"◆

WHERE TO DRAW THE LINES?

"Heinous killings are not going to go away—unless we take fairly radical steps," writes Adrian Raine in "The Future," the final chapter of The Anatomy of Violence. *"It's in this context that I want to explore with you the possible directions neurocriminological knowledge may take us in the future—for better or for worse—in preventing these and other tragedies."*

Raine makes it clear that his goal is not to scare people but to begin a discussion about the complex scientific and ethical issues involved. But, he told senior editor Samuel Hughes, "I wanted to be upfront and transparent about the honest concerns that many people have, and hopefully to try and finish on a positive note: that by taking a biological approach to crime, just like we've had breakthroughs in cancer research, maybe this could lead to a breakthrough in reducing crime and violence."

In this essay, adapted from his book, Raine begins by imagining a new scenario for Kip Kinkel, the very real 15-year-old who murdered his parents, then went to his Oregon high school and sprayed bullets into 27 students, two of whom died. He was sentenced in 1998 to 111 years in prison without the possibility of parole.

Excerpt

WE now move into the future. We pluck the same Kip from 1993 and skip him 40 years ahead in time to 2039. He is now a 10-year-old schoolboy, five years before the fateful killings. A new school screening program has identified him as a potential killer. He obtains residential state-of-the-art treatment that successfully tackles the neurodevelopmental factors placing him at risk for future violence. He is later released and lives out a normal life as a crime-free citizen and functional father. Bill and Faith become doting grandparents, two other children live out their lives instead of dying a harrowing death, and 25 more people are no longer life-scarred victims of deadly assault.

The tipping point came in 2033, when one "low-risk" mentally ill offender was released early on supposedly supervised medication to help relieve the massive prison overcrowding. Through an administrative oversight his dangerousness assessment report had been mixed up with that of another offender. He was high-risk—not low-risk. Just two weeks after his release he held up a store in Washington, DC, during which a young woman was killed in crossfire between the ex-con and the police. By sheer bad luck the victim was the US attorney general's daughter.

This incident, combined with the mounting economic and public concern, now leads the government to launch the LOMBROSO program—Legal Offensive on Murder: Brain Research Operation for the Screening of Offenders. The logic behind LOMBROSO is surprisingly simple. Back at the turn of the century, in 2006, it was known that 22 percent of all those arrested for murder were probationers and parolees—those who had been released from prison. Criminologists in 2009 had then used early machine-learning statistical techniques to predict which parolees would go on to commit homicide. They had only basic demographic and prior-crime data to work with then, and yet they were still able to correctly classify 43 percent as likely to be charged with homicide only two years after their release. Of course there was still the false-positive problem—those who were predicted to commit homicide but who did not. But a replication study with a longer follow-up period provided better results. By the 2020s, interdisciplinary neurocriminologists, statisticians, and social scientists improved the predictive power of this model by adding brain, genetic, and psychological risk factors into the equation. By the early 2030s they took it a step further by developing algorithms for violence in the community at large. Then, in 2034, the LOMBROSO program was put into place. It was a chance for a failing government to reverse its declining popularity in the polls.

Under LOMBROSO, all males in society aged 18 and over have to register at their local hospital for a quick brain scan and DNA testing. One simple finger prick for one drop of blood that takes 10 seconds. Then a five-minute brain scan for the "Fundamental Five Functions": First, a structural scan provides the brain's anatomy. Second, a functional scan shows resting brain activity. Third, enhanced diffusion-tensor imaging is taken to assess the integrity of the white-fiber system in the brain, assessing intricate brain connectivity. Fourth is a reading of the brain's neurochemistry that has been developed from magnetic resonance spectroscopy. Fifth and finally, the cellular functional scan assesses expression of 23,000 different genes at the cellular level. The computerization of all medical, school, psychological,

Illustration by David Plunkert


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census, and neighborhood data makes it easy to combine these traditional risk variables alongside the vast amount of DNA and brain data to form an all-encompassing biosocial data set.

All those convicted of homicide in the United States have been assessed on the Fundamental Five Functions. This was going on for research purposes well before the homicidal tipping point arrived. An equal number of non-criminals was drawn from the community as a comparison group. Fourth-generation machine-learning techniques looked for complex patterns of linear and nonlinear relationships between these predictor variables and the homicide-control grouping. One conceptual advance that was learned in the previous decade and that enhanced the accuracy of violence prediction was the critical importance of factoring in the interaction between social and biological variables. The samples of murderers and controls were randomly divided into three separate pools of data. The first pool of murderers and controls was used as a training set—allowing machine-learning techniques to "learn" how to predict homicide. The second pool of data was used to test out the prediction formula to see if it held water. After further refinement, the formula was tested and finalized on the third data set.

The result is not perfect prediction, but it is pretty darn good—good enough for an outraged society. Those tagged as LP-V (Lombroso Positive–Violence) as a group have a 79 percent chance of committing a serious violent offense within the next five years. Those classified as LP-S (Lombroso Positive–Sex) have an 82 percent chance of committing either rape or pedophilic offenses. Finally, those classified as LP-H (Lombroso Positive–Homicide) have a 51 percent chance of killing someone in the next five years. Some have dual designations.

The program works like this: those who test positive– the LPs—are held in indefinite detention. In light of the administrative lapse that originally sparked LOMBROSO when test results were mixed up, LPs are given the legal right to challenge the findings and be retested by an independent authority. The detention centers are highly secure, but are not the harsh holding bays of decades gone by.

Every LP is reassessed every year, as the changes brought about by the detention environment and treatment can bring about significant epigenetic change and hence a change in their LP status. Release is also possible, and long-term detention can be avoided. The LP-S group, for example, can elect to have surgical castration and will be set free immediately, although they have to continue to undergo mandatory weekly testosterone checks to ensure that they are not taking hormone-replacement therapy. Others, depending on their bioprofile, can also be placed on mandatory medication and tested at halfway houses. Most releases, however, are the result of the intensive treatment programs implemented in the LOMBROSO centers.

These are scientific interventions, deriving from the experimental criminology movement beginning in 1998 espousing practice based on randomized controlled trials. Society accepted that serious recidivistic crime was a clinical disorder when new biological treatments were shown to work. State-of-the-art biopsychosocial treatments are intensively explored for all LPs, but are tailored to their unique biosocial profile.

At first there were remonstrations over excessive government control and breach of civil liberties. But the government has been able to come up with scientific backing for the validity of its policy.

It's now 2039, and five years after the introduction of the LOMBROSO program. An independent analysis was conducted on the efficacy of the government's program. After years of gradual increases, the homicide rate has been cut nearly 25 percent. Similar reductions have been seen for rape, pedophilia, and serious crime. Government spending on health, education, and housing have increased, given the savings on the cost of crime that they shared with private investors. Civil libertarians are flabbergasted by the fact that a scheme they thought would be racially prejudicial actually resulted in a lower proportion of minorities being detained as LPs. The jury system of the 2010s was undoubtedly racially biased, with a black offender more likely to be convicted of the same crime as a white offender. LOMBROSO, in contrast, is scrupulously objective and data-driven, and the results have pleased civil libertarians and minority leaders alike. After all, it was known all along that minorities are disproportionately the victims of violence, and now they are disproportionately benefiting from violence reduction.

In 2040, the National Child Screening Program (NCSP) is announced. All children 10 years of age are given a comprehensive medical, psychological, social, and behavioral evaluation that incorporates all prior school, social, and medical-record data.

Under the new NCSP, parents of some 10-year-olds are informed that their child is a rotten apple. The NCSP determines that little Johnny has a 48 percent chance of developing into a serious violent offender in adulthood, and a 14 percent chance of committing homicide. That's the bad news.

The good news, however, is that the NCSP has developed residential treatment programs that should be successful in cutting these odds by more than half, to 18 percent for serious violence and 6 percent for homicide. It does, of course, mean that Johnny will have to be taken away for two years for intensive biosocial therapy, but after that he will be back home.

What would you decide if you were Johnny's mother or father? Put yourself in their situation. Do you want your child whisked off to an institution for treatment and branded as a potential future offender? What are you going to tell your relatives and friends and neighbors? Think of the stigma. What about Johnny losing his friends? And what bad new friends will he make in this residential program for criminals-in-the-making that might make real a self-fulfilling prophecy?

On the other hand … are you just going to stand by and do nothing? You know full well that Johnny has a very significant chance of ruining not just his own life, but your life, and the lives of innocent victims. These are lives *you* could save if you only act. On balance, the majority of parents give up their children for residential treatment.

In 2042 there is a controversial change to the NCSP initiative after two 11-year-old schoolchildren coldheartedly tortured and killed a three-year-old child, having abducted him from a shopping mall while his mother was distracted. The act was

caught on the global CCTV network. It turned out that both of the killers had been identified by the NCSP the previous year as being in dire need of residential treatment, but their respective parents had elected to decline intervention. Analysts argued that children in the red zone likely have parents who do not have the best interests of their children at heart. They are not responsible parents and not good decision-makers—reasons their child is in the red zone in the first place. NCSP officials now need to act "in loco parentis"—to step into the parents' shoes and make the decision. The treatment now becomes compulsory.

It's now 2049 and the 15th anniversary of the LOMBROSO program. The nation is nine years into the NCSP. Together these programs are undeniably making a dent in the rates of juvenile and adult violence. They have also significantly reduced nonviolent crime. An avant-garde cadre of research analysts and neurocriminologists propose a controversial program that is outvoted by other advisors. But a minority report is written and submitted alongside the majority vote for senior government officials to consider. Following in the traditions of LOMBROSO and NCSP initiatives, the minority report proposes to stop crime before it starts. But this time it proposes that citizens get a license before they even have a child. After a very long and heated debate, there is a small majority vote in favor, and the policy becomes law.

"IT SENDS SHIVERS DOWN MY SPINE TO THINK I COULD BE CONVICTED WITHOUT COMMITTING A CRIME."

The train of thinking in the minority report goes something like this: Poor parenting has undeniably been linked to later violence. Genetic studies documented not just that antisocial parents transmit their bad genes to their children, but that the negative social experience of having a bad parent is also a causal factor for antisocial behavior. The issue is not to use eugenics as a final solution to crime, advocates argue, but to create a social policy to promote positive behavior. Better parents, better children. The minority report's perspective focuses on children's rights—minors need to be protected and better treated, and would-be parents need to be responsible. They must report in for licensing.

Cars can be killers, and so you need a license before you can drive. Kids can be killers too. So the logic goes that you should also have a license before you can have a child. Just as you need to document practical skills in driving a car and also knowledge of the right way to drive, you also need to show theoretical and practical proficiency in rearing a child. It's only right for the child and society.

Civil-rights activists remonstrate loudly against the minority report, claiming it is taking away a fundamental human right. In response, the government adds the caveat of compulsory classes in parenting skills in all schools. Now everyone has the potential to pass the licensing exam, they say. No child left behind. No more excuses.

Classes are structured to be age-appropriate and to start at a relatively early age. They teach children everything from the basics of reproduction to prenatal nutrition, stress reduction, the early needs of a developing baby, providing structure and support for the growing child, negotiation skills with teenagers, what psychological problems teenagers have, and how to help them. The broader context is on becoming a responsible citizen, with the curriculum covering knowledge-acquisition, social skills, decision-making, and emotion regulation.

Some parents are opposed, but what wins the day is that kids actually enjoy the one-hour Friday afternoon class far more than Monday morning's matrix algebra.

Some teenagers never knew that vigorously shaking a baby when it cries cuts the white fibers connecting the prefrontal cortex with the limbic system. They did not know that babies have to be fed in the middle of the night. They never knew the long-term financial cost of having to bring up a kid. They not only learn about how to be a better parent, but they also learn social skills that help them manage their current relationships with their parents, boyfriends, and girlfriends, as well as academic skills on human development, brain development, and behavioral control.

Yet the licensing program still has significant opposition from human-rights advocates. Civil-liberty advocates remonstrate that the government is taking away the right to have children and essentially criminalizing pregnancy. The government's retort is that any woman can become pregnant—she just has to pass the licensing exam before she gives birth. To make it enforceable, there have to be sanctions for illegal parenting—just as there are sanctions for dangerous driving. If she is unlicensed, a mother caught with a baby has her child taken away into a foster home but is also offered a crash course on parenting and the opportunity to take the examination. If she passes, her baby will be returned—although there are inevitably yearly follow-ups on her parental skills, given her documented lack of responsibility and law-breaking behavior. DNA banks also allow the biological fathers to be tracked and sanctioned if they are not licensed. In 2050 the Parental License Act is passed.

In the first few years, parenting skills go up and unwanted pregnancies go down. Juvenile delinquency declines too, as adolescents achieve a greater sense of responsibility, empa-

thy, and agency alongside slightly improved relationships with their parents. There are long-term reductions in child abuse and later adult violence as teenagers grow up to be more responsible parents. The result is a new generation of children more cared for and loved by their parents. It is a winner with the public, and the government continues to win its war on violence—and its battle with the opinion polls.

Let's now step back from Big Brother and the impending glare—or glitter—of these hypothetical programs. Consider two quite different questions on the three future programs I have outlined. Could they happen? Should they happen?

LOMBROSO could certainly come about in practice in 20 years, or something quite like it. Let's face it, elements are already in place right now. The prison at Guantánamo Bay is just one example of how indefinite detention is being used by countries throughout the world in the name of national security. Indefinite imprisonment for dangerous criminal offenders—or "preventive detention," as it is neatly packaged—is common in many countries.

You also know that all it takes is one tinderbox crime to set off a new law to protect society. That happened with Megan's Law, which required the public registration of sex offenders after the rape and murder of seven-year-old Megan Kanka in 1994 by a man with prior convictions for sexual assaults against young girls. Physical castration is offered right now in Germany and some other countries as a treatment option for sex offenders—we don't have to wait two decades for that to happen.

As for parental licensing, this has been debated in both the popular press and the academic press for some years. Articles point out that poor parenting is a well-replicated risk factor for adult violence. Indeed, some governments have already acted to do something about it.

Politicians will continue to overreact to isolated tragic events in order to quell the public outcry and try to solve society's problems. With more water under the bridge, scientific advances in knowledge, and a much broader, multidisciplinary perspective to crime causation that incorporates neurocriminology, the ability to predict—and preemptively act—will, I believe, become more probable, not just possible. These things can happen. You can debate that particular conclusion later, but right now let's move to a more poignant point—do you *want* programs like LOMBROSO?

That's a question for all of us to consider. It sends shivers down my spine to think I could be convicted without committing a crime. It would send shivers down your spine too if you had a brain scan like mine that looks like a serial killer's, together with low resting heart rate, birth complications, minor physical anomalies, early vitamin B deficiency, and a past that included bootlegging and gambling by the age of 11. But let's hear all sides on the neuroethical issues surrounding neurocriminological research, and where we may or may not be taken to in the future.

Of course there are civil-liberties issues in detaining people before they have committed a crime. But as I alluded to earlier, are there not civil-liberty issues involved in *not* doing anything when you know someone has a 79 percent chance of committing a serious violent act—and you can do something to stop that happening? Yes, some people will be detained who may not pose a risk—yet the harsh reality of daily life is that we have to balance risks with benefits.

On the early identification of potentially dangerous children there is no question that there are important neuroethical issues that have to be recognized. At the same time, both the public and scientists alike have an honest and growing interest in what to make of the anatomy of violence.

On parental licensing, is it really a moral right to have a child or not? Should it instead be considered a privilege that needs to be earned? Even today we take away parental rights. Parents who lack the capacity for care and nurturing, and instead hurt their child, lose their paternal rights. Their child is taken away from them into care. It's not too far a leap to go one step further by conducting preventive intervention to preclude harm to the child occurring in the first place.

You may reasonably remonstrate against licensing. I did when I first encountered the idea. It just did not feel right to me for reasons I could not entirely put my finger on. Yet consider adoption. Not everyone is automatically assumed to be a good enough parent to look after a child. Potential parents are scrutinized very carefully by the state on background and financial circumstances to ensure that the child will enter a loving and stable home. Because of that competency screening, the rate of child abuse in adoptive homes has been argued to be less than half of that for children reared by their biological parents. We ensure standards for unwanted children—so why not apply such screening to us all to help every child in society and cut child abuse?

The question comes down to where exactly in the shifting sands of sensible reasoning you are willing to judiciously draw the line that delineates the protection of society on one side and the invasion of civil liberties on the other. The overall risks weighed against the overall benefits. The difference between right and wrong—between life and death. Between acceptance of the neurocriminological knowledge we are rapidly gaining—and the social concerns we all have over equity, ethics, and liberty.

Far too often the slippery slope argument is presented at the end of a discussion. *Well, there's a slippery slope, so let's play it safe and tread no further.* That's a cop-out, and when it comes to the active suppression of new knowledge or the ignorance of silence, it generally stems from the desire of certain groups to maintain the status quo. It turns out that most slopes aren't so slippery after all if we care to confront our fears and cautiously weigh the risks and benefits of action. There is firm ground underfoot and ample opportunities up and down that slope to choose where we stand—*if* we have the courage to do so.

An open and honest dialogue on the issues raised here will prepare the public for future developments—whatever they may be—and help facilitate future success in violence prevention.◆