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Transcript: The Brain Sciences in the Courtroom

The Brain Sciences in the Courtroom

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BOWEN REICHERT: Good morning, everyone. It is my distinct pleasure to welcome all of you to our 2010 Symposium: "The Brain Sciences in the Courtroom." I am Bowen Reichert, the Editor in Chief of the Mercer Law Review.

We are delighted to welcome an incredible group of speakers to Mercer and to Macon, Georgia, and we are truly honored that each of you are here. I would like to thank the Editorial Board and the members of the Law Review who have all worked incredibly hard to make sure that this event happened. I would especially like to thank Courtney Ferrell, our Lead Articles Editor, who is in charge of the Symposium this year. With that, I will ask Courtney to come up and say a few words. Again, thank you for being here.

COURTNEY FERRELL: Good morning and thank you all for attending this very special event during which we will examine the intersections of neuroscience and the law. My name is Courtney Ferrell, and I am the Lead Articles Editor of the Mercer Law Review. This Symposium would not have been possible without the dedication and enthusiasm of Professor Ted Blumoff. Professor Blumoff is responsible for bringing this all-star team of scientists, professors, and practitioners together today. I would like to thank Professor Blumoff, the presenters here today, and the members of Mercer's Law Review for the work they have all put into making this Symposium what we hope will be a resounding success.

TED BLUMOFF: Welcome to all of you, and thank you for coming. We will start this morning's session with an overview from Professor Oliver Goodenough. I am going to turn this over to Judge Morris Hoffman to get us started.

MORRIS HOFFMAN: Thank you, Ted. It really is a testament to Ted that all of us are here. It is even more of a testament that all of us not only came, but we agreed to limit our talks to twenty minutes. It is my pleasure to introduce our first two speakers, one a good friend of mine and one, I hope, a new friend.

Our first speaker, Oliver Goodenough, is a law professor at Vermont Law School where he teaches corporations, intellectual property, entertainment law, and property. Oliver is also a Fellow at Harvard's Berkman Center for Internet and Society, and he is one of the driving forces for the Gruter Institute where most of us met. It is always an honor to go anywhere with Oliver, and it is a pleasure to have him here.

Our second speaker this morning is Dr. Richard Elliott. Richard is a professor of psychiatry at Mercer University's Medical School, and also an adjunct professor at the Law School. He completed his M.D. in 1978 and has a Ph.D. in Biophysics. He did his residency in psychiatry, is a practicing psychiatrist, and is a testifying forensic psychiatrist. Richard is certified by the American Board of Psychiatry and Neurology and the American Board of Forensic Psychology. He served as the Medical Director of Georgia's Mental Health System and is currently the Director of Medical Ethics. Richard has authored more than fifty peer-reviewed publications.

Oliver is going to give an overview of where we are after twelve years of thinking about the intersection of neuroscience and law, and then Richard is going to give an overview of neuroscience, focusing on the complexity of the brain and a little history of neuroscience. Oliver.

OLIVER GOODENOUGH: Thank you very much. First of all, thanks and a quibble. Many thanks to Mercer Law School, the Mercer Law Review, and the Institute of Continuing Legal Education for Georgia for its sponsorship. Ted, a great event.

The quibble is the Symposium title: "The Brain Sciences *in the Courtroom*." Now, as important as neurolaw may eventually be in the courtroom, it will also be at least as important in the legislative chamber, in the board room, in the prison, and in many, many places. Indeed, viewing the law as prosecution and litigation is, I think, actually a problem for this field because, as we see with scientists, they frequently have a kind of Perry Mason view of what we are as lawyers. And, so, my quibble is that maybe we can expand the scope of the title.

As Morris said, I am going to give you a bit of an overview. We're going to move at some speed, and we are going to point to a fair amount of information in passing. The nice thing is that you are going to have a full day on neurolaw, and lots of people are going to present, so you're going to have a chance to assimilate different bits and pieces in more detail and not just rely on the brief summary you are about to get.

So, a decade of neurolaw. Where has it brought us?

My talk will follow this simple outline: first, where did neurolaw come from; second, some history; third, substantive topics and cautions (this part is a bit of a laundry list and a brief personal advertisement here, Goodenough and Tucker, *Law and Cognitive Neuroscience*[1] has a lot of what this is taken from in more detail); and finally, suggestions on going forward. This last section can be summarized as suggestions for a bit less defense and a broader and better offense.

So, where did neurolaw come from, and what is its history? Many of the people in this room have been part of the story. My first exposure, and this corresponds with Morris's notion of twelve years, was at a Gruter Institute conference in 1998. As the idea took hold, there were many parallel investigations in the early 2000s. The Society for Evolutionary Analysis in Law, or SEAL, took this subject on in the mid-2000s. Throughout the past decade, more work has been done, and the field, while still young, is now pretty well established.

In reviewing neuroscience history, we should put a bookmark down for Margaret Gruter who passed away earlier in the decade. She was a pioneer in law and neuroscience studies, and her Institute[2] was a place were much of the work originated. She was prescient about many of these matters, and we should remember her in this context.

Now third, what are the topics that have been particularly treated on in this neurolaw combination? There are three useful divisions for the field. Hank Greely first suggested them to me. The first is the law of neuroscience. In other words, what does law do to regulate neuroscience itself? The second is the study of the cognition and behavior that are relevant to law and policy. This is where the greatest amount of work is going on. Third and finally, there is the study of the cognition and behavior of law itself. In this category we turn the neuroscience lens on what we do as lawyers and judges.

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1. Oliver R. Goodenough & Micaela Tucker, *Law and Cognitive Neuroscience*, 6 ANN. REV. L. & SOC. SCI. 61 (2010).

2. "The Gruter Institute for Law and Behavioral Research brings together a multidisciplinary network of distinguished scholars . . . to pursue interdisciplinary research and teaching in law and the biologically informed behavioral sciences." *Welcome to the Gruter Institute*, GRUTER INSTITUTE, http://www.gruterinstitute.org.

In the law of neuroscience, we deal with issues like regulating scientific research, informed consent, and neural privacy. Topics here also include consciousness, brain death, vegetative states, and enhancements. Neural enhancements will challenge the legal system in the near future. Can we give students enhancements before they take exams or standardized tests? Do we allow students to take Ritalin before they do the LSAT and improve their scores by twenty or thirty points? What about testifying and memory in the courtroom? Can we use pharmacology to enhance them? Intellectual property also plays a part. Can we patent neurolaw discoveries when we invent them? Can we patent neural processes themselves? There are plenty of interesting questions around the law of neuroscience.

Now to the second of the categories: thought and behavior of interest to law. Are there neuroscience discoveries that will help me as a lawyer? I think this is what most of you in the room are here for. One widely discussed topic is the possibility neuroscience has for revealing subjective mental states. Can we use scientific techniques to get behind the opacity of the skull and start to say what is going on in our subjective thinking? One of the applications of this principle that has gotten the most press is the assessment of deception and truth telling. Can a neural lie detector help us know when someone is telling a lie? I think most of us in the field feel that the jury is still out on that one. There is some interesting science, but it is not yet ready for prime time or the courtroom. There are some smart folks on the other side who will argue that with me, but so far, that is my conclusion.

Pain is also interesting. There is a whole set of legal concerns around pain. There is pain and suffering. There is pain as punishment. Pain is one of the subjective states that we can perhaps get windows into through these techniques. Memory–the cognitive science of memory is at an interesting place. Bias–can we understand the cognition of bias? So, revealing subjective states is one category where a lot of work has gone on.

Evidence is an important topic. Can we get neuroscientific evidence into court once we have it? The classic three prongs of reliability, relevance, and possible prejudice are all implicated. In terms of reliability, we are at the stage when the underlying science, such as fMRI scanning, is well developed and reliable. What is not so reliable is the move to the relevance step. What legally relevant matters are we proving when we see all these pretty pictures? That is the more difficult question to answer. And then there is prejudice. There has been argument on how prejudicial neuro-evidence will be. There may be something to the "Christmas tree effect," in which all the pretty lights go on in the brain, leading to delight and confusion in the finder of fact.

There are arguments back and forth and conflicting data on whether that is a real problem or not.

Civil law–this is actually where most of my own practice and teaching is located. Trust and cooperation are getting some attention. What is the neurophysiology of trust? I have written on intellectual property. What are the cognitive aspects of intellectual property, not the intellectual property aspects of cognitive properties? What is going on with the failure of copyright law? My guess is that ninety percent of the people in this room have committed copyright infringement in the last week or two, and most of you would not steal a dime. If there was a dime sitting right here, you would walk by and say, "No, I can't take that." Why is it that we have such a cognitive and behavioral difference between the way we view intellectual property and the way we view tangible property? This is the kind of question that we can look at in a civil context, and one that isn't necessarily just in the courtroom.

But criminal law is a place that has consumed a lot of neurolaw attention and in which our knowledge has the potential to inform substantive areas of law. Attention crimes are almost a product of cognitive knowledge. What is an attention crime? Attention crime is the use of this (holding up cell phone) behind the wheel. With the neuroscience of attention as a guide, we can look into things that we should criminalize, like the ability to drive and text at the same time.

The law of responsibility has received a lot of attention. On this one, I think that Stephen Morse is right: neurolaw won't change things much. Most of today's speakers have written something about this, and in the end, as Stephen points out, folk psychology really answers most of our questions pretty well. The classic tests are reasonable proxies for a neurologically informed approach–we are confirming folk psychology and not contradicting it. Why? I believe that folk psychology actually reflects the strategic dilemmas of interpersonal interaction at a level that is very profoundly inherent in social interaction; therefore, we are probably not going to get a whole lot better than those concepts through a lot of fancy neuroscience work.

I want to take a minute for a methodological point. What should neurolaw look at? It should look at things in which the answers aren't readily available from our traditional legal methods. Traditional legal psychology, traditional folk psychology, and traditional good old-fashioned common law evolutionary processes give us reasonable answers to many of the questions that law has to face. They also give us poor answers to *some* of the questions that law has to face. And the place to go with neurolaw is where we have those problems, where we've gotten the poor answers. With any luck, a little cognitive neuroscience might actually give us some leads on better approaches.

This brings me to criminal law, in which we have some big problems. This isn't just my opinion, this is what we hear from the judges themselves. There are places in our criminal system where society isn't doing a very good job: addiction, the treatment of juveniles, and the treatment of people with mental health problems. Conversations with judges up to the highest level in our U.S. courts confirm that the law needs our help with these questions.

First on the list is addiction. While there is still lots to be done, the basic neurophysiology and neurochemistry of addiction are pretty well roughed out. For instance, we actually understand the role of dopamine in many addiction patterns. What we need to do now is figure out what we do with that knowledge and how to turn, at least in part, from punishment to treatment. I am arguing that because we need to get better outcomes, and a mix of punishment and treatment may be the right way to do it. Drug courts are emerging and beginning to apply this mix.

The areas of juveniles and juvenile justice are particularly interesting because the Supreme Court has actually made some reference to neuroscience as a means of looking at questions of juvenile punishment and development. The intersection of maturation and experience that Abigail Baird is working on provides critical insights into juvenile criminality.[3]

Mental health is an area that is ripe for help in criminal law. We could have a better differentiation of problems, a better fractionation of offenders, better predictions, and better treatment protocols. Mental health problems come in a number of different types, and if we can get better differentiation of our legal response to mental health-based criminal behavior that would be great. We can have better treatment for some of the fractions, and we can have clearer punishment and removal for others if that is called for. We need to support and inform mental health courts, fact-based interventions, and other models that may be helpful in that context.

Turning to the neuroscience of the law itself, we can start with the neuroscience of moral judgment. There is a growing body of cognitive neuroscience work on moral judgment versus legal reasoning. This can help us unpack some of those jurisprudential conundrums like the interrelation of law and morality. Neuroscience can help us to understand how they differ cognitively and can help us understand their roles. Emotion is important in this context.

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3. Abigail Baird, *Executive Function and Brain Maturation*, Current Research: The Teen Species, Laboratory for Development Neuroscience, Vassar College.

What is the neuroscience of punishment? There is a lot of study of hard reciprocity and the possibility of a human taste for punishment. Why do humans feel that inner upwelling when we see someone get justice? Why is one of the greatest feelings in the world the one you get when the person who sped by you on the highway at ninety miles per hour is pulled over by the police about a half a mile further down the road? We clearly have that taste for it. Why? What does that do? How does it work? There is interesting work on the efficacy of disembodied punishment. This is a possible explanation for a rule of law, which may short circuit the mental processes that would otherwise lead to tit-for-tat retaliation contests.

And what about politics and punishment? The political ads this election year are more about being afraid of a deficit than being afraid of people, but politicians can mobilize support by being "tough on crime" and calling on the taste for punishment. Law is a cultural process, and there is work out there on how cultural processes interact with our mental processes that can help us to understand why law works the way it does.

Now to point out some cautions. Caution number one–*neurodazzle*. Do not indulge in neurodazzle. That is when you have already made up your mind about a legal issue and then you find something great like Abigail Baird's work and you quote it extensively to dazzle people, even though it has nothing to do with why you actually believe the conclusion you are purporting to support.

Caution number two is that neurolaw is not simple determinism. It may be complicated determinism, but it is not simple determinism. Asserting that "my brain made me do it" is just silly. Although on one level it is a true statement, because your brain is probably what makes you do everything, on the other hand it is not a disembodied brain that somehow made you do it but rather a complex interaction of neural processes.

And third, avoid creating a stigmatized other. We need to be concerned about that. Amanda Pustilnik's work has been particularly helpful in recognizing this danger.[4] We need to recognize that when we make neurologically based categories there is that danger of distancing the people in them. We tell ourselves, "Okay, that is somebody else, that is not me. I am not like that. I am not a criminal." But that distance is all too often illusory and self-congratulatory. It is worth remembering that there, but for the grace of God, go all of us. So yes, as we do the

4. Amanda C. Pustilnik, *Prisons of the Mind: Social Value and Economic Inefficiency in the Criminal Justice Response to Mental Illness*, 96 J. CRIM. L. & CRIMINOLOGY 217 (2005).

differentiation and fractionation I spoke of earlier, we should always be aware that those categories may be a way to distance–to stigmatize–in ways we have to be careful about. Also, it is worth remembering that what is criminal changes over time, and what we call a criminal category at this point may not be called that next month.

And what am I up to in my own work? Two things currently. One of them is looking at juveniles and the "license of youth." My colleague, Micaela Tucker, and I start with the work of Abby Baird, and mash it into the thinking of Fiery Cushman,[5] who is looking at the role of punishment as a teaching tool. And if you take Abby's point that juveniles have to learn through experience, then experience always means making a mistake at some point or another. One of the reasons why we have this license of youth–for example, reduced penalties for a transgression–is that it creates a space within which young people can learn with consequences but without dire consequences. On the one hand, in the face of juvenile misdeeds, you can't say, "Well, that was okay;" but, on the other hand, if you lock them in jail and throw away the key, as in the case of *Graham v. Florida*,[6] that causes us great uneasiness as well. We have this basic understanding that juveniles can learn, even juveniles who are bad actors at the moment. We are exploring how this reaction to juveniles can be mapped onto the emotions of punishment. This approach allows us to add a new category to the goals of punishment: using punishment as a teaching tool.

I am also working on integrating neuroscience with game theory and mechanism design. There is a lot of structure to the dilemmas of sociality that game theory helps to capture, and we can use that as a tool to think about the structures of our cognitive processes.

I will take just a minute on funding and support. We have been very lucky in the field. We have had a lot of support, particularly from the MacArthur Foundation, for our intellectual program. Many of the presenters here today are part of that project. There have been achievements and wonderful research, but there have also been missed opportunities in the project such as better integration between law and science and for the development of applications. Hopefully, as we go forward in the post-MacArthur world, we will learn from that.

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5. Fiery Cushman is a student conducting a post-doctoral fellowship at Harvard University, studying cognitive processes that give rise to moral judgment, their development, and their evolutional history. In July 2011, Cushman will be an assistant faculty member at Brown University in the Department of Cognitive, Linguistic and Phsychological Sciences.

6. 130 S. Ct. 2011 (2010).

So, what are my suggestions going forward? First, incorporate the ideas of mechanism design. Second, get better integration of brain approaches and understanding the input from experience. How brains work in our environment, how brains work with our culture, and how brains work with our personal experience–the back and forth Abigail Baird has been working on. Third, focus on applications. This is difficult for legal academics and difficult for scientific academics. What I am asking for here is to move neurolaw beyond an academic exercise and into an engineering exercise. Fourth, focus on problems we are having trouble solving with traditional methods.

Fifth, focus on policy levels at least as much, if not more, than on the individual cases. For instance, assessing whether someone is lying is difficult at the moment, and it is going to stay difficult for a while. But we can take away some population level observations that are going to be very powerful about things like addiction and mental health. We need to target the legislatures with this kind of information. When we train judges, they say, "This is very interesting, but I've got to apply the law I'm told to apply, and you should talk to the legislators about this at a policy level rather than on an individual level in the courtroom."

Sixth, focus on doctrinal topics. Again, the big challenges in criminal law hold the big potential for payoffs. Seventh, focus outside of the criminal world, in civil litigation: memory, pain, bias, negligence perception, these are good targets. Keep studying the truth telling tests, but don't put them in the courtroom just yet.

Eighth, we should look more at the thought and behavior of actors in the legal system: judges, juries, lawyers, legislators, government officials, and voters. For instance, our federal legislative process has been widely described as broken. Why are they fighting with each other? Neuroscience suggests that there is a cognitive bias in us to team up and follow the leader who is fighting for us. In a reflective moment we may say that we don't want the wrangling, but then our biases all kick in, particularly in an election year.

Ninth, focus on better integrated law and science collaboration. This is where we really need to work to make this field as good as it can be. There is the problem of people being in silos and not talking across disciplines. We can solve some of that by simply getting people together in the same room, on the same topic, and with a session like this we are taking a step in that direction.

A harder problem is that scientists need to get brave. Scientists, particularly research scientists, love research as an abstracted problem, and it makes them very nervous to suggest what we should do with policy in law and society. It is a step that they are reluctant to take, and there are some good reasons for this reluctance. You get involved

in policy and maybe your funding goes sideways–too controversial, too political. But if we are going to make this neurolaw combination work, we need the help of good scientists who are willing to step up and say, "I know what I'm talking about. Here's what we need to do." So, scientists–get brave, get application-oriented. In some ways we stop needing scientists and start needing engineers instead. I also teach at an engineering school, and engineers want to solve problems. They say, "Hey, let's tinker and make widgets and create applications to solve challenging problems." We need some neurolaw widget-making with folks who are going to come up with some applications because developing good applications for hard problems is what will make the society better.

Lawyers need to get application-oriented as well. Legal scholars like to think they are scientists too, and legal scholars are sometimes very happy to have pointed to some piece of the brain implicated in a particular choice or behavior and say, "Wasn't that cool? I will write a law review article, have it published, and then I'm done, right?" Practicing lawyers know better. They are the equivalent of engineers in the law, and we need to get practitioners involved in neurolaw so that we can move the field from just thinking about things that are cool to actually putting those things into practice.

So our outreach needs to move beyond judges and on to legislators and policy setters, practitioners, and field officers. Several of us among the presenters were involved in a recent training session for federal pre-trial and probation officers. They are where the rubber hits the road in a lot of this, because they are the folks who are actually involved in day-to-day interaction with people who need the insights that we can help provide. It is the kind of place where law and neuroscience can have an effect.

And my final point is that the scientists need to reach out, too. One thing lawyers need to remember is to talk to scientists about our real dilemmas so that we get the scientists beyond a kind of Perry Mason caricature of what law is about and onto some of the real questions we have to worry about.

That is my quick introductory talk. Many thanks to my co-author, Micaela Tucker, and to the Gruter Institute, which has been a leader in studies of law and the brain for a long period of time, and particularly to Margaret Gruter and the current Executive Director Monica Chaney.

MORRIS HOFFMAN: I have a question. If scientists need to get brave, it seems to me that the answer may be that we need caution in some areas and bravery in others. Can you comment about that?

OLIVER GOODENOUGH: So far in the field there has been a lot of attention to the things that were being done badly on neurolaw application. This is part of what the MacArthur Foundation Project did and did well. They called into question some things that needed to be called into question, particularly some of the truth telling pieces. We shouldn't let poorly prepared lawyers throw a bunch of pretty pictures on the screen in a courtroom and say, "As these prove ...." Caution is an important piece of doing neurolaw well. But simply negating what is badly done is still a partial abdication of what we should be doing if we are good scholars in this area, which is also figuring out what can be done and not just what can't be done. We should be in the trenches with the pre-trial and probation people, figuring out what we can do to make the interventions of society's criminal system more effective. There have to be better things we can do. The definition of insanity is doing the same thing over and over again and expecting a different result. We have to do some new things.

So, caution is absolutely necessary because you are tinkering with people's lives with legal interventions. But the legal system is out there tinkering with or without our information, and with any luck we can throw out some better information and maybe help the system work a little better. Being cautious is not the same thing as being timid. Caution and timidity are different things.

AUDIENCE QUESTION: If you could flash forward to some reasonable point in the future, what are three things that you hope will have developed within the next fifteen years? It could be at the broadened policy level or it could be at the level of very practical application.

OLIVER GOODENOUGH: Let me go back to the "big three." There is something in each of those. First, I think that we can have a far better understanding of the effect of drug-based addiction, and we can incorporate that better understanding into how we deal with addicts and how we deal with drugs. If we can put this knowledge to work, I hope we will unplug the current, relatively ineffective cycles that are around. How do we help people cure themselves? As Stephen Morse points out, many people can cure themselves. Can we help them do that? Can we take the harder cases and figure out treatments that will do that?

Second, with juveniles, partly because of the punishment politics we talked about, we see that there has been an increasing "throw the book at every kid" approach, but that is not right. Again, we have this fractionation problem. There are some kids you probably want to throw the book at. How do we help us understand the processes of learning, of rebellion, of trying things out, which is what adolescence is about, at

least in part. I will look forward to hearing Abigail Baird's suggestions about that.

Third, mental health. The criminal law system has become our mental-health, social-work system in most places in the country, and it is a national shame. We can do better. If we start to unpack some of the neurophysiology of mental health problems and we get a better understanding of where that comes from, we will get beyond the "it's their fault, they can really do better if they try" kind of syndrome. Even when we get beyond fault, the legal system often does not know what to do with the mental health cases that show up in court for some moderate infraction. For example, "I'm a judge, not a social worker, and I don't know what to do. This person is in my court for the third time for minor offenses, and the law says I've got to put this person away for a long time. There must be something better I can do."

Getting beyond the "big three," in my own field of intellectual property, I am really eager to help unpack the cognition around property and look at how the difference between tangible and intangible property works in the brain.

MORRIS HOFFMAN: I would like to thank Professor Goodenough again for taking the time to be here. I'll now introduce our next speaker. Dr. Richard Elliott is a professor of psychiatry at Mercer University School of Medicine. He is also an adjunct professor here at Mercer University School of Law.

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Dr. Richard Elliott's presentation on the history of neuropsychiatry in the courtroom from the nineteenth century to the present focused on the distinction between the study of neuropsychiatry from clinical psychiatry. For a more in-depth discussion, see Richard L. Elliott, *Neuropsychiatry in the Courtroom*, 62 MERCER L. REV. 933 (2011).

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LINDA HENSEL: I am Linda Hensel, and I am the Chair of the Biology Department at Mercer University. We are now going to hear from Dr. Abigail Baird. Dr. Baird received her doctorate from Harvard University in developmental psychology, and she is now an Associate Professor at Vassar. She is going to talk today about the interface between teens, the law, and violent behavior.

ABIGAIL BAIRD: I want you guys to watch this clip. (Action-loaded risk-taking video played.) Now, some of you seem to have recognized that clip from the James Bond movie *Casino Royale*.[7] Now, obviously these were stunt people doing all the harrowing jumping and tumbling, but what if I told you that you had an opportunity to actually go to Universal Studios and do something like this with safety wires and mats and all the necessary stuff? How many of you would find that kind of cool? Hold your hands up. If we do a quick head count, it's mostly boys, but there are definitely a few girls who raised their hands as well.

I am going to use the term boy and girl, male and female loosely, and what I want to convince you of is that the behavioral attributes linked with gender identity are actually more important than those linked with biologically–determined sex. Additionally, I hope to demonstrate that it is also the critical mingling of sex and gender–in the context of an adolescent's environment–that is most informative.[8] I am going to use boy and girl in reference to this James Bond flick. Then, we'll come back to what those words really describe at the end of our discussion.

It is important to begin our discussion with a bit of vocabulary. When people think about "teenagers" or "juveniles," many different versions of these personas come to mind. However, when people attempt to discuss adolescents and pubescent individuals, they are quick to interchange these terms when they are actually very different phenomena. Puberty is a biological event.[9] It prepares you to be reproductively active and allows you to bear young.[10] It changes your body, and it changes your brain.[11] The way it changes your brain is something I am increasingly interested in. The way that your brain is changed biologically doesn't happen in a vacuum. There is a social component to every behavior we have and every learning experience we acquire.[12] Simply, adolescence is the social and emotional expression of the biological event known as puberty.

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7. CASINO ROYALE (Columbia Pictures 2006).

8. Wendy Wood & Alice H. Eagly, *Gender Identity, in* HANDBOOK OF INDIVIDUAL DIFFERENCES IN SOCIAL BEHAVIOR 109 (Mark R. Leary & Rick H. Hoyle eds., 2009).

9. Elizabeth A. Shirtcliff, *Biological Underpinnings of Adolescent Development, in* ADOLESCENT HEALTH: UNDERSTANDING AND PREVENTING RISK BEHAVIORS 95 (Ralph J. DiClemente et al. eds., 2009).

10. Frank M. Biro & Lorah D. Dorn, *Puberty and Adolescent Sexuality*, 36 PSYCHIATRIC ANNALS 685 (2006).

11. M.R. Asato et al., *White Matter Development in Adolescence: A DTI Study*, 20 CEREBRAL CORTEX 2122 (2010); Sarah-Jayne Blakemore et al., *The Role of Puberty in the Developing Adolescent Brain*, 31 HUM. BRAIN MAPPING 926 (2010).

12. Miriam H. Beauchamp & Vicki Anderson, *SOCIAL: An Integrative Framework for the Development of Social Skills*, 136 PSYCHOL. BULL. 39 (2010).

Now, there are cultures where you can be fourteen years old and be a completely mature adult, but there is an important caveat to this. To be an adult member of society at fourteen, you have to have undergone the major changes associated with puberty, but more importantly you have to be treated as an adult for a couple of years following the onset of puberty. In the United States, we have an "extended dance mix" of adolescence that we're letting develop into their early twenties,[13] which is neither good nor bad, but the brain will remain developmentally flexible as long as the environment tells it to.[14] So, as long as you're not in your adult role, your brain is not going to develop into your adult brain.

Adolescence, which is a social construct, actually intermingles with the biology of puberty and that's something very important to get your mind around. Normal development needs both. You need biological events to happen and the social construction of those events in order to make yourself a mature, confident, functional adult. So, I would like you to think about adolescence. If you look at it closely, it is strikingly similar to toddlerhood, to a second infancy.[15] I'll grant you the second time around it doesn't smell as good, and it's not as cute, but it does have a lot of the same underlying components. In toddlerhood and adolescence there is a period of time when you acquire a ton of knowledge incredibly quickly.

How did you acquire your first language? Did you get a book, use flash cards, or study? No, you just got it, and you got it in a year and a half. Have any of you tried to learn a foreign language as an adult? Could you do it in a year? No, because your brain is uniquely poised to absorb language when you are a toddler. That said, unless you are socially exposed to language and given corrective feedback, you're not going to sound good, and you're not going to learn the language to the fullest extent possible.[16] At work is the interplay of biological preparedness and the social construction. At the same time, context derives what you learn, so you come with a capacity for a language, you don't

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13. JEFFREY J. ARNETT, *Emerging Adulthood(s): The Cultural Psychology of a New Life Stage, in* BRIDGING CULTURAL AND DEVELOPMENTAL APPROACHES TO PSYCHOLOGY: NEW SYNTHESES IN THEORY, RESEARCH, AND POLICY 255 (Lene Arnett Jensen ed., 2011).

14. Tomáš Paus & Mark H. Johnson, *Developing Human Brain Functions*, 22 PSYCHOLOGIST 924 (2009). TOMÁŠ PAUS, *Brain Development*, *in* 2 HANDBOOK OF ADOLESCENT PSYCHOLOGY 95 (Richard M. Lerner & Laurence Steinberg eds., 3d ed. 2009).

15. Abigail A. Baird, *The Terrible Twelves*, *in* DEVELOPMENTAL SOCIAL COGNITIVE NEUROSCIENCE 191 (Philip D. Zelazo et al. eds., 2010).

16. Ghislaine Dehaene-Lambertz, et al., *Nature and Nurture in Language Acquisition: Anatomical and Functional Brain-Imaging Studies in Infants*, 29 TRENDS IN NEUROSCI. 367 (2006).

come with a language. For example, if you were born in Kansas and you could only speak Mandarin, that's problematic. But if you were born in Kansas with the potential to speak Mandarin, great, because you will learn English and maybe you'll learn Mandarin, too.

Adolescence is a very similar process. You already have your primary language but you have to acquire slang. Older people in the room, how good are you at text language? OMG, seriously? LOL! Texting, with all the abbreviations, is not our language. Adolescents develop slang. It's a second language, and it's intended to keep anyone who is not in their peer group out of the conversation. The slang an adolescent develops forever connects them to their age and geographically-matched peers. Who today would understand the slang you used as a teen? Probably the folks at your high school and college reunions might understand it, but certainly not your grandmother or the typical teenager today. The slang of today's teenagers is unique by design. You should understand a little bit, but it is basically none of your business. It's an inside thing. Again, acquiring slang is based on a capacity, and you need a lot of experience and social awareness in order to become fluent.

Does anyone want to go back to middle school? No. It's really painful. You had to learn a lot of stuff really fast, and you didn't walk in and get a card that said, "We're a one-strap back pack school." You had to figure it out: is it two, is it one, what kind of back pack was it? You didn't get a book of instructions. You had to figure this out yourself. So, very much like the toddler who figures out the boundaries and figures out language, the adolescent has the same kind of pressures and affordances. It is a window of rapid learning.

Development doesn't stop. When you hear the words "arrested development," it's wrong–ignore it. Development is like a ball rolling down a hill–or more appropriately through a mogul field–and depending on where that ball goes, you may arrive at a more or less functional place at the end. When you incarcerate juveniles who are in the prime of their social development, you are taking a kid born in Kansas and only teaching them Mandarin and then releasing them into Kansas. So, when you have someone who is in the prime of their social development and give them an aberrant situation, they will never adapt.[17] They will always behave differently than their peers, and they will always speak and behave with a foreign accent.

Now, there is this problem. What is adolescence really about? It really is about the fact that you either have a penis or you don't. This is my

17. Terence P. Thornberry et al., *The Causal Impact of Childhood-Limited Maltreatment and Adolescent Maltreatment on Early Adult Adjustment*, 46 J. ADOLESCENT HEALTH 359 (2010).

God daughter, Piper, and her good friend Kaleb. (Picture shown.) They had been finger painting, and it was a hot Massachusetts day so her dad took them outside to hose them off. He turns the hose on and they're running back and forth in the cold water, shrieking and laughing. Piper still has on a Pull-Up and Kaleb has graduated into regular underwear. Now, when diapers get wet, they get very heavy; when hers started to fall down, she was like, "Oh, forget this," and took her Pull-Up off. Kaleb responded with, "Oh, cool, it's naked time," and took off his underwear. The two of them continue running back and forth through the water, shrieking and having a great time. All of a sudden, Piper stops and says, "Ooh, you have a penis." Kaleb stops, looks at his penis, looks at her, and says, "You don't have a penis." Her father gives me an elbow to the ribs and says, "Okay, Harvard psychologist, what do we do now?" And in my infinite wisdom–because I am so brilliant–I said, "Well, let's see what happens next." And guess what happened next? They kept playing. What Piper was saying was the equivalent of, "You're a brunette," because at three years old a penis does not have any sexual meaning. These kids have some hormones, but they don't have the reproductive hormones. So, saying someone has a penis really is like saying you have five fingers, you're a blonde, or you have curly hair. It doesn't have that driven intimacy that you get following the hormonal bath of puberty.[18]

So, I'm going to break it down for you. Ladies, I have the guy for you. He is very good looking, makes great money, and has a great car. He's really nice, and he's thirty-five. He lives with his mother in the basement, but he has his own entrance. She has a laundry room upstairs in the kitchen so she doesn't come down a lot. Any single women interested in dating this guy? No, not so much. Why? Think about that for a minute. Why is going on a date with him aversive to you? It shouldn't be. So what if he lives with his mom; that's no big deal. But there is something in our culture and something about that stereotype that makes us go, "Oh, I don't know. There's something wrong with that guy." There is a little biology to it. At puberty every species has one sex that disburses to avoid incest and restricting the gene pool, and it's usually the larger member, so it's almost always the male. During puberty, most males get a hormonal boost of get up and go,

18. John Bancroft, *Biological Factors in Human Sexuality*, 39 J. SEX RES. 15 (2002).

get out of town, find yourself, and explore new things.[19] They get very interested in seeking novelty and very interested in sensation seeking.[20]

There have actually been studies that show the farther a male travels from home, once reaching reproductive age, the more reproductively successful he will be.[21] There are a number of reasons explaining why males who venture far from their birthplace have increased reproductive success. They are better adventurers, they are stronger, and they have accomplished more in terms of a challenge. They got out there, they fought their way very far away, and when they get there, they are cool. They are hot stuff because they have survived this journey.

So, for males in our society who don't go off in search of their own adventure and just stay home, there is a little bit of an evolutionary leftover. You can look at it that way. You can also look at some male teens who are seen as "overly" risky–or sensation seeking–and realize that the biology of puberty might be generating really big impulses.[22] They might have stronger impulses than children and adults.[23] Their bodies are designed to get up and go, do stuff, try stuff, and seek novelty. If you do something really risky as a young guy and you don't die, you are so cool. Everybody knows you, and your status goes through the roof. Boys are very much about status. It is extremely important to them.[24]

We know from neuroscience that during male puberty the amygdala–the part of the brain that acts as a burglar alarm and is responsible for the fight or flight response–gets really big and puffy.[25] It normaliz-

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19. STEPHEN J. SUOMI, *Gene-Environment Interactions and Inter-Individual Differences in Rhesus Monkey Behavioral and Biological Development*, *in* HUMAN DEVELOPMENT IN THE TWENTY-FIRST CENTURY: VISIONARY IDEAS FROM SYSTEMS SCIENTISTS 48 (Alan Fogel et al. eds., 2008).

20. L.P. Spear, *The Adolescent Brain and Age-Related Behavioral Manifestations*, 24 NEUROSCI. & BIOBEHAV. REV. 417 (2000).

21. BARBARA B. SMUTS, SEX AND FRIENDSHIP IN BABOONS (Monique Borgerhoff Mulder & Marc Hauser eds., 2d prtg. 2009).

22. Margo Gardner & Laurence Steinberg, *Peer Influence on Risk Taking, Risk Preference, and Risky Decision Making in Adolescence and Adulthood: An Experimental Study*, 41 DEVELOPMENTAL PSYCHOL. 625 (2005); Laurence Steinberg, *Risk Taking in Adolescence: New Perspectives From Brain and Behavioral Science*, 16 CURRENT DIRECTIONS PSYCHOL. SCI. 55 (2007).

23. Spear, *supra* note 21.

24. Menahem Krakowski, *Violence and Serotonin: Influence of Impulse Control, Affect Regulation, and Social Functioning*, 15 J. NEUROPSYCHIATRY & CLINICAL NEUROSCI. 294 (2003); Allan Mazur & Alan Booth, *Testosterone and Dominance in Men*, 21 BEHAV. & BRAIN SCI. 353 (1998).

25. Rhoshel K. Lenroot & Jay N. Giedd, *Sex Differences in the Adolescent Brain*, 72 BRAIN & COGNITION 46 (2010).

es in adulthood, but it becomes larger and more active in adolescent boys because they're ready to fight or flee. They are figuring out where they fit in the hierarchy. An area of the brain called the nucleus accumbens is also critically involved in male puberty. The nucleus accumbens is particularly active in people when they are anticipating and receiving rewards. The nucleus accumbens is also known as the "pleasure center" of the brain. The feelings of reward that it is able to engender are strong enough to make people continue to take drugs like cocaine–which triggers activity in the nucleus accumbens[26]–even when taking this drug leads to innumerable negative consequences. It simply feels too good to say no. How does this play out in male teens? Well, there is nothing more addictive than the rewarding feeling of being "cool." How does one achieve being cool? What is considered cool is determined by the environment in which the adolescent lives, but it usually involves some risk. Why are bad boys always portrayed as being attractive to women? Well, simply put, they are risk takers who don't die and feel pretty good about themselves for being a successful risk taker. Given all of this, it is easy to understand how the nucleus accumbens could also be involved in the feelings of reward that come along with social status among males.[27]

I did a study on good or bad ideas and on making decisions about whether things are safe or dangerous. When the boys were asked questions like, is it a good idea to light your hair on fire, swim with sharks, bite a lightbulb, or skateboard down the stairs, their reward centers lit up. This is why teenage boys think the movie *Jackass*[28] is funny. The guys never die in the episodes. They do these crazy things, and it actually feels good. It feels like, "Yeah, I can survive that."

Okay, one more clip for you. (Video played.) That was from the movie *Top Gun*.[29] The actress, Kelly McGillis, admonishes Tom Cruise for taking this big risk. Does anybody remember what happens ten minutes later? Yeah, whatever lady. She basically says, don't wreck the plane

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26. Heath D. Schmidt & R. Christopher Pierce, *Cocaine-Induced Neuroadaptations in Glutamate Transmission: Potential Therapeutic Targets for Craving and Addiction*, 1187 ANNALS N.Y. ACAD. SCI. 35 (2010).

27. Matthew J. Fuxjager et al., *Winning Territorial Disputes Selectively Enhances Androgen Sensitivity in Neural Pathways Related to Motivation and Social Aggression*, 107 PNAS 12393 (2010). In this study, researchers posit that winning aggressive encounters increases activity in the nucleus accumbens, an area of the brain that mediates motivation and reward. *See id.* This helps explain why winning aggressive encounters can enhance the desire to seek out additional aggressive encounters. In other words, the nucleus accumbens is involved in motivating and reinforcing this pattern of behavior.

28. JACKASS: THE MOVIE (Paramount Pictures 2002).

29. TOP GUN (Paramount Pictures 1986).

but come over for dinner later because I think you are sexually attractive. That is confusing. Think about that in terms of how men are being raised.

Not surprisingly, given what we have just been talking about, a lot of adolescent boys with this profile, and some girls, are very insensitive to punishment.[30] Is there a young man in the room who is willing to tell me, at a school dance, if you ask a girl to dance and she says no, what's your next move?

AUDIENCE ANSWER: Ask another girl.

DR. BAIRD: Ask another girl, right, and if she says no, ask another girl. Boys are not sensitive to punishment. How many young women have ever asked a boy out? Very rarely. Even at Vassar when I ask this question–at the bastion of female power–three out of thirty women in my class will have asked a man out. And when I ask the women why, they look a bit befuddled and indignantly say, "Guys are supposed to do that." Maybe there is an evolutionary leftover or a byproduct of the boys "get up and go" during puberty that is showing up as an adolescent behavior. Thank goodness they don't feel punished when a girl says no. They just move on and try again. And if they were sensitive to punishment, they would stay in their mother's basement because the world is very hard and very scary. Even more scary is the idea that if most guys stayed in their mother's basement afraid of rejection, the human population might take a significant nose-dive.

Try convincing a twenty-five-year old man to go to war. That is why soldiers are young. They cannot and do not think about the potential realities of war. They are not sensitive to the punishment. They are not sensitive to the risk.[31] They're sensitive to the get up and go, be part of the team, help people, and take risks.[32] That is a great idea. It is suited to a young man's and some women's biology perfectly, but the

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30. G. Barbalat et al., *Risk-Taking in Adolescence: A Neuroeconomics Approach*, 36 ENCEPHALE 147 (2010); Carla Sharp et al., *Children's Subjective Emotional Reactivity to Affective Pictures: Gender Differences and Their Antisocial Correlates in an Unselected Sample of 7-11-Year-Olds*, 47 J. CHILD PSYCH. & PSYCHIATRY 143 (2006).

31. Daniel Romer et al., *Executive Cognitive Functions and Impulsivity as Correlates of Risk Taking and Problem Behavior in Preadolescents*, 47 NEUROPSYCHOLOGIA 2916 (2009).

32. Suzanne Mitchell, Christiane Schoel & Alexander A. Stevens, *Mechanisms Underlying Heightened Risk Taking in Adolescents as Compared with Adults*, 15 PSYCHONOMIC BULL. & REV. 272 (2008); LindaVan Leijenhorst et al., *What Motivates the Adolescent? Brain Regions Mediating Reward Sensitivity Across Adolescence*, 20 CEREBRAL CORTEX 61 (2010).

social consequences are very different. This is when adolescent males not being big thinkers comes in, and this is going to sound like a criticism about boys, and I have two brothers so it is tempting, but this is actually an advantage, the fact that the male's cognitive maturation waits a little longer than females. The female brain tends to mature in the twenty to twenty-two-year old range. The male's is more like fifty; no, I'm kidding, it's about twenty-five.[33]

Auto insurance companies know more about this than neuroscientists. It is not a coincidence that you can't rent a car until you're twenty-five. They don't have to get grants, they have to save money, so they have a bottom line that is completely unbiased. They look at tables. Accidents significantly drop after age twenty-five. Coincidentally, the endocrine system is mature at age twenty-five, as is the brain.[34]

Now, this sounds like a drag for guys who are not big thinkers, but remember, they are more prone to trying physical risks. Given this, you want a neurological system that can heal from an injury and is still not done growing. So, not only do you want them to take those risks, but you want them to recover from them. It's actually an advantage to have guys waiting a little longer to be fully mature.

Status, being cool, and being top dog is what gets guys going.[35] It is what gets them out of bed in the morning, usually not in the morning, by the way, but in the afternoon. That is a whole other talk on Circadian rhythm, but male Circadian rhythm does shift, and it has good reason to. It is an evolutionary leftover. Our biggest and strongest, most fearless people were needed to protect the camp, and they needed to be awake at night. When you delay the start of school for two hours, guys show up and they do well, so do a lot of girls. If you've got an adolescent son who has gone quiet and you want to know what is up in his life, stay up until two o'clock in the morning and make a pot of coffee because he will start talking.[36]

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33. For reviews, see Peg C. Nopoulos & Nancy C. Andreasen, *Gender Differences in Neuroimaging Findings*, *in* GENDER DIFFERENCES IN MOOD AND ANXIETY DISORDERS: FROM BENCH TO BEDSIDE 1 (Ellen Leibenluft ed., 1999); Tomáš Paus, *Mapping Brain Maturation and Development of Social Cognition During Adolescence*, *in* MENTAL CAPITAL AND WELLBEING 87 (Cary L. Cooper et al., 2010).

34. For a review on adolescent physiology, see Kathryn L. Eckert, et al., *Adolescent Physiology*, *in* BEHAVIORAL APPROACHES TO CHRONIC DISEASE IN ADOLESCENCE: A GUIDE TO INTEGRATIVE CARE 29 (William T. O'Donohue & Lauren Woodward Tolle eds., 2009).

35. Krakowski, *supra* note 25; Mazur & Booth, *supra* note 25.

36. Avi Sadeh et al., *Sleep and the Transition to Adolescence: A Longitudinal Study*, 32 SLEEP 1602 (2009); Avi Sadeh et al., *Sleep Patterns and Sleep Disruptions in School-Age Children*, 36 DEVELOPMENTAL PSYCHOL. 291 (2000).

(Picture of a baby holding a balloon shown.) If I told you this is a picture of a little girl, would you believe me?

AUDIENCE ANSWER: Yes.

ABIGAIL BAIRD: Well, it's not. It is my brother, Christopher. (Picture of adult male shown.) Now, he looks a lot different in these two pictures, right? His nose, chin, jaw line, and eyebrow ridge are different. Those are all bones in the face of the male that are sensitive to testosterone.[37] Chris got a big dose of testosterone when he entered puberty. If he looked like this when he was born, it would have been really weird. But if little boys looked like hard core big muscled guys, what would happen? They would be killed by older males who are less dominant among their own group, and this is very true in the animal world. So what evolution has done that is really helpful and protective is to make sure that you don't get your male face until you get the muscle to back it up.[38] You have this androgyny in very young males that exists until their adult system is ready. So, when you start to get that impulsivity, you also start to get facial hair, and your bone structure starts to change to signal that you are reproductively viable. If you're a girl, look at your baby picture and then look at a current picture. Very likely, you don't look that different except for maybe your nose and maybe your chin because we have androgen receptors in both places. Boys, however, can be unrecognizable. They can look very similar, but it depends on the amount of testosterone they receive. And as we talked about a few minutes ago, this is a good thing.

The two main things that are obvious about male puberty are, first, the appearance of secondary sex characteristics that I just pointed out, and second, they begin producing sperm, which is a very costly investment in terms of energy. While these events may be the biological focus, they are often far less obvious than the behavioral changes they inspire. People tend to ignore the fact that while all this is happening in the body, things are happening in the brain, too. The increases in testosterone during male puberty tend to increase brain levels of the neurotransmitter dopamine.[39] Dopamine serves many functions in the

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37. Ian S. Penton-Voak & Jennie Y. Chen, *High Salivary Testosterone is Linked to Masculine Male Facial Appearance in Humans*, 25 EVOLUTION & HUM. BEHAV. 229 (2004).

38. Melanie L. Shoup & Gordon G. Gallup, Jr., *Men's Faces Convey Information About Their Bodies and Their Behavior: What You See is What You Get*, 6 EVOLUTIONARY PSYCHOL. 469 (2008).

39. Cynthia Kuhn et al., *The Emergence of Gonadal Hormone Influences on Dopaminergic Function During Puberty*, 58 HORMONES & BEHAV. 122 (2010).

human brain, one of the most important being to facilitate learning through feelings of reward.[40] The second important function that dopamine serves is that it provides the individual with a "get up and go" impulse to seek novelty and to try new things.[41] It is a very interesting story that it's not until the brain gets these hormones that you start seeing not only secondary sex characteristics like facial hair and increased muscle mass but also significant changes in behavior.

One of my biggest bones to pick in this discussion of males and females is this myth that men are inherently aggressive because of their testosterone. Aggression serves many purposes, and it is still true that physical aggression is more common in men. Yet, very often the physical aggression of males comes out in displays over girls, territory status, etcetera. There is usually not a big drive to hurt one another but to sort out what the hierarchy is. Let me put it to you this way. If I gave you a choice that you could break up a fight between two high school boys or two high school girls, which fight would you rather break up?

AUDIENCE ANSWER: Boys.

ABIGAIL BAIRD: Why?

AUDIENCE ANSWER: Because girls fight dirty.

DR. BAIRD: Yes, girls fight dirty. Boys don't actually want to fight. Boys just want to sort out their status.[42] They don't actually want to kill each other. They don't even want to hurt each other. They just want to figure out who's on top. They are dying for you to break it up. And they're all, "I'll get you later. You better watch your step man." With girls, someone is going to die. It takes a lot more for a girl to physically fight, but if she does, beware. She will kill you and most of your friends, and then her friends will kill your family. Nobody wants to get in on that. But at the same time, people walk around thinking that boys are so aggressive. Boys are jockeying for status. So if boys

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40. Mihaela D. Iordanova, *Dopaminergic Modulation of Appetitive and Aversive Predictive Learning*, 20 REV. NEUROSCI. 383 (2009); Michael A. Nitsche et al., *Dopaminergic Impact on Cortical Excitability in Humans*, 21 REV. NEUROSCI. 289 (2010).

41. W. Adriani et al., *Increased Impulsive Behavior and Risk Proneness Following Lentivirus-Mediated Dopamine Transporter Over-Expression in Rats' Nucleus Accumbens*, 159 NEUROSCIENCE 47 (2009); Dustin Wahlstrom et al., *Developmental Changes in Dopamine Neurotransmission in Adolescence: Behavioral Implications and Issues in Assessment*, 72 BRAIN & COGNITION 146 (2010).

42. Mazur & Booth, *supra* note 25; Matthew L. Newman et al., *Testosterone, Cognition, and Social Status*, 47 HORMONES & BEHAV. 205 (2005).

physically fight to figure out the hierarchy, why do girls physically fight, and why are we so hesitant to try to break it up?

Girl fighting is a whole different phenomenon, which becomes obvious when we take a close look at what it means to be a girl. (Video played.) That clip was from the movie *Mean Girls*,[43] and if you have not seen it and have any interest in adolescent girls, it is a must-see. All you need to know about girls is this: friends close, enemies closer. When girls begin puberty, their bodies get ready to have a baby. Puberty is beginning earlier and earlier in girls.[44] Most sixth grade girls who are starting puberty are not trying or wanting to have a baby, but their bodies are getting ready to. The fact that puberty is starting earlier is a little more complicated because it is not that all of the experience that makes you an adult is happening sooner, it is that the biology is getting earlier. Girls are hitting puberty without the same amount of social experience that girls in the past have had. At puberty, girls get a big dose of estrogen that interacts with a hormone called oxytocin. Oxytocin plays a key role in facilitating all aspects of relationships, including, but not limited to, increasing pro-social behaviors and improving emotional memory.[45] In adolescent females, the frontal lobe and hippocampi show increased growth relative to adolescent boys.[46] These are both structures involving thinking, memory, and planning, so seeing a growth spurt in these areas during female puberty is logical. If you are going to have a child, you're actually going to be very physically vulnerable for a while, so the friends that girls make and the coalitions they build are going to become absolutely critical. So, you have to be really good at building and maintaining important relationships.

Unlike boys, girls are extremely punishment sensitive because their relationships are what it's all about.[47] Having their relationships threatened in any way can make girls suicidal; statistically, it's the second highest cause of suicide. The first cause is having friends who

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43. MEAN GIRLS (Paramount Pictures 2004).

44. Margaret A. McDowell et al., *Has Age at Menarche Changed? Results From the National Health and Nutrition Examination Survey (NHANES) 1999-2004*, 40 J. ADOLESCENT HEALTH 227 (2007).

45. Anne Campbell, *Attachment, Aggression and Affiliation: The Role of Oxytocin in Female Social Behavior*, 77 BIOLOGICAL PSYCHOL. 1 (2008); Shelley E. Taylor, *Tend and Befriend: Biobehavioral Bases of Affiliation Under Stress*, 15 CURRENT DIRECTIONS PSYCHOL. SCI. 273 (2006).

46. Phyllis Anne Teeter Ellison & Amy Nelson, *Brain Development: Evidence of Gender Differences*, *in* NEUROPSYCHOL. OF WOMEN 11 (Elaine Fletcher-Janzen ed., 2009).

47. Sara K. Moeller & Michael D. Robinson, *Sex Differences in Implicit Punishment Sensitivity: Evidence From Two Cognitive Paradigms*, 48 PERSONALITY & INDIVIDUAL DIFFERENCES 283 (2010).

have attempted suicide.[48] This is not a small thing. Because of this, girls are terrified of shame and ostracism so they are much more sensitive to punishment than boys. And again, you have to be careful not to over-punish.

Actually, adolescence makes girls smart enough to know they need to look good, and they need to have the right clothes. If you look at the most popular kid in your middle school yearbook, she wasn't actually physically pretty. A lot of it comes down to hair-style, make up, clothes, and accessories; knowing how to behave is what actually makes you pretty and popular. These things matter to girls because girls are very painfully aware of them. Estrogen plays a critical role in making a girl smart enough to realize the social scene is critical to her survival. For many girls in America today, this is increasingly associated with aggression.

As mentioned in the *Mean Girls* trailer, fights between girls are supposed to be "sneaky," meaning relationally–not physically–agressive. This is the kind of aggression that girls have always been known for: rumor spreading, ostracizing, and aggression aimed at hurting others through their relationships.[49] However, attitudes about females and physical aggression have changed in recent years. These days, we raise our girls to physically defend themselves. We teach them that it is okay to be physically aggressive in *certain* situations. No one would argue that it is inappropriate to defend yourself and your loved ones physically.

In fact, Mother Nature has equipped females with the most intense and effective aggression out there: maternal aggression. Do you want to take on a mother bear with cubs? Everyone knows the answer to this question. When girls begin puberty, they not only get the hormones to have a baby, they also get the hormones to protect that baby. Now, add hormones to the fact that, in our culture today, most pubescent girls do not have a baby to protect. So, where are girls going to actually use those super powers? They are likely to harm anyone who threatens their stuff. They are hitting puberty earlier, and as a result, they are getting these hormones earlier which actually might make them capable of killing. When you see adolescent girls physically fighting, that is what they are doing. They are actually trying to end the life of the other person. And in the instances when their opponents don't die, the fight may be postponed, but it does not end. Because girls have such good social memories, fights are never really over, and that person will always

48. Peter S. Bearman & James Moody, *Suicide and Friendships Among American Adolescents*, 94 AM. J. PUB. HEALTH 89 (2004).

49. Abigail A. Baird et al., *Cognitive Control Reduces Sensitivity to Relational Aggression Among Adolescent Girls*, 5 SOC. NEUROSCI. 519 (2010).

be seen as a potential threat. Once you have come after my cubs, my Fendi purse, or my man, I am not going to forget to look out for you in the future.

This is another important difference between male and female fights. Guys can get in fights and actually resolve stuff. I've seen my brother get into a really nasty verbal argument and go out for a beer about an hour later. Girls, if we're in a fight with somebody, are we going to go out for a beer in an hour? No. You might go out for a beer, but you would lie and say, "I'm fine. No, really, I'm over it." (Sarcastically.) But you really are not. Estrogen and oxytocin make sure that girls never forget a potential social or physical threat. That is how mothers keep their young alive, and that is how girls survive adolescence.

Returning to the idea of the mix of early puberty and changing social norms, the changes in social norms may have inadvertently communicated to girls that unbridled physical aggression is acceptable. In reality, some girls may be unleashing immature maternal aggression. By immature maternal aggression, I mean that adolescent girls may have the biology to generate the intense and relentless aggression that mothers use to protect their young but lack the social experience to know how and when to use it. This may be particularly true if they do not have children of their own, which most young teens do not. Having access to this kind of aggression without the requisite social experience may be like handing an Uzi to a four year old. In other words, the rising rates of assault among adolescent girls may very well continue to climb.

So, what does this mean? We are taught that every girl is going to face rejection and is going to face problems. Between 2000 and 2009 violent crimes among girls under eighteen dropped by about 17%, while arrests for assault increased by approximately 6%. Interestingly, arrest rates for assault by males under eighteen-years-old dropped 10%.[50] Maybe police are more sensitive to assault in girls and more likely to arrest them for it. I don't know, but I do know that it's on the rise. And I do know we need to be giving girls different skills than they currently have.

One of the most important pieces of information that I would like to remind you of is that initial poll that we took, in which it wasn't all boys who put up their hands, and it wasn't all girls who put up their hands. So, while there are things that we think of as being traditionally male and traditionally female, we need to switch our mind set and understand that some people are going to be more inclined to be risky, and those people are not always going to be male. I am going to pick on Courtney

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50. *Ten-Year Arrest Trends by Sex, 2000-2009*, BI http://www2.fbi.gov/ucr/cius2009/data/table_33.html (last updated Sept. 2010).

because she put her hand up when I asked who wanted to try the James Bond stunts. I had the pleasure of dining with her last night, and guess what she did when she was a kid? Gymnastics. Isn't that right Courtney?

COURTNEY FERRELL: Yes.

ABIGAIL BAIRD: A gymnast can't have a lot of fear because if you hesitate you will get physically hurt. You can't hesitate. So, it may be time for individuals looking at how we think of these things as gendered to rethink these matters. They might shake out in a way that is very foreign for the justice system. When you are in puberty, pre- or post-hormonal blast may actually determine how aggressive you are able to be and how much trouble you are likely to get in. We really need to better understand the interaction of individual temperament–how risky or how relational a person is–with peer influence, social context, and biology.

For example, punishing adolescents who are likely to take risks will not work. They don't get it. And they particularly don't get it if it's six weeks between when they commit the crime and appear in front of a judge. And by the way, it also is making them cool because they are not dead, they are not getting punished, and they are not getting shamed in front of anybody. I don't want you to think that I am saying XY means male every time and XX means female every time. There are a lot of boys who are extremely relational. And boys who are very relational, we actually need to treat them differently than we treat boys who are very risky. The same goes for girls. This is an important piece to add to the puzzle about how brain development, social context, and behavior filter into the juvenile justice system.

Obviously, this is far from a one-woman show. I have an amazing team of students who work with me, and Shari Silver, a first year law student at the University of Maryland, was the point person behind this presentation. Now, one or two questions very quickly.

AUDIENCE QUESTION: I have a question about your view on the relative degree of influence of biology on the one hand and culture and economics on the other. We read that a huge percentage of thirty-something Italian males live at home with their moms. Would you predict from that they are disproportionately less successful than American boys?

ABIGAIL BAIRD: If you put them in capitalist America, yes. There are cultures in which boys live at home after college because it's silly to

waste money on an apartment until you get married, and it's particularly true if you are from Italy. If it is part of the culture, it's a whole different ball game. America is a relatively new culture, so we see our biology played out in more obvious ways than in older cultures. If a specific behavior is the norm for your culture and you're simply following that social norm, it is not a problem. But I would also say that the American work ethic, the independence and all the things that we define as being American, those Italian boys would not be as good at. That does not mean that they are not absolutely perfectly suited to their environment. The goal of development is to produce an adult who will thrive in the environment they live in. They would not thrive in capitalist America, but they could thrive in Italy. And if you grow up in a gang, you're going to thrive in that environment; you are not going to thrive in a strict boarding school.

Thank you.

THOMAS MATTHEWS: Thank you, Dr. Baird. That was a wonderful speech. I am very impressed by the work you are doing. When scientists do research, and then we try to take advantage of that research in court, it does not always translate easily. I am very keen on the idea that courts are certainly more than science, although we certainly need to be better informed by science than we are. What we do in court involves greater considerations than the scientific aspect. We have the community and public safety to worry about. When Dr. Baird talks about adolescence and the difference between boys and girls, she is talking about something within the context of general society. That is narrowed down in juvenile court into the really bad offenders, and we hope that ideas of zero tolerance won't push everybody who has a problem at school into court. We have to separate the ones who can be handled in school from the ones who need to be handled in court.

I was reminded of another speech on brain science when the speaker talked about the imaging processes available these days and said something like, If you're thirteen-year-old daughter says, 'I hate you,' your reaction is generally, 'You don't mean that, dear.' However, today we can establish by science that she does mean it, and she's capable of twice as much hatred as you are.

We deal with that kind of extreme level in juvenile court, and it is important that we talk about not just reaction after the bad stuff happens. It is better to deal with things before the bad stuff happens and to intervene before a child becomes an offender. If you wait until the child is thirteen, it is often too late and you cannot get them back onto the right track easily. If you could only get that child at age zero. But society does not seem to want to work that way because we are a

reactive society, and we pass laws that are reactions to the bad stuff that has already happened. So, we end up with a punitive rather than a rehabilitative model even in juvenile court where rehabilitation is supposed to happen.

In juvenile court, this is complicated under the law and under the Constitution. You can only go so far intervening with children because parents have rights. Those rights are protected to some degree, although nobody is exactly sure to what degree, because parents have the protection of the Constitution. There was a case, *Troxel v. Granville*,[51] that could have sorted this out, but the case ended up leaving us more confused than ever about the nature of the Constitution's protection of parents' rights as against the state. So, early intervention is problematic, costly, and politically not what people seem to want to spend their money on. However, it is something we should think about.

In juvenile court, we also deal with a multi-headed monster. We deal with not just a child who is an offender, but the peer groups that contain offenders, and families in which an offender has been created. You cannot simply address the child, although we have to punish or rehabilitate the child. You have to deal with the family, and there is not a lot of room to deal with the family. There were family-based therapies that have some good impact, and we had those until a few years ago. There is no money to do that today, and that is a challenge for the practitioners who come into juvenile court and the judges who deal with juvenile offenders.

When I started prosecuting in juvenile court in the late 1970s approximately 20% of the cases involved girls. Now it is more like 40% of the cases are girls, and they are different kinds of cases. The most serious juvenile cases involve drive-by shootings. Generally, these shootings involve a boy–boys and guns. If you want a knife fight, it usually involves girls. This is a common observation in juvenile court.

Judge Christian deals with juveniles who have been transferred either by original jurisdiction or transferred from my court. That is a doubly difficult problem because then you are dealing with a system that is exclusively made for adults. It is much more punitive and less rehabilitation-based, although it does involve rehabilitation efforts under those circumstances. But we have a system created in juvenile court that has a rehabilitative effect on a child and reunification of families. It does not always work because the money is spent at the wrong time, and there is not enough money to go around. So, it is extremely important that we understand what is going on with children in juvenile

51. 530 U.S. 57 (2000).

court and understand the way they are thinking. This terrific presentation gives more insight into this.

Thank you.

LINDA HENSEL: We will now hear from Professor Theodore Blumoff. Ted is a professor of law at Mercer University School of Law, and a regular contributor to the Gruter Institute and the Society for the Evolutionary Analysis of Law.

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For more on Professor Blumoff's presentation, see Theodore Y. Blumoff, *The Brain Sciences and Criminal Law Norms*, 62 MERCER L. REV. 705 (2011).

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STEPHEN MORSE: We are now going to talk about evidentiary possibilities, and we have Neal Feigenson and Francis Shen presenting. Neal Feigenson is a professor of law at Quinnipiac University School of Law and a research affiliate in the Yale University Department of Psychology. We will then hear from Francis Shen who is a research fellow in the MacArthur Foundation Law and Neuroscience Project,[52] and a visiting scholar at Vanderbilt University Law School. We will first hear from Professor Feigenson.

NEAL FEIGENSON: Imagine being able to scan a person's brain and generate a reasonably accurate moving image of what the person remembers having seen. The first steps towards this seemingly fanciful scenario have already been taken. Neuroscientists have reconstructed visual images from fMRIs of the visual cortex of a person looking at images. Other neuroscientists have identified episodic memories from scans of the hippocampus. It has even been proclaimed in a leading neuroscience journal that "reconstruction of the subjective contents of human perception may soon be a reality."[53]

Daunting and perhaps insuperable hurdles, both technological and conceptual, stand between these existing findings and what we might call visual memory reconstruction, or VMR. But imagine, if only as a

52. For more information on the Law and Neuroscience Project, see *The Law & Neuroscience Project*, LAWNEURO.ORG, http://www.lawneuro.org.

53. Kendrick N. Kay & Jack L. Gallant, *I Can See What You See*, 12 NATURE NEUROSCI. 245, 246 (2009).

kind of thought experiment, that this technology were operational. Then it would be feasible to scan eyewitnesses before trial and make visible to others what those eyewitnesses actually remember having seen. Consider what a useful forensic tool this would be. Triers of fact would have a more faithful and complete visual record of witnesses' memories instead of verbal descriptions prone to inadvertent or deliberate distortion and ambiguous, opinionated verbal expression. There would be visual proof. Wouldn't we want to take advantage of this proof?

The urge to employ VMR evidence would be so strong that some courts might admit it despite many reasons why it could never provide the kind of proof that the courts need, but that is not my main concern. Instead, I want to focus on the urge itself. Visual memory reconstruction represents a kind of fantasy, a fulfillment of a longing for incontestable visual proof of contested facts, and in particular, the claims of eyewitnesses. But if VMR is unlikely ever to be realized, why bother thinking about it? Just as the study of psychopathologies can help us to understand normal mental functioning, examining what makes VMR so compelling can inform our thinking about the usually more reliable and probative outputs of visual technologies that judges and jurors already confront.

So, in my remaining time, I will briefly describe current research in visual imagery reconstruction and episodic memory identification and then present some reasons why the possible technology of visual memory reconstruction is unlikely to yield reliable proof of what a witness remembers having seen. I will then explain why VMR would nevertheless be extremely alluring to many participants in the legal system. First, it would appear to be a highly credible form of visual representation because it tightly knits together expert scientific and everyday common sense knowledge. Second, VMR as a movie both in and from the brain appeals to multiple overlapping desires, so that audiences will want to believe that it truthfully shows them what it purports to show. I will then apply these ideas to understand an example of visual evidence already used in court–a computer animated recreation of a witness's subjective perceptions and thoughts.

In the late nineteenth century, many people supposed that the likeness of a murderer could be found as if photographed in the eye of the victim. Now, with what seems to be greater scientific warrant, it appears once again that traces of external reality may soon be extracted from human perceptions.

Let's start with visual image reconstruction. The video segment I played earlier described one of a number of research programs. Participants were shown a series of images, abstract shapes or letters, each consisting of a grid of 10 x 10 binary elements, while researchers

recorded fMRI signals from their early visual areas. Using a complex statistical decoder, the researchers reconstructed from the fMRI data what each participant was looking at. They found that the reconstructed images showed specific features of the original abstract shapes.[54]

Brain scans have also been used to identify the contents of people's memories. One group of researchers had participants repeatedly watch three short film clips depicting everyday events and then, while being scanned recall each episode in as much detail as possible. By applying a complicated decoding algorithm, researchers were able to predict solely from the fMRI data taken from the hippocampus which specific memory the participant was recalling. The researchers wrote, "[W]e have documented for the first time that traces of individuals' rich episodic memories are detectable and distinguishable in the human hippocampus."[55]

Advances in scanning technologies, statistical methods, and visualization tools are likely to yield great improvements in the ability to discriminate perceptions and memories and in the richness with which these visual memories can be displayed. Neuroscientists are already speculating that by combining visual imagery reconstruction with episodic memory identification, it may some day be possible "to read the contents of a person's memory"[56]–to which I would add, and to show those memories on a screen.

Yet there are many reasons why visual memory reconstruction is unlikely ever to be feasible as a forensic device. We can begin with the well-recognized limitations on the generalizability of experimental fMRI findings in a real world setting, including, among other things, less than fully compliant witnesses. Consider in this regard the memory identification research I just mentioned. Participants' hippocampal responses were measured minutes after they were repeatedly exposed to the stimulus film clips. But memory traces of the sort that witnesses are likely to recall in court would usually be of events occurring just once, months or years previously, in which the eyewitness may have had a strong personal and emotional involvement and which would likely have been the subject of verbal labeling or other mental processing in the interim–all factors that have been established to alter memories.

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54. Yoichi Miyawaki et al., *Visual Image Reconstruction From Human Brain Activity Using a Combination of Multiscale Local Image Decoders*, 60 NEURON 915 (2009).

55. Martin J. Chadwick et al., *Decoding Individual Episodic Memory Traces in the Human Hippocampus*, 20 CURRENT BIOLOGY 544, 545 (2010).

56. Johannes Schultz, *Brain Imaging: Decoding Your Memories*, 20 CURRENT BIOLOGY R269, R271 (2010).

It is not at all clear what this VMR movie would look like. Challenging and remarkable as it is to have reconstructed with reasonable accuracy from the brain scans of perceiving participants single images consisting of a hundred binary elements, reconstructing from the brain scans of remembering participants sequences of moving images in something approaching the complexity and range of tonality, spatial, and depth cues and other features of ordinary natural perception would seem to be another matter altogether. And this is not just a matter of computing power. Think of the differences between perceiving and remembering. However plausible it is to suppose that normal visual experience more or less closely corresponds to perceivable features of a visual stimulus, the mental imagery that is associated with episodic memories of the sort most likely to be an issue in trials surely does not correspond in the same way as remembered reality for many reasons. Consider, for instance, that what we encode are merely fragments of incoming data. Retrieved episodic memories are active mental reconstructions from those fragments, and, of course, memory traces tend to become weaker over time.

Presumably, visual memory reconstruction researchers could translate their fMRI data into any sort of visual representation they choose to yield something that viewers would recognize as more like an observational video. But to the extent that happens, the VMR movie would bear only an attenuated connection to the witness's neuronal representation of the remembered events, which would undermine its status as independent evidence.

For these and many other reasons, I think that VMR is unlikely ever to be a forensic tool whose output would be admissible in court. But that doesn't make the idea of it any less fascinating. Let's put our doubts to the side for the moment and ask, "What does the fascination with a technology that could depict memories as movies tell us about our attitude toward technology and scientific visualization more generally?"

I think that jurors and judges might well find VMR to be a highly convincing form of visual knowledge. What makes a picture of scientific evidence especially credible and compelling in general as a representation of reality? For the sake of our argument, let's assume that while truth rests partly on correspondence between representation and reality and partly on coherence between this representation and others, in a heterogeneous epistemological environment (some would say that characterizes all scientific knowledge; it certainly characterizes the use of science to find facts at trial), different modes of knowledge or styles of reasoning lay claim to legitimacy. In this sort of environment, truth is most convincingly constructed by marshaling as many knowledge regimes as possible in ways that link representations and reality as

closely as possible. Statements or visualizations that simultaneously invoke more densely imbricated systems of reference will appear more credible.

Think about visual memory reconstruction in this regard. It combines scientific expertise and common sense knowledge in a particularly tight way. VMR unites, in a single moving image, epistemic registers that are ordinarily thought of as complete opposites. It deploys fMRI, the most cutting-edge of neuroscientific technologies, the one most steeped in both the modern machinery and the social and institutional organization of expertise, to represent that most elementary form of empirical knowledge–eyewitnessing. The accessibility of the VMR movie from the brain gives lay decision makers the impression that they can rely on their own perceptions and judgments to analyze the evidence, mitigating any concerns that they may have been taken in by expert testimony they do not fully understand. Conversely, the fMRI images, which a VMR expert may introduce to explain the underlying science to the court, reassure viewers that the VMR movie they see is indeed the movie from the eyewitness's brain. That movie from the brain has the ontological status of the eyewitness's experience, but it is validated because it has been processed by a fundamentally quantitative and, therefore, essentially scientific method.

Our beliefs about reality and the forms that knowledge of it should take are also driven by what we want that reality and those forms of knowledge to be. I want to argue that the VMR movie of the brain as evidence of a witness's visual memory attracts and fascinates us because it also evokes multiple overlapping fantasies. Human beings long for, among other things, complete knowledge, coherent self-awareness, consonance with the world, and a sense of community with others. The movie in the brain invites us to imagine, however fleetingly, that these desires can be satisfied. It is this promise of wish fulfillment, which movies share with dreams, that I believe ultimately accounts for the attraction of a technology that would purport to let us see what others remember. I will just go through a couple of these.

The first fantasy reflected by the movie in the brain metaphor is that our perceptions yield and our memories preserve a seamless and direct knowledge of external reality; at the very least, that our memories now offer unmediated access to our thoughts and perceptions then. A movie that more or less resembles an observational video would seem to be the best kind of proof of a witness's memory that we could ever have. But no movie, much less this VMR movie, can ever provide the sort of direct access to what we want to know. We may think they do because observational videos and even traditional Hollywood movies tend to

efface themselves as media. Viewers tend not to notice how the way the movie is constructed creates the reality that they think they see.

The second fantasy that the movie in the brain evokes is subconscious. It is the illusion of the unified and autonomous self. According to basic Lacanian film theory, spectatorship of classic Hollywood movies characterized by continuity editing and narrative closure epitomizes what Lacan calls the "imaginary" by transparently depicting what seems to be a complete and coherent world and by inviting viewers to assimilate their awareness to that of the invisible camera through which that world is known.[57] Movies encourage viewers to understand themselves as self-coherent knowers and masters of reality.

The movie in the brain metaphor expresses the same idea of a unified self-consciousness as a visual encounter with the perceived world. And the actual movie from the brain that would be shown in court offers judges and jurors the satisfying experience of wholeness in the act of knowing remembered reality. Yet, this enticing vision of psychic coherence is specious, whether because it is, for Lacan, a "misrecognition," or because, according to Freud, the memories shown in court would be screen memories, or for other reasons that vary with whatever psychoanalytic theory you prefer.

I will mention one more of these desires. The movie in the brain speaks to a desire to achieve consonance between internal and external reality. According to neuroscientist and psychiatrist Bruce Wexler, we are biologically disposed so that our growing brains adapt to the world, and we are psychologically disposed as adults to make our worlds adapt to what our brains have come to expect.[58] The VMR movie in the brain appeals to this sense of consonance by promising to connect internal reality to the external world. The visual display of the very contents of subjective consciousness encoded in the witness's neurons seems to offer physical proof of that connection.

But, of course, visual memory reconstruction cannot really provide proof of consonance. Memories, as noted, are active reconstructions from encoded fragments of thought. They are irreducibly subjective. And the tangible representation of that subjectivity on the courtroom screen, as I have already noted, depends on the decoding algorithms that the fMRI researchers choose, so that the appearance of correspondence between outer and inner reality is really more a function of methodological artifice.

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57. *See generally* TODD MCGOWAN, THE REAL GAZE: FILM THEORY AFTER LACAN (2007).

58. BRUCE E. WEXLER, BRAIN AND CULTURE: NEUROBIOLOGY, IDEOLOGY, AND SOCIAL CHANGE (2006).

So, what might the appeal of visual memory reconstruction tell us about actual visual evidence? I want to discuss a type of computer animation that has already been used in court to visualize for jurors not what actually happened (according to an accident reconstruction expert, for instance), but what the defendant believed he saw as the crucial events unfolded to support his claim that his beliefs and the actions he took on the basis of that belief were reasonable and therefore justified.

Here is the case in a nutshell. A police officer was charged with first degree assault for firing his gun repeatedly at a driver who was attempting to drive away after the police officer had pulled him over. Here is the dashcam video that the prosecution played for the jury. (Video played.) So, it does not look good for the defense. What do you do to persuade the jury that although that's what the dashcam recorded, you, the officer, under the stress of the moment, at that key moment, thought that the other guy's car was coming right at you, and that it was that mistaken but reasonable misperception that led you to think you had to use your firearm in self-defense? To enable the jurors to see what the officer thought he saw, the defense showed this. (Video played.) Now the jury can see what was in the officer's mind as he remembers it on the stand. It is a kind of visual memory reconstruction, although one that, of course, occupies a completely different epistemological status than VMR via fMRI. The visualization of the witness's memory depends entirely on his verbal recollection. It is not a movie in the brain in the same sense as I was talking about before.

But I think this display is indicative of a very strong desire for visual evidence even of subjective thoughts. And our discussion of VMR can help us understand why the jurors may have found this video plus animation persuasive. Let me offer just one of several reasons. Much as VMR purports to link the eyewitness's subjective recollection with objective reality, what's encoded in his brain, this video plus animation offered jurors a visual integration of the witness's subjective truth with the presumptively objective proof from the dashcam video. For instance, by starting with the dashcam's point of view and swinging the camera around to the defendant, the animation implicitly claims that both the defendant's subjectivity and the camera objectivity were looking at the same reality.

My aim in focusing on visual memory reconstruction has been to identify more clearly the attractions of certain kinds of visual scientific evidence precisely when those attractions are not embedded in any probative value (as they are presumably in the case of all actually admitted visual displays). We can then take what we have learned, I hope, to understand how the knowledge on which judges and jurors today are invited to rely in court is shaped not only by the factors that

are usually addressed under the rubric of reliability but also by what they think that knowledge ought to look like and what they want it to look like.

Thank you.

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Francis Shen's presentation discussed the admissibility of fMRI lie detection evidence and the most recent case of *United States v. Semrau*.[59] For a more in-depth analysis, see Francis X. Shen & Owen D. Jones, *Brain Scans as Evidence: Truths, Proofs, Lies, and Lessons*, 62 MERCER L. REV. 861 (2011).

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LUNCHEON BREAK

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JULIE SEAMAN: Good afternoon. I am Julie Seaman from Emory Law School, and I am going to discuss the role of race in the criminal and civil justice system and, more specifically, the potential influence of race on the way jurors respond to and weigh evidence at trial. I do this with a view toward a research study in which I am involved, which will use brain-scanning technology to investigate this question. Should it turn out that there is a race effect on the way that jurors evaluate otherwise race-neutral evidence, I would like to explore whether–and how–that would make any difference to the law, to policy, and to our understanding of discrimination in the jury system.

I want to start with a disclaimer. As I mentioned, this experiment involves the use of brain-scanning technology to look at the neural correlates of a certain kind of decision-making–evaluation of the weight of various items of trial evidence. However, I'm not talking about adjudicative use of MRI machines. I'm not envisioning scanning potential jurors and putting them through an MRI machine. Rather, I want to talk about how people in general, including jurors, respond to and evaluate evidence. The question this study is designed to address is whether a jurors' evaluation of the probative weight of an item of evidence in a criminal trial may be affected by the race of the defendant.

There are several areas of doctrine that are relevant to issues surrounding jurors and race bias, and I will first very briefly describe

59. No. 1:07cr10074 (W.D. Tenn. June 17, 2010).

those. Then, I will touch on some of the relevant social science and previous neuroscience research. Finally, I'll consider the question of whether there is any value added by a neuroscientific approach to this question.

Several doctrinal areas are broadly relevant to the question of juror bias and, in particular, the impact of race in the criminal justice system. First, I think it is fair to say that there exists fairly broad agreement that race has a significant effect on the criminal justice system. But there's quite a lot of dispute over causality and which actors and which steps in the process are most significantly related to observed disparate outcomes in terms of race. Several scholars have argued that the criminal justice system would be more fair if jurors of the same race as the defendant were included on the defendant's jury. In terms of the legal doctrine, the Supreme Court has long held that exclusion from jury pools or from juries on the basis of race violates the Equal Protection Clause.[60] However, the Court has also made clear that the Constitution does not guarantee a jury of the same race as the defendant, a proportional jury, and so forth. Thus, there is nothing inherently improper from an equal protection or due process standpoint about a black defendant tried before an all-white jury, so long as the government has not attempted to exclude–directly or indirectly–black people from the jury pool and so long as the prosecution has not challenged individual jurors for discriminatory reasons.

With respect to challenges to individual members of the jury venire, it is clear that the government may not remove a potential juror on the basis of race. For that matter, neither may a criminal defendant remove a potential juror, even if he does so in the hope of a more racially diverse jury, as Justice Scalia has pointedly noted.[61] Enforcement of this prohibition is, by many accounts, fairly ineffectual because of the difficulty of proving discrimination. The *Batson v. Kentucky*[62] evidentiary framework and the loose scrutiny by many courts of the nondiscriminatory reasons offered by the prosecution makes it an often ineffective safeguard against bias in the jury selection process.

Turning next to the question of race bias during jury deliberations, Federal Rule of Evidence 606(b)[63] and its state analogs generally prohibit jurors from giving evidence about internal jury deliberations and decisional processes after a verdict has been rendered. In a few

60. *See, e.g.*, Batson v. Kentucky, 476 U.S. 79 (1986); Strauder v. West Virginia, 100 U.S. 303 (1879); *see also* U.S. CONST. amend. XIV, § 1.

61. Edmonson v. Leesville Concrete Co., 500 U.S. 614 (1991) (Scalia, J., dissenting).

62. 476 U.S. 79 (1986).

63. FED. R. EVID. 606(b).

cases, courts have addressed the question whether admission of evidence of racial bias is prohibited by the rule. Most of these courts have held, following the Supreme Court's lead in the *Tanner v. United States*[64] "party jury" case, that race bias, like drug and alcohol effects, is an "internal influence" and thus encompassed by the rule's exclusionary scope.[65] A few courts, including the United States Court of Appeals for the First Circuit last year,[66] have held that the Sixth Amendment[67] and the Due Process Clause[68] can override the application of Rule 606(b) under these circumstances. Again, despite the applicable rule, it's at least arguable that a lot of bias is not going to surface. In many cases it's possible that any evidence of bias will remain locked inside the black box of the jury room. In many other cases it is likely that bias is subtle or hidden.

Turning to race and punishment–and in particular imposition of the death penalty–the Supreme Court has held that individualized proof of discrimination is required such that statistical evidence is not sufficient to show a constitutional violation. In *McCleskey v. Kemp*,[69] the Supreme Court addressed the relevance of statistical research that found a significant effect of race on imposition of the death penalty in Georgia. The Court reasoned that, even assuming the validity of the study, such evidence was insufficient to raise a constitutional claim.

Subsequent to the Baldus Study[70] that was at issue in *McCleskey*, a fair amount of social science research has accumulated on the question of the effect of race on both guilt determinations and sentencing.[71] The findings from these various studies are inconsistent and inconclusive. There have been three recent meta-analyses of this data, and the first two reached opposite conclusions as to whether there was a race effect

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64. 483 U.S. 107 (1987).

65. *See, e.g.*, United States v. Benally, 546 F.3d 1230 (10th Cir. 2008); Williams v. Folino, No. 98-1320, 2009 WL 2998154 (W.D. Pa. 2009).

66. *See* United States v. Villar, 586 F.3d 76 (1st Cir. 2009) (holding that although Rule 606(b) precludes inquiry into juror prejudice, courts have discretion under the Sixth Amendment and the Due Process Clause to make inquiry into such allegations).

67. U.S. CONST. amend. VI.

68. U.S. CONST. amend. V.

69. 481 U.S. 279 (1987).

70. For a detailed account of the study that supported the challenge in *McCleskey*, see DAVID C. BALDUS ET AL., EQUAL JUSTICE AND THE DEATH PENALTY: A LEGAL AND EMPIRICAL ANALYSIS (1990).

71. David C. Baldus, Charles Pulaski & George Woodworth, *Comparative Review of Death Sentences: An Empirical Study of the Georgia Experience*, 74 J. CRIM. L. & CRIMINOLOGY 661, 674 (1983).

and, if so, how large it might be.[72] The third, which is the most recent, redefined discrimination because the prior two studies had included only white jurors' bias against black defendants.[73] This third meta-analysis looked at the original data and new studies and redefined discrimination to encompass any in-group out-group effect. The bottom line from these meta-analyses is that there is some race effect. The effect is larger in terms of sentencing than it is in guilty/not guilty verdicts, but the analysis also found a small race effect on guilt determinations.

The methodology of some of these studies has been criticized. In particular, the earlier studies often used a continuous guilt scale rather than a binary guilty/not guilty determination. There was some argument that this would inflate the effect. Furthermore, there have been questions raised about the ecological validity of much of the research. As was mentioned earlier, most of the subjects have been college students who are, perhaps, not very representative of jury pools. And often in these studies there is no instruction given to jurors about the burden of proof. Finally, in most of these studies jurors don't deliberate, though some of the mock jury designs do include jury deliberation.

So, the bottom line is there is a fair amount of behavioral and statistical data. We know that there are ways to test these outcomes without using brain imaging. Statistical studies of actual verdicts and actual sentences tell us a good deal about racial disparities in the system. These statistical analyses demonstrate that the race of the victim has the most pronounced effect on outcomes, but the race of the defendant also has an impact.

Before turning to the question of brain imaging, I would like to touch on the potential relevance of the large body of data on implicit associations, or unconscious bias. There is a robust–though not uncontested–body of data that demonstrates that most people have unconscious negative associations for black people and other minority groups. Interestingly, a law professor at the University of Hawaii, Justin Levinson, has created an Implicit Association Test (IAT) that specifically looks at whether subjects more easily associate African-Americans with the trait of criminality or guilt. His "guilty/not guilty IAT" did find such

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72. Ronald Mazzella & Alan Feingold, *The Effects of Physical Attractiveness, Race, Socioeconomic Status, and Gender of Defendants and Victims on Judgments of Mock Jurors: A Meta-Analysis*, 24 J. APPLIED SOC. PSYCHOL. 1315 (1994); Laura T. Sweeney & Craig Haney, *The Influence of Race on Sentencing: A Meta-Analytic Review of Experimental Studies*, 10 BEHAV. SCI. & L. 179 (1992).

73. Tara L. Mitchell et al., *Racial Bias in Mock Juror Decision-Making: A Meta-Analytic Review of Defendant Treatment*, 29 L. & HUM. BEHAV. 621 (2005).

an association.[74] One tantalizing aspect of his findings is that the black/guilty association was different from the bias effect that's found in the usual implicit association race test. It wasn't correlated with the implicit association of good or bad. In other words, a subject might hold black/criminality or black/guilty association even though he or she did not reveal other, more general negative associations.

Professor Levinson and his colleagues then conducted follow-up research in which they found that the existence in particular subjects of an implicit association between black people and guilt predicted the way that the subject evaluated ambiguous trial evidence when the race of the defendant was varied. The subjects who had stronger implicit associations were more likely to find a black defendant guilty in a mock trial scenario.[75] Given this finding, the crucial question I hope to address is whether such behavioral data would be enriched by learning more about the brain activity that is correlated with this kind of decision-making by jurors.

In terms of neuroimaging studies that might be relevant, there are the in-group/out-group imaging studies that have been done by Professor Phelps's lab at NYU, and other studies as well,[76] which show a differential amygdala activation when looking at images of out-group faces. The amygdala is known to be involved in emotional response, including fear. A more recent study of criminal responsibility by Buckholtz[77] showed a differential activation in different areas of the brain when deciding criminal responsibility versus punishment. From their data, the researchers tentatively conclude that there are two different neural mechanisms doing these different jobs of deciding whether someone is responsible for an act or outcome and then separately assessing the magnitude of punishment that should attach. What they found is that typically it was the prefrontal lobe, the rational area (what is often termed the "cold cognition" area), that was more highly activated during decisions about criminal responsibility. For punishment decisions, the study showed activation in "hot," emotionally-associated areas such as the amygdala. A commentary response to this study, noting that its findings are consistent with an emerging view that

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74. Justin D. Levinson et al., *Guilty By Implicit Racial Bias: The Guilty/Not Guilty Implicit Association Test*, 8 OHIO ST. J. CRIM. L. 187 (2010).

75. Justin D. Levinson & Danielle Young, *Different Shades of Bias: Skin Tone, Implicit Racial Bias, and Judgments of Ambiguous Evidence*, 112 W. VA. L. REV. 307 (2010).

76. *See, e.g.*, Elizabeth A. Phelps et al., *Performance on Indirect Measures of Race Evaluation Predicts Amygdala Activation*, 12 J. COGNITIVE NEUROSCI. 729 (2000).

77. Joshua W. Buckholtz et al., *The Neural Correlates of Third-Party Punishment*, 60 NEURON 930 (2008).

a certain brain area is involved in inhibiting pre-potent emotional response, suggests that its "result[s] might . . . elucidate the neural source of judicial impartiality."[78]

So, turning to our study, we all know that our perceptions, judgments, and decisions can be influenced by the surrounding context of the facts that we're shown. A very simple illustration of this is the optical illusion that most of you have probably seen before, which is the circle in the middle surrounded by smaller circles and then surrounded by bigger circles. The middle circles are the same size in both pictures, but we perceive them differently because of their surrounding context. It may not be a very great analogy to what we're doing with our study, but it's the same idea as to whether a person would look at an item of evidence that is not changing but in which some other circumstance–here the defendant's race–changes and affects their interpretation of that evidence.

Something I found recently demonstrates the effect of cultural context, as opposed to perceptual context, on interpretation of an image. If you look at this picture and you see the kind of corner shadow, what does that look like to you? (Picture shown.) That's a window. Someone said they're sitting under a tree with a window behind them. If you grew up in East Africa, you would probably say that this is a group of people sitting outside under a tree, and you would also say that this is a box or a metal can on this woman's head. Westerners say that the people are sitting in a room and that's a window with a tree outside the window. So, this again illustrates the influence of social or cultural context on the way we evaluate objective images.

Our neuroimaging study will try to elucidate what areas of the brain are activated when jurors are making decisions about the weight of evidence at trial and whether that brain activation differs according to contextual factors such as the race of the defendant. That will be relevant to scholarship on how juries make decisions, whether burdens of proof, instructions about reasonable doubt, and so forth, are really important or whether jurors just disregard those and go with their gut as to what they think is the most likely story. We also would like to see whether it is possible to mitigate any racial effect by, for example, making the racial element explicit or providing other kinds of jury instructions.

AUDIENCE QUESTION: As a federal judge trying to make a ruling on a scientific issue under Federal Rule 702, I am required to bring some

78. Johannes Haushofer & Ernst Fehr, *You Shouldn't Have: Your Brain on Others' Crimes*, 60 NEURON 738, 739 (2008).

degree of skepticism into the courtroom, and that skepticism is based on the proposition that the proponent of the witness has the burden of proof in order for the testimony to be admitted. I would like to tie that into the phrase "ecological validity or the real world stakes" that I learned earlier today. Juries, especially when they're deliberating, are very dynamic. How is it, then, that you can take what you are doing and what you've described and put that into a real world situation?

JULIE SEAMAN: That is a really good question. Even with the mock juror studies, there are a lot of those that use just one subject at a time and others that have the jurors deliberate, and there are some arguments that deliberation significantly changes the result. And if there is a certain critical mass of jurors of the same race or ethnicity as the defendant, that also makes a difference. So, if there's only one person from the defendant's group, some of the literature suggests that a person can be intimidated into going along, but if there are three or four people, that can make a difference.

One of the things that is interesting from a lot of this bias research is that people are at least starting to think about how to counteract these effects, whether it's possible, and if so, how. For example, if giving a certain kind of jury instruction causes what would otherwise be implicit bias to be made explicit, there is some evidence that people then work to counteract their biases.

AUDIENCE QUESTION: Do the subjects in your study know that it's specifically about race?

JULIE SEAMAN: They don't know it's about race.

AUDIENCE QUESTION: When they get incriminating DNA evidence, are they also given some exculpatory DNA evidence?

JULIE SEAMAN: Yes. They are not getting incriminating DNA evidence; they're only getting exculpatory, but it comes afterwards. It's a post-verdict addition. The kind of incriminating evidence they are getting during the main part of the study is a little ambiguous because there is non-imaging work out there that suggests the bias effect is greatest when the case is in a middle range whereas very strong or very weak cases do not give rise to bias effects.

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ASHLEY ROYAL: We're going to start with Professor Imwinkelried, who is an accomplished expert in evidence. I went to the University of California's website, and his list of publications is three or four pages long. Professor Imwinkelried is going to talk about Federal Rule of Evidence 702 and how it applies to what we've been talking about today.

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Professor Imwinkelried presented a survey of the recent trilogy on the admissibility of expert testimony in federal courts. For a more in-depth analysis, see Edward J. Imwinkelried, *Serendipitous Timing: The Coincidental Emergence of the New Brain Science and the Advent of an Epistemological Approach to Determining the Admissibility of Expert Testimony*, 62 MERCER L. REV. 959 (2011).

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SARAH GERWIG-MOORE: I am Sarah Gerwig-Moore, and I am on the faculty here at Mercer Law School. This is the best kind of symposium because it can be applicable to scholarship, teaching, and also to practice.

The title of this portion of the Symposium is, "At the Edges of New Brain Sciences." The first presenter is Professor Susan Bandes. Susan teaches criminal law and procedure and civil rights at DePaul University College of Law. She received her law degree from the University of Michigan. She began her career as an appellate public defender in Chicago and then served as an attorney with the ACLU in Chicago. For the past decade, she has been teaching and publishing on the topic of emotion and the law, and that is what she will be speaking on today.

SUSAN BANDES: Thank you, Sarah. Thank you to the Law Review, to Ted, and to all of you for being here. I am happy to be part of this wonderful Symposium.

I am going to talk today about whether it is wrong to hold people criminally liable for their heedless and clueless behavior–by which I mean negligent behavior that any reasonable person would know is dangerous.[79] The argument I am exploring is that we should not be holding people liable for things that are not in their conscious minds. The idea is that we do not consciously choose to act negligently, so we

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79. For a longer treatment of this argument, see Susan A. Bandes, *Is it Immoral to Punish the Heedless and Clueless? A Comment on Alexander, Ferzan and Morse: Crime and Culpability*, 29 LAW & PHIL. 433 (2010).

should not be punished when we do so. I am going to argue that this description of how we behave when we behave negligently is inaccurate or at least something we need to reconsider given all we are learning about conscious and subconscious behavior due to advances in neuroscience. I am going to take up a couple of challenges that were thrown out earlier today, including the ones by Oliver Goodenough.

First of all, a lot of what I am talking about is directed at the legislature and not the courtroom because I am talking about whether we should be criminalizing or decriminalizing negligent behavior. I am also going to focus on the question of how we should structure our legal institutions and other governmental and non-governmental institutions in ways that can help us achieve the goals that we want to achieve. How can we structure our legal institutions–like our criminal justice system for example–to model and encourage good behavior or discourage bad behavior?

I am going to veer away from what we have been hearing a bit. I hope to provide some comfort to those of you who fear that neuroscience will wreak havoc with the concept of free will, and that it will make it impossible to hold anybody responsible for their criminal behavior when you cannot blame people for what their brains make them do. I always come back to Stephen Morse's very helpful brain overclaim syndrome article.[80] My argument to the contrary is that we should understand that subconscious behaviors can be regulated and trained, and maybe we can hold more people liable for criminal behavior. I am not going to stand up here and say that we should be locking more people up, necessarily. I believe that we should focus on the most effective ways to prevent negligence and encourage non-negligent behavior.

We can talk about whether criminal punishment is effective or not, but before we do that we have to refute or at least explore better these descriptive claims about what negligent behavior is. (Video excerpt played from the television show *Mad Men*, showing Betty Draper's daughter with a dry cleaning bag over her head and Betty scolding her daughter for messing up the clothing.)[81] Now, why is this funny? As some critics may note, this is one of the things that we all like about *Mad Men*–those of us who like it–a retrospective wink at past ignorance; that is what makes it funny. It is a joke based on a widely recognized shift in knowledge about the norms of safe behavior. As the clip suggests, it does not need to be spelled out that Betty Draper's reaction is clueless and inappropriate. This is not to say that everyone has

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80. Stephen Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397 (2006).

81. *Mad Men: Ladies Room* (Lionsgate Television broadcast July 26, 2007).

learned this lesson. About twenty-five infants a year still suffocate when left unsupervised with dry cleaning bags. People still leave babies in the bath unsupervised. They leave gates to their swimming pools unlocked. People drive drunk, and women drink and smoke while pregnant. But in all these cases there has been a measurable shift in norms.

As one Mothers Against Drunk Driving (MADD) executive put it, before the 1980s drinking and driving was how people got home.[82] It was normal behavior. Today, everyone knows you do not drink and drive. We all know now about safe rides and designated drivers, and we know that we should be using them. But people still rationalize their own choices. They minimize their state of drunkenness, and they exaggerate their ability to drive, but it is hard to imagine a driver today claiming that he had no idea it was unsafe to drink and drive or that he just plain forgot that it was risky.

So, how do those shifts come about? Public information campaigns–such as the highly effective MADD campaigns–over the years are a big part of it. In some cases this sort of public information, especially when it is visceral enough to communicate the imminent consequences to either self or to others when violating the norm, can be effective at changing our deeply held attitudes. In the *Mad Men* era, everybody smoked cigarettes. If you have any kids, you know that children are so thoroughly indoctrinated against smoking now that when they see a smoker they are often shocked and baffled at the evil that still stalks the earth.

To a greater or lesser extent, the criminal law has played a role in the evolution of many of these norms. Criminalization of drunk driving, heightened penalties, lower levels for blood alcohol content, and more consistent enforcement, these are all central to MADD's mission. We are now seeing a similar campaign unfold around texting while driving. (Humorous video played depicting the dangers of texting while driving.) Now, this is something we are seeing unfold right before our eyes. In the last year, studies have shown that the risk of texting while driving is at least twice as high as driving with a .08 blood alcohol level.[83] The State of Utah, among others, has just passed a law penalizing a texting driver who causes a fatality as harshly as it does a drunk driver who causes a fatality. Its sponsors announced that the law puts Utah drivers on notice that texting while driving is inherently reckless.[84]

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82. Laurie Davis, *25 Years of Saving Lives*, DRIVEN, Fall 2005, at 8, http://www.madd.org/about-us/history/madd25thhistory.pdf.

83. Matt Richtel, *Not Driving Drunk, but Texting? Utah Law Sees Little Difference*, N.Y. TIMES, Aug. 29, 2009, at A1.

84. UTAH CODE ANN. § 76-5-207.5 (LexisNexis 2010).

Criminal law reflects changing norms, and we see it unfolding before our very eyes. When I was growing up, no one would have been prosecuted for failing to use a seatbelt. My father used to put his arm out to make sure I didn't fly through the window. You are not going to see that today. Criminal law not only helps reflect changing norms, it also helps shape the norms. It influences the way they change.

The criminalization of various forms of vehicular homicide, child endangerment, and other uses of criminal law keys into an age-old debate about whether we should use the criminal law to punish people for their negligent acts. A long line of criminal theorists have argued that we shouldn't do this, and that this prohibition goes to the moral heart of the criminal law. They say there might be some utilitarian reasons for punishing someone to set an example for others, but we can't set an example for others unless we are also punishing someone who himself is morally culpable. Then they say a negligent actor is not morally culpable because he did not choose to ignore a known risk, he simply spaced out on the fact that he was engaged in a risky behavior. His act was unconscious and, therefore, there is nothing the law could have done to influence his behavior. Thus, there is nothing the criminal law should do to punish him. This is the argument I am going to refute: criminal law requires both a wrongful act and a guilty mind–actus reus and mens rea. In the old quaint language, *mens rea*, an act does not make a person guilty unless the mind be guilty. This principle is universal and persistent in mature systems of law.

Of course, it is not necessarily obvious that the texting driver, the drunk driver, or the modern day Betty Draper lacks a guilty mind, but that is when the controversy comes in. The argument is that the negligent actor is blamed and punished for what isn't in her mind, and that is what I want to talk about.

I'll be talking about a recent prominent book by law professors Larry Alexander and Kim Ferzan written in conjunction with Stephen Morse.[85] Professors Alexander and Ferzan argue that it violates the threshold requirement of the criminal law to hold people criminally responsible for failing to pay attention to a risk if their failure to pay attention to the risk did not involve a conscious choice. I am going to use their example about Sam and Ruth. They are the parents of a baby who drowns in the bath because the parents are distracted by the party they are throwing. Here is what Professors Alexander and Ferzan argue: The child's situation slipped out of their minds, and once the

85. LARRY ALEXANDER & KIMBERLY KESSLER FERZAN WITH STEPHEN J. MORSE, CRIME AND CULPABILITY: A THEORY OF CRIMINAL LAW (2009).

thought was out of their minds, they had no power to retrieve it; therefore, they should not be criminally punished.

If you Google "baby drowns," you get scores of bathtub hits, including "baby drowns in bathtub while mom shops for shoes," among many others. Needless to say, if we take negligence off the table, then we are going to end up with some pretty perverse results. The parent who somehow failed well into the twenty-first century to focus on the dangerousness of leaving the baby in the bath is off the hook. The parent who kept the danger in mind but took a chance on leaving a baby alone for just a couple of minutes might be liable as reckless.

The concept of conscious choice on which this argument rests assumes a very sharp distinction between the conscious and subconscious minds. It assumes there is this reasonable and conscious true self on the one hand. The actor himself can know his own conscious mind. He can describe it in words, and it can be understood by others. It is open to influence, reason, and correction. The unconscious, on the other hand, is inaccessible, mysterious, and ultimately unknowable. It is impervious to external influence except, perhaps, after years of Freudian analysis. So, the inaccessibility or inscrutability of the subconscious mind means that only experts can access it.

This is, as we heard earlier today, a folk conception of conscious and subconscious mind with a sharp distinction between the conscious and the subconscious. It assumes that it only goes one way from the subconscious to the conscious and not vice versa and that the conscious cannot resist the flow of the unconscious. The unconscious is bad. It is suspect, and it creeps into the conscious and influences it. But the scientific consensus is very different. It says that the boundaries between our conscious and unconscious minds are permeable, dynamic, and interactive.

Here is a slide from Jerome Kagan.[86] All of this is always going to be provisional, as those who do this kind of work well know. This is a changing and fluid field. Kagan talks about four types of consciousness: awareness of sensations, cognitive awareness, awareness of control, and self-awareness. He would say that the legal rules say that only the fourth one, only cognitive awareness, the one that you can describe narratively and that is in the forefront of your mind, can be the predicate for criminal liability. But, in fact, if you are aware of your ability to control your actions, even if you can't put them into words and even if they are not in the forefront of your conscious mind, then it may

86. JEROME KAGAN, THREE SEDUCTIVE IDEAS 46-49 (1998).

very well be that that ability to control is enough to hold you criminally liable and enough for you to be able to change your behavior.

The argument against criminal negligence assumes that you have got to have cognitive awareness because otherwise we are not reasoning and we are not appraising moral worth. But what we are learning increasingly is that very little of our information processing and very little of our decision-making is actually occurring on a conscious cognitive level. Most of it is occurring at another level at which nonconscious mental systems perform most of the self-regulatory work that we're doing. We acquire skills, and once we acquire them, we perform them automatically without conscious thought. Initially we need conscious choice and guidance to perform these behaviors, but later on we become so used to them that it becomes superfluous and drops out of the process, and that is far more efficient. We could not function if every time we drove the car home, returned a tennis serve, cooked breakfast, or judged someone's character we had to process, evaluate, and plan every conscious step in the realm of speech and awareness.

Here is what we can do with this in real legal life. First of all, we can educate people to make subconscious operations accessible. Simply directing attention to people's internal states often seems sufficient to reverse or reduce the effect of certain implicit attitudes–getting back to Julie's point earlier–stereotypes and associations. The subconscious can learn from past behavior and thus improve subsequent subconscious behavior. If this weren't so, then think about Sam and Ruth and the baby. Presumably, according to this way of thinking about things, if Sam and Ruth drown their second baby because that baby had also slipped out of their minds, then I guess we could not hold them responsible for that either. And yet, we are not really going to believe they were forgetful twice.

Consider a murder/manslaughter case in which a drunk driver killed three people, including a pitcher for a major league baseball team. The prosecutor charged the case as a second degree murder instead of a manslaughter because the drunk driver had a previous DUI conviction, had specific knowledge of the dangers of drinking and driving from his own experience, and had signed a court form from the earlier case saying he understood he could be charged with murder if he drove drunk again and killed someone. If you do it again after that, you don't get to say, "Oops, it slipped out of my mind again." You are assumed to be on notice at that point.

So, what is the change there? We have a really terrific study that shows police officers can be trained to make better split-second decisions

on whether to shoot in a stressful situation.[87] Officer training yielded a decreased tendency to shoot and decreased racial bias. Doctors, with feedback from others, can improve their clinical intuition by recognizing and remembering their mistakes and incorporating those into their thinking. Judges and jurors can become more aware of implicit racial, ethnic, and gender prejudice. Date rapists can be brought to understand that they are misreading the signs and that their advances are not, in fact, welcome. People can be trained to improve their empathic capacity. In short, despite the fact that much of our decision making operates automatically well outside of our conscious awareness and with great speed, this low road decisional capacity is evidently trainable.

Legal institutions are a great place for this kind of training to occur. Legal institutions communicate messages that educate the public that translate into easily remembered heuristics and rules of thumb that guide subconscious behavior. Don't drink and drive or you will go to prison might have an extra kick to it. It does not inspire perfect compliance, but it is a rule that we have successfully internalized.

I am going to end with the thought that we shouldn't put so much stock in conscious reasoning and in conscious ability to describe our own internal states. In a way, we are never doing that, right? We cannot put too much stock in our ability to describe our own internal states–intent as well as negligence. First, they are a legal construct and not actual photos of what is in our mind. Second, we always look for external evidence of these states.

If somebody points a gun at his girlfriend's heart and pulls the trigger and then says, "I didn't intend to do that," we are not simply going to take his word for it. We are going to look for external evidence just as we can and should do with subconscious behaviors and with negligent behaviors. There is nothing different about this. It is all evidence, and it all relies on external cues as well as self-reporting.

And my last point is about self-reporting. Our conscious reasons are often post-act explanations, not reflections of some actual process. Moral intuitions appear quickly. We cannot readily articulate why we act on them. What we think we are doing while we are consciously deliberating actually hasn't got that much effect on how we act. Most of the time we have already made a judgment, and we are looking for a legitimate and coherent narrative to explain what we have done. And to complicate matters, when what's going to happen after we figure out what we have done is that we may or may not go to jail because of it, there is a fair amount riding on how we think about what we have done. When the

87. Joshua Correll et al., *Across the Thin Blue Line: Police Officers and Racial Bias in the Decision to Shoot*, 92 J. PERSONALITY & SOC. PSYCHOL. 1006 (2007).

question is, did I consciously take a chance on leaving that baby in the bath or did I just forget about the baby in the bath, your own self-knowledge and self-reporting is going to be affected no matter how you slice it by your knowledge of the consequences. The problem is not only that we articulate self-defensive excuses, we have every incentive to believe our own excuses. Remember Newt Gingrich with his youthful indiscretions? It turned out they all happened while he was in his forties and there were, I think, about fifty of them.

Two days ago there was a really interesting article in the *New York Times* about memory.[88] When we think about the things we feel really bad about, they all seem to have happened many years ago. The things we feel good about just happened. That is how our brain reorders itself. This is the problem. This is not about lying. It is about how we understand ourselves and how we look for ways to believe that we are good people who maybe did something out of character. We don't want to rely too much on self-reporting. And once we are looking at external cues as well, there is no difference in kind between negligence and intentional actions. It is all subject to the same vagaries and the same need for external evidence. And therefore, if we want to lock more people up, we can do it. Or at the very least, the moral argument against punishing negligence is based on highly questionable descriptive claims. But this is not to say that as a policy matter we ought to lock people up for criminally negligent acts.

The important point is that institutions such as the tort system and the criminal justice system shape moral intuitions, for good or for ill. For an example of ill, Gerd Gezeringer talks about what he calls "split-brain institutions," institutions that reward employees for being protective of their–and their institution's–reputations, even though it requires self deception and avoidance of responsibility.[89] One project worthy of our attention is to investigate how we create or reform institutions–governmental agencies, financial institutions, and universities that help train and reinforce moral intuitions that promote individual and institutional accountability. We should be concerned when the law creates incentives to cluelessness and disincentives to paying attention.

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88. Benedict Carey, *Why Indiscretions Appear Youthful*, N.Y. TIMES, Oct. 4, 2010, http://www.nytimes.com/12010/10105/health/views/05mind.html?r=2&scp=58&sq=good+memories&st=nyt.

89. GERD GIGERENZER, GUT FEELINGS: THE INTELLIGENCE OF THE UNCONSCIOUS (2007).

SARAH GERWIG-MOORE: Our second presenter is Amanda Pustilnik from the University of Maryland School of Law, educated first at Harvard and then at Yale. She was a lecturer before joining the faculty at the University of Maryland at Harvard and then taught at Cambridge University. She will be speaking on quantifying pain and neuroscience and how that might be useful in the courtroom. She will also explore the ethical and moral component of the neuroscience that has the scientific component but also the moral and ethical undertones that we are all wrestling with.

AMANDA PUSTILNIK:[90] Today, I am going to speak on two subjects: the neuroimaging of pain and the need for translational work that must take place between neuroscience and law before any neuroscientific findings can directly influence any body of legal doctrine or aspect of legal practice. I will start with pain: how it is represented in the brain, how neuroimaging can contribute to understanding acute and chronic pain, and how this information may–or may not–inform areas of legal doctrine concerned with acute and chronic pain. Then, I will discuss the concept of translation. Despite hopes for the development of "scientific law" or aspirations that neuroscience may produce simple tools to solve particular legal questions, findings in neuroscience and in other branches of the sciences can rarely be imported into legal frameworks directly. This translational work is possible, but it is not straightforward.

I started thinking about pain because pain is a phenomenon that is relevant to law while being more amenable to neuroimaging than other potentially productive areas of law and neuroscience–like free will or responsibility. A lot of work has been done on the neuroscience of responsibility. I think that is extremely interesting work, but responsibility, at least as we use it in law, is essentially a normative concept; a community can define it any way that it wants to. And since responsibility can mean so many things, that makes it very hard to locate its physical correlates–if indeed, the construct of responsibility even holds up in such a way.

Pain, on the other hand, arises out of, or at least relates to, physical facts. Certainly, pain is subjective. Different people experience pain differently. It is extremely hard to measure, describe, quantify, or relate one's pain to another person who hasn't had the kind of pain you are experiencing. Nevertheless, although pain is not an entirely stable or

90. This portion of the transcript is lightly footnoted.

unitary phenomenon, there is no doubt that it corresponds to things that are real in the body in ways that responsibility may not.

Pain is not only more physical and more amenable to neuroimaging than other phenomena that are being studied in law and neuroscience, it is also extremely important across many different branches of law. Pain appears in the law in everything from tort to torture. There are pain and suffering damages for physical and emotional pain in tort. Claims of chronic pain make up the single largest category of payouts under the Social Security Disability Program. Pain shows up in our criminal justice system in the form of an aggravating factor in capital cases: infliction of "excess" pain upon a victim constitutes "atrocious and cruel treatment" of the victim and can aggravate a non-capital murder to a capital murder. These statutes are worded in terms of the infliction of "agony" or "extreme pain" upon a victim. State torture, a thorny and very important contemporary issue, is described in most nation states' statutes and in international conventions as the infliction of "severe pain" or agony. Pain even shows up in constitutional debates about the permissible level of pain incident to a lawful execution. In *Baze v. Rees*,[91] the Supreme Court decided on whether Kentucky's lethal injection was constitutional based upon whether it tended to cause an unacceptably high level of pain.

So, pain appears across a broad range of legal arenas and can play roles ranging from providing the basis for legal entitlement to compensation and benefits (as in tort and disability) to enhancing criminal culpability to providing boundaries on the permissible treatment of prisoners by states. Because there is a conjunction of pain being more physical than free will or responsibility and of pain being important to the law, I thought it would be a fruitful area to explore as we think about how neuroimaging and neuroscience more generally may be able to contribute to the law in pain-related areas. Is there anything like a unifying treatment of pain in law? Should there be? Could various areas of law be improved by greater scientific understandings of pain and by theorizing about the work that pain does in different legal contexts? I suggest some answers to these questions later on.

There is another big issue with pain that makes it ripe for neuroscientific exploration–pain is extremely hard to know. We may be familiar with the pain rating scale–you may have encountered it yourselves if you go to a doctor or a hospital. The scale asks, how much does it hurt? And you're supposed to point to a smiley face or a frowny face to indicate how much pain you're in. What does that really mean?

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91. 553 U.S. 35 (2008).

It gives the appearance of quantification because the faces are numbered from one to ten, but there is complete variability in the underlying subjective experience that patients are being asked to quantify. Different people are going to give this very different ratings. Your "ten" is not my "ten," and my "ten" today may be different than my "ten" at some point in the future when I have experienced worse pain, and so, have an enlarged imagination about how bad pain can really be.

Because of these various challenges and the number of potentially involved legal arenas, I was excited to try to figure out if can we know pain better through neural imaging. I will briefly introduce the biology of pain, then will touch on what we can know through the neuroimaging of pain, and then I'll conclude by going back to this important translational concept that I want to emphasize.

I am sure it won't surprise anybody in the audience today to hear that you experience pain in your brain. No matter the part of your body in which you are experiencing the sensation of pain, it is your brain that is producing that experience. This dissociation of where it *feels like* the pain is and where the sensation of pain actually is *being generated* is well demonstrated by phenomena like phantom limb pain. With phantom limb pain, a person who has lost an arm or a leg can still feel quite intense pain "in" that arm or "in" that leg–even though the limb is no longer there. The pain is real. It's not psychological. It's not manufactured or hysterical.[92] But it is a neurological phantom, and that is not so different from how we experience sensation–including pain–in any intact parts of the body.

When a person experiences pain, what is happening in his or her brain? Using functional magnetic resonance imaging (fMRI), researchers have repeatedly demonstrated the brain correlates of pain experience. Numerous areas of the brain become active during the experience of pain because pain is a multi-sensory, multi-dimensional experience; also, pain in different parts of the body will present somewhat differently, as do different kinds and qualities of pain. Despite these variations in pain experience, two areas of the brain consistently become active. These are the thalamus and the contralateral insula.[93] Parts of the brain known as the somatosensory area and in the somatic association cortices will

92. The major theory of phantom limb pain in the prior century was psychoanalytic; this theory held that phantom limb pain was a hysterical conversion–or "somatization"–of emotional difficulties related to the loss of the limb.

93. The brain has two hemispheres, and the structures in each hemisphere are mirror images of each other. "Ipsilateral" means "on the same side as," and "contralateral" means "on the opposite side." If you experience a painful stimulus to your left hand, it is the right insula–your contralateral insula–that will show the greatest activity.

display activity, although precisely where there is activity in these areas will depend on which parts of the body are experiencing the noxious stimulus.

The insula and the thalamus become involved/associated with nociception as well as pain. Other areas of the brain are associated with pain only; that is, with the conscious experience of pain only. These are areas of the brain that relate to effect, to emotional experience. The amygdala and the anterior cingulate cortex (ACC) become involved in the affective experience of pain. The prefrontal cortex (PFC) also plays a complex role in pain; it is not fully understood and is very much under investigation.

When a person is experiencing not only aversive stimuli–or nociception–but is also having a conscious and affective experience of *pain* that arises from nociception, typically you will expect to see some activation in the thalamus, the insula, the amygdala, and the ACC. Other brain regions may become more active as well, but these four regions are most specifically associated with the conscious experience of pain.

So, this sounds like a relatively simple story: "We can put a person in a brain scanner and when we see activity in these four areas, we know that the person is in pain." Unfortunately, it's not so simple. It is true that these areas characteristically become active when a person experiences pain. But each of these regions has many functions; each may display activation for a host of reasons unrelated to the experience of pain. This is an example of the reverse inference problem: while we know that a subject experiencing pain will generally display activity in these areas, it is not reliably possible to infer in the other direction–that if a scan shows activity in these four areas that a subject is necessarily in pain.

In addition to the reverse inference problem, there are also the significant problems of individual variation and subjectivity. Not only will different people report pain (as opposed to discomfort) at different thresholds of an aversive stimulus, they also will report subjective levels of pain that correlate inconsistently with degrees of observed brain activation. I will explain a typical pain experiment to illustrate what this means. What pain researchers do is get a whole bunch of subjects–usually grad students working in related labs–and apply a heat stimulus to one arm of each subject. The researchers gradually increase the heat until the subject self-reports that the stimulus is painful. The level of heat that different people find painful varies a lot. It not only varies between subjects–Jack's general pain sensitivity may be greater or lower than Joe's–but it also varies within subjects depending on how they're feeling. Jack is more pain sensitive when he is sleep deprived, anxious, or hasn't had breakfast, so his blood sugar is low. This

illustrates that there is intersubjective variation (variation among distinct subjects) and intrasubjective variation (variation within the same subject over time).

How does this relate back to the brain activity we were discussing earlier? A researcher may see activity in these characteristic areas of the brain (the four that I talked about before), but the subject may honestly self-report that he is not experiencing pain. So, their brain scan shows activity that's normally related to pain, but the person is honestly self-reporting, "No, that's uncomfortable, but it doesn't hurt."[94] Conversely, a researcher may have a subject who says, "Yes, that hurts," but the scan does not reveal a significant degree of activation in the relevant brain regions. In other words, self-reporting about painfulness does not correlate perfectly with the degree of activation visible on brain scans. There is some correlation, but it is not strong enough to read painfulness from the scan itself; what one has is a probability, a confidence interval, that if a scan looks like x, then the person likely is or is not in pain. Accordingly, the subjective experience, the phenomenological experience of pain remains an extremely important diagnostic component of determining whether somebody is in pain. This prevents us (at least at this point) from using fMRI as a pain-o-meter for the experience of acute pain.

Building on what Dr. Elliott said this morning, it may be possible to develop ratings of sensitivity and specificity for these scans. Such ratings might make it possible to infer the degree of pain a person is *likely* experiencing. How many standard deviations would it take in order for the fMRI image to correlate with either "no pain" on the one side or "extreme pain" on the other. I think that kind of testing could be possible. It is just that it hasn't been done.

So far, we have been talking about acute pain. Chronic pain presents distinct issues and shows up somewhat differently. And chronic pain is the one that's really the big financial problem for the legal and medical systems. The burden of chronic pain–what is called "the disease burden"–is extremely high. There are so many people suffering from chronic pain, and many of them have what is called "chronic pain without lesion." That is, they have chronic pain that does not stem from an identifiable physical injury or abnormality. Much chronic lower back

94. This raises the question of "toughness" or "being stoic." Researchers strongly encourage the subjects to honestly self-report. We would say a person who is in pain but denies it–"It's but a scratch!"–is stoic; we might also say that he's lying. A person who genuinely is not in pain when most other subjects would be is someone with what is called a high pain threshold. This person is not tough or stoic in the same way that a person who is not afraid of snakes–or likes them–is not "brave" when she handles them.

pain arises in the absence of causal orthopedic findings; chronic headache syndromes, like chronic daily headache, do not result from visible abnormalities in the nervous or vascular systems. So, the pain is very real–it is not psychologically fabricated–and yet its causes are invisible. At the same time, there is also the concern that a lot of people perpetrate fraud on the system by claiming to have some kind of chronic but invisible pain.

As between two subjects who state that they are experiencing chronic pain without lesion, how can you tell which one genuinely is in pain and which one is faking for gain? There was a case in New York State recently, about a year and a half ago, in which it turned out that 98% of retired workers from the State's railroad system who had had desk jobs, not who had had jobs on the tracks, were receiving disability benefits for back pain. It just is not plausible that 98% of desk workers were disabled by back pain. So, there is a problem of *under*-treatment and *under*-compensation for genuine chronic pain patients, but there is also a problem of *over*-compensation of fraud. This is when there may be a role for neuroimaging (although some of the best ways to separate genuine from dishonest claimants are decidedly low-tech).[95]

Chronic pain does not show the same signature as acute pain with these four characteristic areas, but it does produce several important disruptions in brain function. Long term chronic pain can affect brain *volume*. Dr. Vania Apkarian, a researcher at Northwestern University, has shown the correlation between chronic pain and loss of grey matter using a technique called "voxel-based morphometry" (VBM).[96] A voxel is a volumetric pixel; VBM measures volume changes in the brain. Apkarian has shown that long term chronic back pain correlates with loss of gray matter in the prefrontal cortex. It is unclear whether cell death is a cause of chronic pain, a result of chronic pain, or a side effect of some other cellular process or hormonal process that is occurring in the brain. But the changes do appear to be a consistent, robust finding. Chronic pain also affects the resting state communication patterns

95. Low-tech ways of spotting fraud include tracking which doctors have made the diagnosis in question and reviewing patient medical records. A common sign of fraud is that a single doctor will have certified that a related group of claimants suffers from a disability. This was the case with the New York railroad workers; they all got a similar letter from the same doctor, which at least suggests that the doctor's business model was in providing disability letters. Since genuine chronic pain patients already labor under a burden of suspicion, and pain management doctors are highly committed to treating among the most intractable conditions, fraud of this kind has particularly unfortunate effects for patients, doctors, the disability system, and the cultural perception of chronic pain.

96. A. Vania Apkarian et al., *Chronic Back Pain is Associated with Decreased Prefrontal and Thalamic Gray Matter Density*, 24 J. NEUROSCI. 10410 (2004).

between different regions of the brain. It may ultimately be possible to detect resting state variations and then apply to a certain degree of certainty those findings to whether or not a person has chronic pain.

I am cautious about using these types of findings–resting state aberrations and volumetric loss–as evidence of chronic pain in individual cases because individual brains vary hugely. There already have been cautions stated about that this morning. But on the level of *doctrine*, I think that disability regulations about what constitutes chronic pain could bear revision. Currently, chronic pain without a lesion is recognized under disability jurisprudence only as a psychiatric condition–as what is called "somatoform pain disorder." But there is increasingly strong evidence that different types of chronic pain syndromes are in fact neurological diseases. Of course, psychiatric diseases are neurological as well. What I mean when I attempt to distinguish neurological diseases of chronic pain from psychiatric syndromes of chronic pain is as follows: the neurological diseases are non-affectively driven and have distinct disease histories and etiologies that mark them out as conditions distinct from psychiatric pathologies. I suggest more fully in a forthcoming paper how disability law and jurisprudence should be revised to distinguish somatoform pain disorder (the psychiatric diagnosis) from neurological conditions of pain chronification.

While I propose that there may be relatively concrete applications for neuroimaging of chronic pain in the areas of tort and disability law, there are other areas of law that I alluded to earlier–criminal law, torture, and death penalty jurisprudence–where the law appears to speak in the language of pain. Can acute pain imaging be useful in these arenas?

The statutes in these areas of law discuss and are expressly framed in terms of excruciating pain. We are familiar with debates in the last few years in this country over the question of how painful something has to be before it constitutes torture. Is water boarding painful enough to constitute torture? How painful is this interrogation method? Does it rise to the level of torture? Similarly, how painful is this execution method? Is it sufficiently painful that it violates the Eighth Amendment[97] prohibition on "cruel" punishments? We might ask, "Can neuroimaging help establish how painful something is so that it can be determined whether it is too painful to constitute lawful treatment?"

Let's say that it would be possible to hook subjects up to an fMRI or other pain-measuring machine and determine that the average subject

97. U.S. CONST. amend. VIII.

finds a particular technique to be painful to a level of 85 out of a possible, arbitrary scale of 100. If lawmakers established the threshold for torture at 90 units of pain, and sufficient testing were done such that the average painfulness of different techniques could be established, would this be the right way to settle the torture debate or the cruel and unusual punishment debate? What kinds of conduct constitute cruel or atrocious treatment for death penalty purposes?

Some of you may have a gut reaction that hooking a person up to a machine and determining that 91 units of pain is torturous but 89 units of pain is okay is simply the wrong approach. I would suggest that if you have such a reaction it is because you have internalized a set of values that the law has implicit within it.

When the law speaks in the language of acute pain in the areas of murder, torture, the death penalty, and similarly charged areas, I believe that physical pain is rarely the actual subject. What is transpiring, instead, is a conversation about values–about who is deserving, about what values the law seeks to represent.

When one looks at torture murder statutes, those statutes are phrased in terms of "excess pain" inflicted upon the victim, in which "excess pain" is pain above that necessary to have achieved the victim's death. In a statue phrased in those terms, is it really quanta of pain that the law is targeting? I reviewed a large number of torture-murder cases, and I found that in quite a few of the cases, the victim was unconscious during the infliction of the torturous conduct, or the victim was paralyzed and so would not have been able to feel the torturous conduct. Yet even in such cases, the courts' opinions speak in terms of the infliction of heinous pain, concluding that the death penalty is appropriate because of the excess pain inflicted. At least as to such cases, the judicial discourse about pain is not really *about* pain at all; I suggest it is about characterizing the *values* of the torturer as repugnant–as abhorrent–as shown through his willingness to engage in such conduct, regardless of whether the victim felt the pain at all.

Similarly, in debates about torture, language about pain often serves as a proxy for values. In reviewing the torture statutes of nation states, international and non-governmental organization (NGO) torture conventions, and academic work on torture, I have noticed that use of language about the body–and about pain levels specifically–lines up perfectly with whether the text is taking an expansive or a narrow view of what types of conduct should be permissible. The more a text describes the conduct that constitutes torture in terms of degrees of pain–or quanta of pain–the more likely it is that the author of the document seeks to allow a broader range of conduct to be inflicted upon a subject. Conversely, the more the discourse is carried out in terms of

moral values and less narrowly about bodily pain, the more likely it is that the proponent is seeking to guard subjects more broadly from a range of potentially torturous conduct. This is perhaps not surprising: if a document is framed in terms of quanta of pain, it is possible to debate almost infinitely whether certain techniques are or are not too painful. Further, such pain thresholds tend to be set quite high, establishing a permissive standard. Finally, torture standards that are explicitly pain-based do not encompass the range of harms that might be considered purely psychological or purely dignitary.

To bring together these two strains, language about pain serves an interesting dual role in law when at times it is more closely about facts about the body and at other times it is more about signaling values. While the treatment of–and assumptions about–people with chronic pain may be normatively-laden, the discourse about pain in this area is more closely about attempting to understand facts about the body: whether a person is a chronic pain sufferer and therefore entitled to compensation. At other times, law is using discourse about pain as a proxy for important moral values. The use of pain language to signal moral values appears in other highly contentious areas of the law as well: language about pain comes up in some of the most hot-button legal and political contexts, like fetal pain during abortion, the death penalty, and animal rights. In each of these arenas, discourse circles around degree of suffering that should be permissible; yet, the "pain tolerance" of advocates on these subjects closely maps onto the degree of permissiveness they contend that the law should permit as to each of these practices.

So, I have argued that language about pain in law is often a stand-in for conversations about values. I believe that it is, but I would claim that the relationship between physical facts about pain and moral values expressed in the idiom of pain goes farther. Rather, I could contend that our notion of morality is in part tied to our notion of the physical. Drawing on a concept of embodied morality, I believe that legal concepts of rights and duties, although distinct from human physiology, are informed by physiology and physicality–by embodied experience.

To wrap up with some conclusions, it is not possible to move from physical findings directly to moral and legal conclusions. At the same time, however, moral and legal conclusions *un*informed by an understanding of human biology will often ring hollow. Accordingly, definitions of torture that abjure any connection to the body are in their own ways as unconvincing as those that speak only in terms of the body. There is a long and important translational chain from positive or descriptive fact to legal implication. That is clearest in areas like the torture debate: physical findings about pain levels cannot provide clear

rules about what constitutes torture, even though torture definitions are largely framed in terms of the language of pain. Translational work between physical fact, moral value, and the relationship between embodiment and morality may also be important in applying neuroimaging findings to disability and tort. Although less overtly value-laden than torture and torture-murder, lawmaking and jurisprudence in these arenas also incorporates norms about who is–or is not–a worthy sufferer and what degree of credence, compensation, and redress should be available to sufferers of physical pain. Neuroimaging can provide some of the material for these discussions. They cannot resolve the inherently normative dimensions of these controversies, but by altering our conception of what pain is and how it functions within the body, it can influence our norms about the body by enhancing our understanding of what the body actually is.

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TIMOTHY FLOYD: Kathryn Kase is Senior Staff Attorney at the Texas Defender Service, in Houston. She has extensive experience in the representation of persons facing the death penalty. In particular, she has represented many clients with mental illness and intellectual disability in litigating incompetence and sanity cases. Kathryn first gained significant capital experience in the 1990s in New York. In fact, in 2002 she was named the Outstanding Criminal Practitioner in the State of New York. Apparently having no more worlds to conquer in New York, she then moved back to Texas where she had started her career, which is also, of course, the epicenter of the death penalty universe. In Texas, she has provided invaluable counsel and leadership under difficult circumstances in that environment. And in addition to being a go-to attorney in death penalty cases, she provides national leadership in many ways–in particular, as a member of the American Law Institute in which she serves on the Ad Hoc Death Penalty Committee.

KATHRYN KASE: For those of you who are going out to practice, the question you need to ask yourselves is the question judges are asking. They are not going to admit to this but they're saying, "Who is going to pay for this?" Scanning is incredibly expensive, and it is not just machine time we are talking about.

Before anybody climbs into the machine, we tell capital defense lawyers at training that there is a great deal of preparatory work that needs to happen. Scanning never should be treated as a "let's pop the hood and look at what's inside; let's find out if he's got a brain"

endeavor. Before that ever happens, we tell Texas capital defense lawyers to perform a comprehensive and thorough biopsychosocial history.[98] You have to pull every educational record and medical record you can find about that client.[99] You must also go back three generations in the family and obtain those records.[100] You need to know what the family tree looks like, and what's on it.[101] Is there mental illness? Is there what we formerly knew as mental retardation but is now intellectual disability?[102] Is it cancer? Are there other problems?

That work will take between twelve to eighteen months because, as you might imagine, people don't just sit down and bare their souls when a defense lawyer and his mitigation specialist come to the door and say, "Hi, we've been appointed by the court, and we're here to help your son." People will not start talking about problems within their families until they have developed rapport with the defense team.[103] Even when rapport is developed, we find other issues that must be addressed before family history is discussed. It is not uncommon to hear from family members, "Is this a safe place for me to tell you that I was raped by my father? Can I tell you that in my family everybody has been an addict for as long as I've known them?"

You may well ask why any of this information matters if what we really want to know is whether there is some dysfunction with someone's brain. If a brain is, as Igor in *Young Frankenstein*[104] phrased it, "Abby Normal," why would we need to perform this background work? Because before we engage in a neuropsychological, neuropsychiatric, or neuroscience-based inquiry, we need to know the questions we're asking science to answer and where we want science to look in answering those questions. We can't know the questions or the relevant areas of inquiry before we engage in the investigation.

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98. American Bar Association, *Guidelines for the Appointment and Performance of Defense Counsel in Death Penalty Cases,* 10.7 & Cmt. (rev. ed. 2003), *reprinted in* 31 HOFSTRA L. REV. 913 (2003); American Bar Association, *Supplementary Guidelines for the Mitigation Function of Defense Teams in Death Penalty Cases,* 10.11 (2008), *reprinted in* 36 HOFSTRA L. REV. 677 (2008).

99. American Bar Association, *Supplementary Guidelines, supra* note 98.

100. *Id.*

101. *Id.*

102. ROBERT L. SCHALOCK ET AL., AMERICAN ASSOCIATION ON INTELLECTUAL AND DEVELOPMENTAL DISABILITIES, INTELLECTUAL DISABILITY: DEFINITION, CLASSIFICATION, AND SYSTEMS OF SUPPORTS (11th ed. 2010).

103. Craig M. Cooley, *Mapping the Monster's Mental Health and Social History: Why Capital Defense Attorneys and Public Defender Death Penalty Units Require the Services of Mitigation Specialists,* 30 OKLA. CITY U. L. REV. 23 (2005).

104. YOUNG FRANKENSTEIN (Gruskoff/Venture Films 1974).

The duty to investigate before capital defense teams seek testing is not limited to scanning. It exists wherever we believe a forensic evaluation might be required. That said, some of the hoopla over scanning appears to mirror the old *Playboy* pictures-versus-articles debate. It was okay to read the articles but to look at the pictures was considered a far different level of involvement. Contrary to many of the discussions accompanying scanning, neuroscience has been used in courtrooms for a long time. We've long admitted data from neuropsychological evaluations, an accepted form of psychological evaluation that tells us about executive functioning. That is neuroscience. What is new is that we now have depictions of brains from scans that can provide further insight into brain function.

None of this, however, diminishes defense counsel's duty to learn the client's history, his story, and to rely on sources in addition to the client. This story has to come from multiple sources because, as we know from the movie *Rashomon*,[105] not everybody recounts the same story in similar fashion.

Once the investigation is substantially done, defense teams must then consult with experts about the next steps. This consultation period, which is very important, is something that courts also have to pay for. There are no rich men on death row; most people charged with capital crimes are indigent. Just as the courts must fund a thorough and searching mitigation investigation, they also must fund the defense team's consultation with experts. Consultation involves taking the information you've gathered, sitting down with experts in various disciplines, and saying, "This is what we have. What do we do next? Should we engage in psychological testing? Do we then think about scanning? Do we need more facts? Or should we be going in a different direction?"

We don't want to put clients into a machine merely because we hope we will obtain useful pictures. This is akin to administering an IQ test without knowing the proper parameters for such testing. For example, in Texas, a defendant whose primary language was Spanish was administered an English-language instrument translated by an interpreter untrained in test administration. Psychological instruments are very carefully calibrated for language, and on-the-fly translation by an untrained interpreter can render the testing invalid.[106] So, before

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105. RASHOMON (Daiei Motion Picture Co. 1950).

106. *See, e.g.*, AMERICAN EDUCATIONAL RESEARCH ASSOCIATION, STANDARDS FOR EDUCATIONAL AND PSYCHOLOGICAL TESTING (1999) (psychological tests should be translated only by bilingual professionals trained in their administration); AMERICAN PSYCHOLOGICAL ASSOCIATION, ETHICAL PRINCIPLES OF PSYCHOLOGISTS AND CODE OF CONDUCT 9.02 (2010)

we do any testing we have to take what we know about the client, consult with experts, and carefully plan our next steps. All of that takes time and money.

Let us assume that we have done our investigation, consulted with our experts, had neuropsychological testing performed, and decided to take the next step of obtaining some type of brain scan. At this point, we need a neurologist to make a referral. We probably will need a neuropsychologist to help us interpret the scans and a neurologist–who may not be the referring doctor–to assist with interpretation, and there likely will be a radiologist involved in this process, as well. All of these professionals will want to be paid.

The other challenge is that not all scanners are created equal. Scanners are–for want of a better analogy–like microscopes, the higher the power they have, the more we see. It's not good enough to go down to the neighborhood scanning center and throw the client in that scanner. If you speak to the people who do this work with brain scanning, they're going to tell you that you may need at least a 3.0 Tesla MRI, and that refers to the power of the magnet in the MRI, and you will at minimum need a second-generation PET scanner.

Now, if you live in West Elbow, Texas, way out in the middle of nowhere, the nearest scanning center may not have machines of that caliber. We have them in Houston because we have a major medical center. However, in Houston, we have often found that the leading hospitals do not want to scan the brains of capital defendants for security reasons. So, you may have the right scanning machine in your community, but you may not have access to it. If you can get access and your client is incarcerated pre-trial, as so many of our capital clients are, you will need to coordinate the process for getting him transported from the jail to the scanning center and back. In a celebrated federal capital case,[107] the defendant was transported to a hospital in the middle of the night for scanning. There was an enormous amount of negotiation that defense counsel engaged in before that occurred. If your client is not a celebrated defendant, but just the guy accused of shooting the clerk in a convenience store, the trial court still will have many questions related to the cost of scanning. These questions aren't limited to trial judges; post-conviction judges also have concerns about what it costs to forensically evaluate the client.

(only qualified individuals may perform psychological testing), *available at* http://www/apa.org/ethics/code/index.aspx; MATHILDA B. CANTER ET AL., ETHICS FOR PSYCHOLOGISTS: A COMMENTARY ON THE APA ETHICS CODE (1994) (lay people untrained in psychological assessment should not administer test instruments).

107. The orders in this case remain ex parte and under seal.

In one federal capital habeas case, the death row inmate had long-term, paranoid schizophrenia and was alleged to be too incompetent to be executed. This is known as a *Ford* claim.[108] In preparation for the hearing inquiring into the inmate's competence, the defense team did its investigation and then sought scanning because there is a fairly well-accepted theory that schizophrenia over the long term can be a brain-wasting disease.[109] The defense team's thinking was that scans showing loss of brain volume would complement psychological testing and confirm the schizophrenia diagnosis. Defense counsel also concluded that scanning would help them combat two claims expected to be made by the state: first, that the death-row inmate was malingering–that is, making up his schizophrenia and his incompetence–and second, that he could be medicated back to competence so that he could be lethally injected. The literature suggests that the likelihood of medication back to competence diminishes with brain atrophy.[110]

However, in federal court there is a $7500 presumptive cap on expenses in capital cases.[111] And in my circuit, the Fifth Circuit, judges must get permission at the circuit level to exceed that cap.[112] Let me tell you, $7500 is not a lot of money in a capital case,[113] and in a case when you want to do scanning, those funds won't even get you

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108. Ford v. Wainwright, 477 U.S. 399 (1986).

109. Nicola Andreone et al., *Cerebral Atrophy and White Matter Disruption in Chronic Schizophrenia,* 257 EURO. ARCHIVES PSYCHIATRY & CLINICAL NEUROSCI. 3 (2007); Leonardo Bonilha et al., *Neurocognitive Deficits and Prefrontal Cortical Atrophy in Patients with Schizophrenia,* 101 SCHIZOPHRENIA RES. 142 (2008); Neeltje E.M. van Haren et al., *Focal Gray Matter Changes in Schizophrenia Across the Course of the Illness: A 5-year Follow-Up Study,* 32 NEUROPSYCHOPHARMACOLOGY 2057 (2007).

110. *See, e.g.*, Stefan Leucht et al., *How Effective Are Second-Generation Antipsychotic Drugs? A Meta-Analysis of Placebo-Controlled Trials,* 14 MOLECULAR PSYCHIATRY 429 (2009) (finding that 41% of those diagnosed with schizophrenia showed therapeutic response to an antipsychotic medication); Evan Schwalbe et al., *Cognitive Dysfunction and Competency Restoration: Using Cognitive Remediation to Help Restore the Unrestorable,* 35 J. AM. ACAD. PSYCHIATRY L. 518 (2007) (citing a study showing that 70% of defendants who could not be restored to competence had a neuropsychological brain abnormality such as AIDS-related dementia, Pick's disease, Alzheimer's disease, mental retardation, or alcoholic dementia).

111. 18 U.S.C. § 3599(g)(2) (2006).

112. This is a statutory requirement. *See id.*

113. Between 1998 and 2004, $101,592 was the median cost for experts in federal capital cases that were tried where the death penalty was sought. JON B. GOULD & LISA GREENMAN, REPORT TO THE COMMITTEE ON DEFENDER SERVICES: UPDATE ON THE COST AND QUALITY OF DEFENSE REPRESENTATION IN FEDERAL DEATH PENALTY CASES (2010), *available at* http://www.uscourts.gov/uscourts/FederalCourts/AppointmentOfCounsel/FDPC2010.pdf#page#1. For federal capital cases in which death was sought but ended in pleas, the median cost of experts was $42,049. *Id.*

down the street. In the *Ford* case, the team was not able to get approval for the scanning because of the expense.

In my experience, money looms very large when we speak of brain scanning because if we don't get funding from the courts, scanning doesn't get done. This is true of state courts as well as federal courts. We know the country is in an economic recession, and the courts are feeling it too. There already is a lot of judicial resistance when capital defense counsel seek funding for thorough mitigation investigations and for competent psychological evaluations. The resistance becomes stronger when defense counsel returns to say, "I now need this much money for brain scanning."

The judicial system's focus on defense costs too often seems independent of whether there is strategic need for those expenditures. This is concerning to defense counsel because we are charged with providing constitutionally competent representation. So, if your investigation and your experts advise that you should be getting your client's brain scanned, and you can't get it done because the court doesn't want to spend the money, the requirement of competent representation begins to seem an unreachable goal.

There is an idea abroad that capital defense work should be performed pro bono or that a big law firm should represent the client pro bono and pay all costs. This is unrealistic and unreasonable given the number of cases in the system. Beyond that, the court reporter, the prosecutor, the police officer, and the judge all get paychecks. Why is it that when a person's life is in the balance, budget issues are in the foreground, and the defense is supposed to work for free?

I will close with the line that was in the movie, but was not in the book, *All the President's Men*,[114] and that is, "Follow the money." If you really want to understand the application of neuroscience in criminal law and, in particular, how scanning is used, follow the money. Watch where it is and is not spent. What you will find is that, in far too many places, we're not doing a lot of brain scanning because of the costs involved.

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AUDIENCE QUESTION: When you talk about the expense, can you put a number on it? If I wanted to get a brain scan, how much would you have to pay for the machine?

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114. *Compare* ALL THE PRESIDENT'S MEN (Warner Bros. Pictures 1976), *with* CARL BERNSTEIN & BOB WOODWARD, ALL THE PRESIDENT'S MEN (1974).

KATHRYN KASE: It is highly dependent on what you are having done: whether you are having an fMRI, a SPECT scan, or a PET. It's also dependent on what you're doing beforehand. To have good neuropsychological testing, assuming no cultural aspects–so assuming you're an English speaker and we don't have to worry about getting tests or instruments in Spanish–a good neuropsychological testing can cost $10,000 and that's before we get into the scanning suite. And then beyond that, it really depends. Emily and I have both talked to experts who want $15,000 to interpret the pictures that come out of the scanner.

AUDIENCE QUESTION: How about the machine itself, the pictures themselves? What's the range from the lowest to the highest?

EMILY PAAVOLA: If I want an MRI and a PET scan, that's probably going to cost me around $7,000 or $8,000 just for the scans. Then you're going to need $15,000 for the quantitative analysis of the scans after they've been completed. As I said, the University of Pennsylvania is the only place that I know of that does the quantitative analysis, and they told me as recently as last month that it would be $15,000 to do the quantitative analysis of a PET or an MRI that I already have.

AUDIENCE QUESTION: What does "a quantitative analysis" mean?

EMILY PAAVOLA: Generally the scans are read by a specialist who looks at the scans, but the scanning process itself generates data that is still available that contains the DICOM. I don't even know what that means, but it's a little disk, and we send it to them. They run it through a computer program that visually takes measurements and quantifies it as opposed to conducting qualitative analysis–looking at it and saying this looks right or not.

AUDIENCE QUESTION: A "quantitative analysis" not a judgment of a doctor or technician, it's just your admission price to get into whatever computer program that tells you the answer?

EMILY PAAVOLA: Sort of. They have a database. It's access to the database, and then they have a variety of specialists who do a number of different calculations, and then they tell you what is statistically significant. They tell you how many standard deviations from the norm the differences are and whether there are any associations with those particular differences and any known disorders or if there aren't, and then they testify.

AUDIENCE QUESTION: Is it ever the case that jurors react to evidence of severe and permanent brain dysfunction by saying that because it's incurable and future dangerousness is the issue, he should just be put to death anyway?

KATHRYN KASE: Elizabeth Vartkessian presented a paper at the Law & Society Conference in Denver this summer based on interviews with fifty Texas jurors about this sort of thing.[115] Remember, Texas is the place where we convicted and sentenced to death Johnny Paul Penry when there was no question he had mental retardation. And interviews with those jurors was that he's damaged and nobody is going to be able to do anything about it so we might as well kill him. Her work basically confirmed that jurors who are told of these severe disabilities are unwilling to consider life sentences absent some showing of ability to rehabilitate. So, the caveat for lawyers is you shouldn't be using the brain scan with the big picture of the hole in his brain unless you can affirmatively deal with how a prison system can hold that defendant, care for him, and prevent him from being violent as a result of whatever his essential brain malfunction problem is, whether it's the hole or temporal lobe epilepsy or whatever it is. Jurors will say, "He is damaged goods, let's just put him down."

AUDIENCE COMMENT: If you look at the trial transcript from *Roper v. Simmons*,[116] the prosecutor said, "He's been damaged; let's kill him." And the jury said, "Well, sure." The evidence in mitigation actually was used against him.

EMILY PAAVOLA: It's really a constant tension in all capital cases. Almost all categories of mitigation evidence can have this dual role, and you have to always try to think about ways to neutralize the possibility that the jury will look at your mitigation evidence as a reason to sentence the defendant to death. A lot of jurors think that it's the humane thing, that we should sentence him to death because he's not redeemable in some way. But I think that there are lots of ways that you can address it, and it all relates to what kind of story you're telling and how you're telling it. It does compare your brain in ways that relate to how you make judgments, how you decide things, and how you plan and think about long term consequences. It can be mitigating, but you

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115. Elizabeth Vartkessian, Fatal Distraction: Does the Texas Capital Statute Discourage the Consideration of Mitigating Evidence? (May 27, 2009) (unpublished manuscript), *available at* http://www.allacademic.com/meta/p405914_index.html.

116. 543 U.S. 551 (2005).

can also see how it can be used to suggest future dangerousness. Tell the jury a story about how this guy was operating with a bad brain to begin with, and he had all this other stuff going on that created the perfect storm that allowed for this crime to happen. They can see it that way. Then you can tell them that in the future, if you sentence him to life without parole, he's not going to be on drugs, dealing with his family issues, and all these other things that were going on when this crime happened, so he's probably not going to be that dangerous in the future because you're going to take away all of the other environmental factors that contributed to what happened.

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Emily Paavola discussed the use of neuroimaging in capital cases to conclude that brain imaging can be an important tool for capital defenders, but that serious risks must be considered before deciding whether to use brain scans. For a more in-depth discussion, see John H. Blume & Emily C. Paavola, *Life, Death and Neuroimaging: The Advantages and Disadvantages of the Defense's Use of Neuroimages in Capital Cases–Lessons From the Front*, 62 MERCER L. REV. 909 (2011).

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Professor Stephen Morse discussed how many of the promises of neuroscience may be over-hyped. For a more in-depth analysis, see Stephen J. Morse, *Avoiding Irrational NeuroLaw Exuberance: A Plea for Neuromodesty*, 62 MERCER L. REV. 837 (2011).

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Judge Morris Hoffman analyzed the failures of Bayesian reasoning, in-group and out-group dissonances, and blaming and punishment dissonances. For more on this topic, see Morris B. Hoffman, *Ten Legal Dissonances*, 62 MERCER L. REV. 989 (2011).