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THROUGH A SCANNER DARKLY: THE USE OF FMRI AS EVIDENCE OF MENS REA[†]

TENEILLE BROWN, J.D.[*]
EMILY R. MURPHY, PH.D.[**]

MR. DE BANATE:

Good evening. Welcome and thank you for coming to the Journal of Law & Health's last speaker series event this year. My name is Fil de Banate [and] with Adam Saurwein, we serve as the editors-in-chief of the Journal. Last week we hosted an event focused on health care policy. Tonight we are pleased to host an event exploring fMRI and its legal significance.

Although [neuroimaging] is still an emerging technology, it has proven to be very consequential in at least one situation. In September 2008, the New York Times reported that a court in India allowed the use of brain scan images in a criminal case, which ultimately led to the conviction of an Indian woman accused of poisoning her fiancé. To this day, the Indian woman maintains her innocence.[1] Hank Greely, a

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[†] This is a transcription of the Journal of Law and Health's Speaker Series event held on April 6, 2009 at the Joseph W. Bartunek III Moot Court Room, Cleveland-Marshall College of Law. Although the editors formatted the text and added headings and footnotes for the reader's convenience, the substantive content has been preserved. Any errors that may remain are the fault of the editors and not the original presenters.

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[1] *See* Anand Giridharadas, *India's Novel Use of Brains Scans in Court is Debated*, THE NEW YORK TIMES, Sept. 15, 2009, *available at* http://www.nytimes.com/2008/09/15/world/asia/15brainscan.html (last visited Apr. 5, 2009); *see also* Emily Murphy, *BEOS Ruling from Indian Court*, Stanford Center for Law & the Biosciences Blog, Dec. 10, 2008, *available at* http://lawandbiosciences.wordpress.com/2008/12/10/beos-ruling-from-indian-court/ (last visited June 1, 2009).

bioethicist at Stanford Law School and a colleague of our speakers, commented on the verdict, [characterizing it as] "both interesting and disturbing."[2] He also wrote in the American Journal of Law and Medicine the following:

> If brain scans are widely adopted, the legal issues alone are enormous, implicating at least the 1st, 4th, 5th, 6th, 7th and 14th Amendments to the U.S. Constitution. At the same time, the potential benefits to society of such a technology, if used well, could be at least equally large.[3]

Tonight, our speakers who are, as I said, Mr. Greely's colleagues, will present on this topic, but it will be more focused [on] evidentiary issues….Adam will now present our speakers.

MR. SAURWEIN:

The Journal of Law and Health pulled some strings this week to welcome our guests with a little lake-effect snow.

Prior to joining Stanford, Teneille Brown practiced law for two years at Latham & Watkins in Washington, D.C., where she represented early-stage pharmaceutical device companies. Brown received her undergraduate degree in history and sociology of science at the University of Pennsylvania with a concentration in bioethics. While at Penn, she wrote an honors thesis on the ethics of elective cosmetic surgery and conducted HIV clinical research. She also conducted research at Penn Bioethics Center and drafted a bill on genetic testing informed consent. Brown graduated from the University of Michigan Law School focusing on bioethics in medicine and the law. She assisted in the creation of the Pediatric Advocacy Initiative, a legal clinic that offers free services to patients. Teneille Brown is a post-doctoral fellow at the Stanford Center for Biomedical Ethics, a fellow at the Center for Law & Biosciences and a research fellow at the MacArthur Foundation Law and Neurosciences Project. Her academic work focuses on the intersection of behavior, biology in the law with particular interest in evidentiary regulatory issues surrounding genetics and neuroscience.

Dr. Emily Murphy is a fellow at the Stanford Law School Center for Law & Biosciences and a research fellow on the MacArthur Foundation Law and Neuroscience Project based at the University of California, Santa Barbara. Murphy's current research focuses on issues surrounding the application of neuroimaging -- of neuroscience and neuroimaging technology in criminal law and civil law, the effect of neuroimaging evidence on individual concepts of the agency and designing hypothesis-driven neuroimaging work that can directly inform legal or policy-based challenges. Murphy graduated from Harvard University and completed her doctoral work in the Department of Experimental Psychology at the University of Cambridge while on a Gates Cambridge scholarship. Her doctoral research examines neural and neurochemical bases of impulsivity and behavioral flexibility.

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[2] *Id.* Psychologists and neuroscientists in the United States who have been at the forefront of brain-based lie detection characterized the Indian court's application of the technology to a legal case as "fascinating," "ridiculous," "chilling" and "unconscionable." *Id.*

[3] *Id.*; *see also* Hank T. Greely & Judy Illes, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, 33 AM. J. L. & MED. 377 (2007).

Join me in welcoming our guests.

MS. MURPHY:

Thank you so much for having us here today. It is interesting to see snow, as we're from California now. You'll forgive us if we're slightly casual in our presentation style. If there's anything that's incredibly unclear technically speaking, please let us know. But if we can, we'll hold some of the bigger questions for the end. We have tried to leave time for that.

Today we're representing our paper which was, as we found out last night – we found out this paper, which is titled "*Through a Scanner Darkly: fMRI as Evidence of Mens Rea*," is going to be published in the Stanford Law Review, Volume 62. So, we're pleased to have the opportunity to present to you guys and to get feedback that we can incorporate into the final draft of our paper.

We're going to talk briefly about neuroscience and law in general. You've probably been hearing more and more about that in the media and in other law reviews and in other law contexts. We think this paper fills a necessary gap in discussing what is admissible, what is not admissible, what purposes different brain imaging technologies can be used for. And so, we hope that this will become a real touchstone of this field as it starts to grow.

I should comment that the India case,[4] we were pleased to learn that as of December, the woman who was convicted and her husband, who was convicted as well, although he did not undergo the brain scanning technology, were released on bail because there were many other evidentiary flaws in the case.[5] So, we don't know how that's proceeding other than that, but things seem to be looking up, and are going to.

We're here today because this technology is quite literally on our doorstep. This is the cover of last year's California Bar Review which strongly suggests that if there are such things as truth and lies and violence that need to be sorted out, surely we can find the answer somewhere in our brains. And as a neuroscientist, I have to say: Everything is in our brain. Obviously every action, every thought, every social interaction, everything we've ever learned is all represented somewhere in our brain. It does not mean—and this is going to be the take-away of the point—that the technology, these technologies to extract such information from our brains, are perfect or that they will ever be perfect to the degree that people are hoping for. And we think this matters because it's already being used in courts.

California v. Savinon was a case brought to our attention a couple weeks ago. The defendant was accused of attempted murder. He, after losing his job, becoming incredibly despondent and breaking up with the victim, went to her house stalked her for several hours, attacked her, duct-taped her into the car seat and tried to suffocate them both with carbon monoxide. He entered pleas of not guilty and not guilty by reason of insanity on the basis that because of his major depression and his recent carbon monoxide exposure, he could not have formed the requisite intent to kill her,

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[4] *See supra* note 1.

[5] *See* Emily Murphy, *Update on Indian BEOS Case: Accused Released on Bail*, Stanford Center for Law & the Biosciences Blog, Apr. 2, 2009, *available at* http://lawandbiosciences.wordpress.com/author/emilyrmurphy/ (last visited June 1, 2009).

setting aside the fact that he then drove her home and bandaged her wounds and gave her the phone to call 911. The claims were going to be supported—and this is why we were contacted—by the testimony of William Klindt, who runs a brain scanning clinic in San Jose and who planned to rely on functional brain images of the defendant taken six months after the fact to support the claims of major depression and carbon monoxide poisoning, neither of which are medically approved uses for this particular brain scan. The prosecutor was, in our opinion, rightly concerned because she worried if she gets these brain scans in front of the jury, that's going to be incredibly convincing. And this was a hypothetical case that landed in our laps after we had written this paper, but this is exactly what we're concerned about, and we'll explain why.

The other reason it matters is because it's available all over the place. There is no FDA regulation of this, of brain scanning industries, and there are many. This is just a sampling of the third party companies, where you can go and get your own brain scanned. Two of the targets for greatest criticism have been this company, No Lie MRI,[6] which was also involved in a recent case in the last two weeks in San Diego—Teneille will talk more about that. The company offers such services to people as risk reduction in dating and issues concerning the underlying topics of sex, power and money. You can see that there are suggested customers: lawyers, law firms, government, corporate customers, individual customers, anybody who values the truth. Another egregious offender in our perspective is the Amen Clinics[7] in Newport Beach which offers SPECT scans, which are radiological scans looking at blood flow to different parts of the brain for many purposes, including, you'll notice, legal issues. On this website are many reported case studies of said legal issues, particularly those explaining the brain's basis of the violent behavior of several people facing criminal charges. Again, you think this is not a good use and Amen's testimony has indeed been challenged in court, and rightly so.

There are many different types of brain scanning technologies that have come into the courtroom and that we expect to see in the future. Today we're focusing specifically on fMRI, which stands for "functional magnetic resonance imaging." Other methods or tests that I mentioned use radioactive tracers; fMRI does not. It is a basic MRI machine that is effectively tuned to pick up the difference between oxygenated and deoxygenated blood.

This is how it basically works: a cognition or behavior of interest is mapped onto your functional brain anatomy based on this kind of principal—a subject, you or anyone who performs a task. In this case, the picture represents a symbol of a finger-tapping task, which is going to activate to the multiprime and the motor cortex in the opposite sides that, of course, runs to that finger. The increased neuronal activity is strongly correlated with an increase in oxygenated blood flow, although there is a timeline. One of the theoretical reasons behind this is that neurons themselves do not store energy; they don't store oxygen or glucose. So, once the neuron has depleted its energy reserve, it sends signals to other neurons to make things happen. It needs to be replenished and you get this increase in oxygenated blood, which brings all sorts of nutrients and oxygen. Oxygenated and deoxygenated blood have very different magnetic properties, and the magnetic resonance scanner

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[6] No Lie MRI, http://noliemri.com/ (last visited June 1, 2009).

[7] Amen Clinics, http://www.amenclinics.com/ (last visited June 1, 2009).

can pick these up. After much processing, we can end up creating what you pictured, that you're probably more used to seeing, a pre-activation map.

fMRI is a fairly young technology. It's definitely in its teenage years. It was discovered in about 1990. And we're going to emphasize a couple of points in this topic: that fMRI inventors correlate neural activity but not neural activity directly. This is an extremely complex and, as yet, poorly-understood relationship. And just in the last three months there have been a handful of papers questioning how strong this association really is. Sometimes the papers have shown an influx of blood flow in the absence of any neuronal activity at all. So, this is an inferential to separate here that you're looking at. So just remember, when you see these pictures, you're looking at blood flow, not of the actual firing of neurons, which is how information is transmitted to the brain.

THE PRESENTERS' THESIS

The thesis of our paper, before we get into a little bit more of the science, is basically this: that in terms of considering the utility of functional brain scanning, particularly fMRI, for evidentiary purposes, we think that Rule 403 of the Federal Rules of Evidence, which weighs the probative versus the prejudicial value, is going to do the most work in terms of determining whether or not this technology should be admitted. And just to save haste, the rule says: Relevant evidence can be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, misleading the jury, considerations of undue delay, waste of time or needless presentation of cumulative evidence.[8]

PROBATIVE VALUE

I'm going to talk briefly now about the probative value side of this. We think a proper analysis of the science should show that the probative value of fMRI addressed to questions of mental state is marginal at best. These are the number of reasons as to why we think fMRI has almost no probative value for assessing mens rea. I'll move through these one by one with examples. The first is base rates and reference classes. The second will be individual differences. The third is the BOLD response. The fourth is standardized methods. And the fifth and sixth are ecological validity and time travel.

Base Rates and Reference Classes

We'll do base-rates and reference classes first. I'm going to go through a base-rate problem here that is sort of specific to lie detection. This is one of the applications, not that we deal with it specifically in this paper, but it is one that

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[8] *See* FED. R. EVID. 403. To quote the rule:

> Rule 403. Exclusion of Relevant Evidence on Grounds of Prejudice, Confusion, or Waste of Time
>
> > Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.
>
> *Id.*

we've already seen being attempted to be admitted into court. And the problem here is that it's not enough to say, "This technology is 90 percent accurate." because there are different meanings of accuracy. Do you mean it's 90 percent accurate of ruling in the truth positives, ruling out false positives?

Let me give you an example of what we call the "base-rate problem," which has to do with basing. For any test that classifies information into two categories—like a lie-detection test, lying or not lying—there are obviously four possibilities: true positives, false positives, true negatives, false negatives. So there are different measures that we're interested in.

I'm going to just walk through this example, because it's easier to see a concrete example. Let's say we have 100 travelers we want to screen. Ten percent of them are lying—ten percent of them intend to blow up the plane. So, a brain scan with 90 percent specificity and 90 percent sensitivity sounds pretty good. So, this is what cuts rates down. The 90 percent sensitivity says that we're going to correctly allow 81 people to go. And these are our false positives, we're going to accidentally detain nine people; too bad for them. Our 90 percent specificity says we're going to correctly detain nine people, and we're going to let—this is going to be the guy that blows up the plane. This is the false negative that we don't want in this situation.

What's really important here, though, is that sensitivity and specificity aren't the only two numbers that matter. What's critical is what's called positive predictive value. Positive predictive value takes into account sensitivity, specificity and the base-rate prevalence, which, in this case percent. But the positive predictive value is that when this scan says to detain someone 50 percent of the time it's actually going to be wrong. It gets worse when the base-rates go down. Let's say we have a one percent prevalence. Other things that include 1 percent prevalence are schizophrenia, psychopathy, probably murders—I mean, there are other things with 1 percent prevalence that we know of. So, the example breaks down even more. So, we're going to detain nine, but our positive predictive value now goes down to, at a 1 percent prevalence rate the scan incorrectly says to detain 99 out of 108 people. We're actually wrong 91.7 percent of the time.

So, the take-away point here is when somebody tells you this is accurate or it works, you need to ask them, "What is your positive predictive value? What is the base rate?" This is a problem for my section. And Teneille might talk more about this, with No Lie fMRI cases where we have no information—zero information—about the base rate prevalence of lying in the general public.

MALE 1:

You're referring to lying in the context of these fMRIs, right?

MS. MURPHY:

Yes. This applies to other lie-detection technologies, too.

MALE 1:

There's a whole area of validity testing since the early '80s about positive or negative thinking power. They take the base rate analysis as well. And they're fairly—by 99 or 98—

MS. MURPHY:

Are you talking about the polygraph?

MALE 1:

No. Simple validity testing. Malingering and behavioral psychology.

MS. MURPHY:

That's a different—we might know something more about that. I'm talking specifically about this case. But the point here is, that the Bazian analysis does break down like this, and these are our validities if you want to know any kind of diagnostic situation.

MALE 1:

That's correct. (Inaudible) in more context.

MS. MURPHY:

In other context, yes. When we know more about it, the more information you have, the more you can say, "This is valid or not valid."

So, the other question besides the base rate is the reference class. And by that I mean: What is normal? Who are we comparing this person to? Can I show that the particular person in question has a mental abnormality, say, that's underscored by a brain abnormality? Well, first I need something to compare him to. And, in this case, perhaps you'd want in a legal case your ideal average rational actor to the law who expects to obey the rules. So I'm going take a bunch of people and compare that individual to a normal brain. Well, this is problematic. First of all, who's going to make up the normal group—people of the same sex, socioeconomic status, background, or people who are actual, if you have someone in question of violating the law, people who are in question who are law abiders? The other interesting thing about this is that experiments in general—basically all of what we know from functional brain imaging—are done on groups of subjects and is finding they're averaged. This is in part because the fMRI signal is indeed very subtle. It's a physiological signal that's very, very subtle, so you need quite a lot of data to select out what are true signals versus what is called "background noise."

So, the law is generally interested in one person at a time. So, the whole point of this slide is, that normal is a statistical creation and an entirely normal one. We have to decide: Who do we mean by normal to compare this person to? And even if we do that, is it valid to compare one person's data which might have extreme physiological noise with a nice, clean average reading? The take-away point here for anybody—a practitioner who is faced with this kind of thing—is you want to know who is in that normal class and what all of their scans look like.

Individual Differences

And the reason for that is because one of the other major problems with brain scanning as evidence is individual differences. Indeed, we all have the same brains respectively, but they're wired up in different ways and we use what we have in different ways. Here's an example that shows the problematic nature of what I'm talking about in evidentiary context. This is a particular vision of which you're looking down on the slice through someone's brain like this. It's called a "glass brain depiction." These nine normal people are doing an episodic memory retrieval test. And circled in red on each individual person is the area voxel—in a brain scanning, a voxel like a 3-dimensional pixel of greatest per significant activation. What would happen is in the study, these nine people, their entire brain data is averaged and you get this. This is the area involved in episodic memory retrieval because this is the part that pops out. If you notice there's very few, if any—arguably only this guy—people in the normal group who look like the average. So, when you say, "Who's in the normal group? What is the average?" it really depends. An individual person who goes into the normal group could be compared and held up to the normal group saying, "This person is abnormal." when, in fact, they themselves went into making that average. This is very, this is all completely obscure in most brain imaging studies, intentionally so. But we think that's highly problematic for this forensic use. Statisticians and scientists are working on this problem of the grouped individual inference, which is not just unique to neuroscience but particularly problematic. And someday we think these comparisons might be possible with stats of more powerful algorithms and analysis technique, but that power does not exist today.

BOLD Response

The BOLD response is another problem for probative value. "BOLD" refers to "blood oxygen level dependent" response, and that is the oxygenation of blood is greater when an area has been activated or you're looking at the differential in oxygenation. The reason for that, these are just recent papers, we don't actually know yet as neuroscientists what the BOLD response really means. For example, we don't know, when you get a spot in the brain that lights up, whether that represents input being received, internal processing in a module, or an output. The inhibition problem, which is one of my favorite areas I used to work on, 15 to 20 percent of the neurons in your brain are inhibitory neurons in that when they fire they inhibit the next neuron from firing. This helps shift circuits so they can be used for more than one purpose. We don't really know how inhibitory neurons work in the BOLD response. It seems like they don't show up very well.

The other point here is that what your brain is not doing can be just as important as what it is doing. We're not sure what the BOLD response tells us about that. Another physiological problem is astrocytes, which are the purported cells within the brain that do not think, do not transmit electrical impulse as information. They've been typically ignored in a lot of cognitive neuroscience research as, "Well, they're there, but we don't know what to do with them, so we ignore them." Recent papers strongly suggest that they affect the BOLD response in ways that we really don't yet understand. And, as I mentioned earlier, a paper in January suggested that blood flow may not actually be coupled with neuronal activity itself, in which case it's really hard to interpret what it means.

So, this graph here is just to remind you that the signal that we're looking at is very, very, very small and sensitive. This is the brain's sort of energy budget. This is our intrinsic activity. With evoked activity, such as stimulating somebody to do a task or stimulating someone to tell a lie, there's going to be a very small fraction of the overall brain energy usage. To filter out a meaningful signal is very hard to do. The take-away point here is that fMRI is not yet in and of itself completely understood. It's great as a research tool, especially to develop other questions, but it has limitations, it is not yet a mind-reading machine. The standardized methods, it's a prong of the *Daubert*[9] analysis, and I'm just going to talk about one aspect of that in terms of probative value. And the reason we bring this up is because brain images, when you process them from the raw data to get these pretty pictures, can be manipulated in several different ways.

For example, it appears in this slide that the image on the left has much more activation than the image on the right. And, Your Honor, I submit that my client, who is on the right, clearly has deficient brain activity and, therefore, should not be held responsible for his or her crime. However, these are all images of the same set of brains, averaged at different statistical thresholds. The lower the threshold the less of that signal we're going to see. The choice of the statistical threshold can drastically affect the interpretation of brain scanning results. And there are multiple statistical programs and analysis packages in use across labs, but no industry or academic-wide standardization. One of the things we do offer in our paper at the end is a list of questions that we think the judge could ask of the offering party to assess the robustness and validity of the processing methods and statistical analyses of the raw data. We also think that these people should be able to ask for the raw data and rerun the analysis. There is so much that goes on in the computer that could be obscured, and this is what neurologist Helen Tabor, who has testified in a number of cases, calls "the opportunity to dial a defect either knowingly or unknowingly."

Ecological Validity

The last two points here are ecological validity and time travel. With ecological validity, the problem here that we think is that defining mens rea—which is a legal term of art and not something that neuroscientists use in our day-to-day life in a way that it could be captured by a functional imaging experiment—is not something that I think anyone is going to agree on for quite some time. Furthermore, we think something as slippery as intent can obviously vary between contexts and different motivational states. Note that to have a brain scan, the subject must be highly compliant and sit in a tight space with your head fixed in a frame, and be willing to hold very, very still and participate in the task. There's just no way that that is, in an ecological way, like the time of the incident in question. That would be a sort of very silly assertion, in my opinion. They're not the same conditions in which someone has committed a crime, and it certainly isn't taking place at the same time. We do not have any information as to how someone's motivational state or someone's belief state, or how many times somebody has rehearsed a set of questions; or it might be displaying counter measures, like thinking about a pink elephant. Thinking about anything else could disrupt or alter a particular brain scan.

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[9] *See* Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579 (1993).

Time Travel

The last point is time travel. And by this we mean there is distance between the time of the crime and the time of the assessment. In the *Savinon* case that I mentioned in the beginning, this distance was six months—a time in which not only could someone change their mind or practice or rehearse their story, but in which significant brain plasticity could occur. Gross lesions or tumors may still be visible, but that's not what we're talking about here. We're talking about functional imaging and mental state. Six months is more than enough time for someone with a mental disease or defect to go into remission or to decompensate and get worse. Obviously, the courts are making assessments about past mental states based on a person's present condition all the time. That's what courts and juries are meant to do. We're just saying here that we shouldn't have great expectations that brain imaging is going to add any particularly strong probative value to this type of assessment. And with that, I'm going to turn it over to Teneille, who's going to bring it back to our thesis. We went over the probative side, she's going to talk about the prejudicial side.

POTENTIAL FOR PREJUDICE

MS. BROWN:

So, Emily spoke about the probative value aspect, and you can see it's a balancing test. You're probably all fairly familiar with test 403 or your counterpart here in Ohio.[10] I'm going to talk about potential for prejudice. And we don't yet have a lot of empirical data on this, but we don't need to because you can just analogize the other types of evidence and see what the potential for prejudice is. And, on balance, if the probative value is substantially outweighed by this potential for prejudice, this is an evidentiary rule that can exclude all types of evidence, not just scientific evidence.

And why 403? We've been asked this by a number of scientific evidence experts. And the reason we're interested in 403 is it really brings up our thesis about the prejudice and the unique and persuasive power of these images. As Emily stated, here's the rule: substantially outweighed by the danger of unfair prejudice. And I'm going to walk through some of the different types of prejudice, including confusing the issues, misleading the jury, undue delay and waste, and also representing cumulative evidence, which is cumulative social psychological evidence, which is actually better in this case.

So why not 702?[11] Does Ohio have *Frye*[12] or are you a *Daubert* State?

MALE 2:

Daubert.[13]

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[10] *See* OHIO R. EVID. 403.

[11] FED. R. EVID. 702 (rule governing testimony by experts).

[12] Frye v. U.S., 293 F. 1013 (D.C. Cir. 1923).

[13] *See* Miller v. Bike Athletic Co., 80 Ohio St.3d 607 (Ohio 1998) (adopting the *Daubert* test and rejecting the *Frye* test).

MS. BROWN:

You're a *Daubert* state. Okay.

So, the question is: Why not try to include this under the rules that are specifically targeted at scientific evidence? And we could have in that we do think that a lot of our arguments and a lot of the points that Emily raised that go to probative value actually speak to the weak validity of brain imagining under a *Daubert* type of test. And the reason we didn't focus on *Daubert* in our paper, we're very interested in: if the science develops, becomes better, and becomes valid for particular uses, then what? What about this potential for prejudice and the effect that these images themselves will have on the jury?

And there's more of a practical test in 403, looking at the waste and looking at the cost of these scans, and it's a little more flexible to allow for changes in the methodology. But even so, this clearly could be excluded under *Daubert* or *Frye*. And the reason being is—for our particular purpose of looking at past mental states—it's not peer reviewed and valid and tested for that purpose.

"Epistemic Mismatch"

But we're focusing here on 403. At the first prong -- I'm going to go through each of these in turn. But the first potential for prejudice is something that Adina Roskies has called the "epistemic mismatch." And that's where there's a difference between what you think you're seeing and the image, what you think it can convey, and what it actually conveys, and all the steps that are required to get to the construction of that image. So, you see a picture of a brain—an fMRI image is referred to a snapshot of the brain—and you think it's actually frozen in time. This is someone's picture of someone's brain or a video of someone's brain at some given point in time. And what you still don't see are all these heavy levels and multiple steps of processing that occur with the dialing of defects, with the picking the statistical package and all of the many discretionary steps that a researcher could engage in to clean up the data. Also, it's not done to distort the data, but it can have that effect if you have a particular legal argument you wanted to make.

Here is a representation of this epistemic mismatch where you start with the fMRI signal and go to the BOLD response and walk through each of these steps that are required to end up on the upper right with this past or future behavior. And that's the legally relevant question, but it requires all these many inferential steps, and at any step of the process, you could be weakening the value of the inferential change. So, by the time you get the projection forward for some future date that's in question or looking back to see if someone had the requisite mental state, it's a very, very weak statement to make. And it's possible, certainly, and as Emily mentioned, these are the kinds of steps that are taken in other types of evidence as well, but the fact that the image blurs this process and doesn't make it obvious that you're going from a signal of the BOLD response in correlation with greater energy consumption all the way up to the past or future behavior or mental state. That's the problem with this evidence is that this is not obvious—all of these steps are not obvious. And, in fact, the final step when you're looking at the past or future behavioral mental state, this is something that really requires a lot of empirical research with cognitive psychology and a lot of agreement among psychologists as to what that behavior means. And it's certainly prone to confirmation bias if you think that you're looking for a specific type of behavior.

Undue Weight of Evidence

The second potential for prejudice is that people will give this image exaggerated weight. You might think of a gruesome photo or computer-animated images that might also fall under this category for potential for prejudice. And this slide captures this undue weight that's given to the images. Emily and I were at a training for judges in November of 2007, where someone whose job it is actually to train judges on how to assess this evidence presented fMRI as "magical" and it would be admitted under any jurisdiction regardless of the scientific *Daubert* or *Frye* tests, and kind of apprised us of what purpose it would be used for. And the reason being is that it had been in 20,000 peer review journals; it was incredibly objective and it was basically going to save the day.

And the problem with this, obviously, is that it's not magical. Just because some process involves computers or algorithms, it doesn't mean that there's not a human involved to decide how to construct those algorithms. So, this is just getting at that idea that brain images are not magical. There's also something called "neurorealism" and "neuroessentialism," where it promises, fMRI seems to promise—and if you saw the CBS video clip,[14] there's discussion about that—where you think you're seeing you yourself in the brain, it's represented in the brain. And you are your brain in a way that you're not any other organ in your body. And you wouldn't think of you being your liver or your gut. You are your brain, and that is kind of the reduction of who you are. And so, it's covered in the media, getting into neurorealism. This is the way that brain imaging in often discussed. You've seen it in the headlines: this is your brain on politics, or God, or a Super Bowl ad. And they're always accompanied by pictures of brains dotted with seemingly significant splotches of color. Now, some scientists have seen enough. We're like moths, they say, lured by the flickering lights of neuroimaging and uncritically accepting of conclusions drawn from it. So, it's obviously being covered in the media quite a bit, and it's often done with this very kind of starry-eyed gaze into what it can promise. And that's definitely a potential for prejudice because of the way it's discussed and the way it's represented.

Cumulative Evidence

The third potential for prejudice is that brain images are actually cumulative with other types of evidence. As Emily mentioned in the construction of the image, you have to start with some tasks, some statements or behavior, something that would then be triggering the BOLD response to activation in the brain. And so, if you have that, then why do you need the brain imaging if all it does is bolster the social-type qualities?

An example of this would be the *Savinon* case that Emily discussed. If you have behavior at the time of the crime, you have a criminal defendant saying and the victim—who is a rare case where we actually have a victim who can speak and testify as to what happened at the time of the crime—she's saying, "He waited outside of my apartment. He tied me up. I somehow convinced him to let me go.

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[14] *See How Technology May Soon "Read" Your Mind*, CBS NEWS, Jan. 4, 2009, *available at* http://www.cbsnews. com/stories/2008/12/31/60minutes/main4694713.shtml (last visited June 1, 2009) (article includes the video of a segment on fMRI technology which aired in CBS's 60 Minutes).

He pleaded with me, 'Don't tell the cops. I'm going to take you back to your apartment. I'll help you bandage your wounds. I'm going to give you a phone to call 911 for help, but don't tell them I was involved.'" That speaks to his mental state at the time of the crime in a way that's so much more than what an after-the-fact brain image can tell us.

And maybe it's not always perfect, and we don't always have behavior at the time of the crime we can draw inferences from about mental state, but when we do have that, then the brain image really adds nothing. It's incredibly expensive and because of all the other potentials for prejudice, it's something that could be eliminated based on the cumulative nature.

So, here, this is another way of representing this. When you're constructing the image, the B state is the experimental state, so that's when you give the subject a task that they have to do, something that you've asked them to get some emotional process. It's something that's supposed to be representing their ability to form intent. Emily's point is a very good one, too, that "intent": what does that mean? Criminal mens rea, intent in a neuroscience setting, it's very specific to the type of action you're taking. But here, you have this B state where there's an activation state from the experiment. You're subtracting a control state, which might be resting or might be doing some other task that's not engaging the ability to form intention. And then, you subtract the two, and you're looking at the difference in the activation between the experimental state and the controlled state. And this just brings home the point again that if you're looking at behavior subtracting from a control state, and then looking at the brain image that results, why don't you just look at the behavior and what does this add?

"Psycho-Legal Error"

And the fourth type of prejudice is something called the "psycho-legal error." It's the fundamental psycho-legal error. It's coined by Stephen Morse, who's a law professor at the University of Pennsylvania. And what this gets at is if you can somehow identify something that's occurring or being collared by the brain that, therefore, that should automatically lead to mitigation. And there is the tendency to think that if you can construct a story that leads up to the brain and it's the cause of the behavior that's in the brain, that, therefore, that leads to mitigation. And, of course, this isn't the case because, as Emily mentioned, everything begins in the brain. So, just because you can show that something has a functional correlate and it begins in the brain, that shouldn't lead to mitigation, but it often does in the way that these cases are argued. So, that's a potential for prejudice just because you need to take that basis from functional thought, and just because you show that someone's brain looks different, it doesn't mean that it acts differently.

Impairs Ability to Assess Evidence

And the fifth potential for prejudice is that it actually impairs people's ability to assess evidence. And this is where we actually have preliminary empirical data. It's not done on mock jury, and that's something that we're working on with the MacArthur Project, is actually taking this sort of situation and apply it to a mock jury. But we'll walk through a few, two preliminary studies that explain this final potential for prejudice.

So, here we have an explanation of something called "the curse of knowledge." And this is a research design where subjects were given this explanation, and you

can read it over with me. Subjects were given the description of this phenomenon, the curse of knowledge, and then they were offered explanations. And they were supposed to rate how satisfying they found the explanation for this phenomenon. And this study was done at Yale.

Curse of knowledge is when you know something, and so you assume everybody knows it. And we all have friends like this, where they know what the capital of some country is, and if you don't know it they're shocked. But just because they know something, they think it's wide-spread knowledge.

And so, then, the subjects were given explanations of this behavior and asked whether or not they thought the explanations were good or bad. So, the bad explanation for the behavior is circular. And it takes a little while to read through this to see that it, in fact, is circular because it doesn't add anything more than what the subjects were first told; it just restates the same thing. The researchers claim that this curse happens because subjects make more mistakes when they have to judge the knowledge of others. People are much better at judging what they themselves know. So, in the experiment, they were actually just re-stating what they had already told the subject. And the good explanation adds something. It adds some explanation that wasn't given before. In this case, it talks about the point of view and the inability to switch your point of view to see that someone else may, in fact, not know this. And what's encouraging is, that subjects were pretty good at differentiating between the good explanation and the bad explanation.

But then, you add this neuro-babble, and you say, "Brain scans indicate...and there's something going on in the frontal lobe where it's known to be involved in self-knowledge." And you add that to the good and the bad explanation, and what happens is here on the left where you don't have the neuroscience evidence, it's an unsatisfying explanation. When you add the neuro-babble on the right, it goes from being a bad explanation to not a great explanation, but at least a good explanation, better than it was before, just by saying, "Brain scans indicate." And so you see they can tell the difference between a good and bad explanation. But when you add the neuro-babble, it somehow makes the bad explanation look better than it is, even though it doesn't add any explanatory power.

And another study that was done is the McCabe & Castel study. This is taking it one step further and not just looking at whether or not neuroscience evidence was presented, but looking at the format of the evidence and whether it makes a difference if it's presented as a brain image itself. So, subjects were given various statements like this one: "Watching TV helps with math ability because both activate the temporal lobe." Obviously this is a logical fallacy because just because two things happen at once, we all know from our LSAT test, that doesn't mean they're correlated. It doesn't mean that one helps the other. So, subjects were just given this statement. And then, they were supposed to rate how scientifically reasonable they thought it was, how sensible this explanation was. And they were given different types of information along with this statement. So, some subjects were just told to read this: "Watching TV helps with math because they both activate the temporal lobe." Some were given this information, plus a graph which is supposed to show that both TV watching and math, they're both interacting the temporal lobe to about the same degree. And then, a third group of subjects were given statements with this brain image, where it's supposed to show that they both activate the temporal lobe to a similar degree. And it was one of those three that the subjects were placed into. And you can see here from this graph that it's not just the fact that this is visual

information. There's something about the brain image that takes you from saying that this is a somewhat sensible argument to now it's much more—this statement makes much more sense just because you put a brain image next to it. And it's not just the visual because the bar graph didn't have that effect. It's something about the brain image itself. And this is preliminary data.

We didn't get many examples of different types of phenomena they were asking the subjects about, but this is something that we're hoping to follow up with and see if we can test this and control for other things like cross-examination, and if you could still this effect, that a brain image can make an argument more powerful. That seems like a pretty clear-cut case of prejudice. You have an argument that's bad; you put a brain image next to it, and now it's better.

So, to conclude here, as Emily mentioned, this is happening right now. It's pervasive, it's persuasive, and it's already upon us. And the technology isn't perfect, but people think that it is. And one issue that comes up here is people blur the uses. So, you have something that's very useful in a research context—or you can think of a blood pressure pump that's really good at measuring your blood pressure, but then if you try to take that same pump and use it to determine whether or not someone is lying, or maybe some theory that if they're stressed their blood pressure will increase, it's not validated for that purpose. But that's what's happening here is that people are trying to blur all the purposes together, and say, "Look, it's being used to track Alzheimer's progress and stroke victims, and so, therefore, we're going to use it to see whether or not someone is depressed and whether or not they had the intent to kill someone in a murder case," which is a totally different usage.

But there is a recent case in San Diego—Emily actually wrote this case; we can send you our blog address where you can read about it.[15] It was an individual, it was a dependency hearing—I'm going to be careful of what I say here because a lot of it is confidential, which might be why they tried to introduce it in this case—so, it's a dependancy case where an individual, a 14-year-old girl was arguing that she had been—she wasn't herself arguing, but the State and the welfare organization were arguing—that she had been sexually abused. And her father was introducing brain imagining evidence to argue that when he made the statement that he did not sexually assault his daughter, he's telling the truth. So, it's not used to detect a lie; he's using it to verify the fact that he's telling the truth.

And what's really troubling about this is California is a *Frye*-type state, so it's whether or not this evidence is generally accepted in the relevant scientific community. And the problem was this is a sealed case; it's a dependancy hearing. So, if they hadn't succeeded in getting it in, nobody would know. But we happened to be contacted by the State welfare services' counsel, who was really concerned about this, and he saw the report. The report is not public. But he saw the report where even internally, there were some inconsistencies in the conclusions that were drawn from the scientists. But then, they were ready to say, "This is generally accepted in the field. This is a valid way to tell whether or not somebody is telling

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[15] *See* Emily Murphy, *No Lie MRI Being Offered as Evidence in Court*, Stanford Center for Law & the Biosciences Blog, Mar. 14, 2009, *available at* http://lawandbiosciences.wordpress.com/2009/03/14/no-lie-mri-being-offered-as-evidence-in-court/ (last visited June 1, 2009).

the truth." And you've got this young woman who's trying to go up against a brain image that her father is introducing, saying that he's telling the truth when he said he didn't abuse her. And the problem is, if it's the general acceptance by the relevant community standard, the whole problem with the test like *Frye* is that you've got this small pocket of people who are actually researching this field. And the broader base of the community is fMRI researchers, they responded very loudly, saying, "There's no way this is generally accepted in the broader fMRI community." If you want to look just at the community of commercial researchers, who are trying to flip around to make money in this lie detection contest, that's, like, four people. And if you ask them, they'll say it's generally accepted because they're conflicted in their interests and they have investors who are going to make money based on this. But that sort of gets back to the whole problem of polygraphs. And the difference between *Frye* and *Daubert*. This is one area where the difference between *Frye* and *Daubert*, it's a huge practical difference, unless you look at the relevant distance in the scientific community, which is in pretty wide agreement that the fMRI technology that was used in this particular case is not valid and it's not an appropriate use at all.

And fortunately the outcome of that was we were contacted by the counsel, we got involved. We were trying to just help them get up to speed on how they can challenge this. There was a *Kelly*[16] hearing, which is the equivalent of the *Frye* hearing in California, where the father was trying to introduce this and get it approved. I don't know exactly what happened as to why they withdrew the request, but the Defendant's counsel was ready to put on a pretty good challenge against this evidence. And he contacted Mark Rakel (phonetic), who is a member of the Long Arm Stanton Project and a senior Nobel-caliber PET imaging researcher at Washington and St. Louis, and he was ready to fly back to San Diego to testify, to say this wasn't generally accepted in the field. And there was enough noise online with people responding to our blog saying, "I can't believe this would ever be acceptable." Before the father's counsel knew that Mark Rakel was going to be the expert witness, they withdrew the request probably because, I would speculate, they wanted to test the waters. And once they realized there was going to be this very physical public response to their introduction, then they stepped back and thought, "Maybe this isn't the right case to be doing this. We don't want our first time we attempt to introduce this publicly, in case it's not accepted." So, it's a very real live case that was last week when they withdrew the request.[17]

So, the conclusion here: at present, is fMRI a valid method for measuring mental states that are relevant to mens rea? No. Is there a danger of unfair prejudice? Yes. Are there alternative forms of mens rea evidence that are at least as probative and less prejudicial? This is the old sheet packs where you have to look and see if there are alternative forms, which there are and they're less prejudicial, then you go with that. So, in this case, it would be the behavior at the time of the crime. With the *Savinon* case, the alternative form of mens rea evidence is the victim's testimony about what was the cover up and the concealment that the defendant tried to engage

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[16] *See* People v. Kelly, 549 P.2d 1240 (Cal. 1976) (adopting the *Frye* test).

[17] *See* Teneille Brown, *Request to Admit No Lie MRI Report in California Case is Withdrawn*, Stanford Center for Law & the Biosciences Blog, Mar. 25, 2009, *available at* http://lawandbiosciences.wordpress.com/2009/03/25/ request-to-admit-no-lie-mri-report-in-california-case-is-withdrawn/ (last visited June 1, 2009).

in. And given the current status of the science, fMRI evidence should be excluded so that neither judges nor jurors are prejudiced.

That's sort of a take-home point from our talk, but we'd also be totally open to a question-and-answer session that follows after that to answer questions about any other quirky things that you think might be interesting: constitutional questions; the 5th Amendment; whether or not this might be considered testimonial evidence and whether or not it would indicate your ability not to incriminate yourself; 4th Amendment issues; hearsay issues. There are all sorts of very interesting evidentiary and Constitutional issues—6th Amendment issues, that we have this argument that tends to be addressed to criminal defendants, would they maybe have a 6th Amendment right to possess this exculpatory evidence because it has to be reliable and probably wouldn't be allowed to be looked at it in the 6th Amendment? But anyway, all these things are free. If you want to chat, you can go ahead and ask some questions now, unless you wanted to add anything as kind of a conclusion.

MS. MURPHY:

Only to say that we're very glad to take questions. We recognize that this is a very controversial area, and we recognize this is a very new and young area. This is a 30,000-word paper. There are a lot of details both technical, scientifically technical, and legal that we've gone through quite quickly here. So, if you want more detail, feel free to ask us. But we're happy to take questions. And we want to say thanks to all of these people, and thank you for having us here today.

FEMALE 1:

If this question is too elemental, just skip it. I'm curious on what they showed the jury to convict the Indian woman when she poisoned whoever she was poisoning. Were they sketches of brain scans and they thought she was lying or what?

MS. BROWN:

What's interesting about this case is that there actually wasn't a jury. It was something like an inquisitorial method where it's one judge who's receiving evidence and who makes the decision and also assists a jury and fact-finder.

And this is the field methodology, and maybe we can show you. What it's doing is reading statements where they're saying—this case was about poisoning and whether or not this woman poisoned her ex-fiance—and so, reading statements leading up to the crime, which are, "I bought the arsenic. I went to the temple, I picked up the Versed. I laced the Versed with the arsenic. I gave the arsenic to Houdi (phonetic)," who's her ex." And then, seeing if there was some sort of recognition in her brain, that her brain recognized—it was EEG, this was not functional magnetic resonance imaging, it was an EEG. Electrodes on the scalp, which was supposed to measure the electro activity when they mentioned these statements to her. And the idea was, we'd have a P300 (phonetic) wave of recognition, but there's no ability currently to differentiate between whether you recognize that stimuli because you know what the charges are against you. And so if you hear someone read back the charge sheet of, "You bought the arsenic, you poisoned your ex-fiance," if your brain looks overactive because you recognize that,

it might be because you know what you're charged with and not because you engaged in the behavior and actually bought the arsenic and actually poisoned your ex-fiance.

MS. MURPHY:

Just to say a word about the technology: it's a brain scan in which it measures functional activity, but you don't get the pretty picture. It's an EEG, which is a cap of electrodes that anybody can wear, including a baby, that measures recordable activity, just superficial brain activity, nothing you can see; whereas, an fMRI and other things can get in the whole brain. And it works basically like this.

MS. BROWN:

We can forward the opinion to you.

MS. MURPHY

The EEG noise, like all other brain physiological signals, is very noisy. So, in this case, this person would be listening to a sound, say, "I bought the arsenic," which was one of the questions that this woman was read. And then, the actual measurement that comes out of her brain is like this. They then repeat, and as I said with the fMRI scanning, you repeat trials dozens and hundreds to times, and sometimes you average or often average cross subjects because this trace here is so noisy. But when you do it over 100 trials, you can get what's called the "event-related potential." Again, though, repetition of things a number of times, we think, is very problematic. There's adaptation in brain; there's no comparison. What happened in that trial is, they made these statements, they read them to her, and then the computer created a report. So, obviously, there was no bias because it was the computer who did it. And all they submitted was the computer evidence. We never saw any brain-trace evidence in that particular case.

MS. BROWN:

But it's a really good question because it is problematic because we don't have peer-review data on this methodology. It's very private. It's a forensic lab out of Dubai, India. And if you look at the case itself, the facts against this individual were incredibly weak; it was all circumstantial. The inferences were always drawn against her, where, "Oh, she stayed in this hotel, which was right by her ex-fiance's house." Clearly, she could have poisoned him, or maybe it's because it's a cheap hotel, or maybe because it has sentimental value with her current husband. But the inferences were always drawn in a way that's very negative towards this woman.

And so, this—it's is called BEOS technology—seemed to play a very important role in convicting her because the other evidence was so weak. And, "Look, we have this EEG data that makes her look very guilty." But the troubling part is that there's not any good peer review that looks at the methodology to see if we can do that. And when we talked to researchers at Stanford who are engaged in similar types of research, they say that it's impossible to be able to get at the source of the

knowledge and the difference between experiencing an event and having some brain recognition activation versus being aware of it after the fact.

And I don't know if you watched the CBS video where John Dylan-Haynes was taking people through the video game, or looking at houses or looking at rooms, and then later showing them some of those visuals and putting them in rooms that they didn't see and being able to detect the rooms that they had seen from the rooms that they had not seen.[18] And the problem there is it seems like it's very interesting work. But what's the legal application? Because what are the odds in a real world setting that you would be able to control the stimuli that someone has seen? They were able to construct this room that they know you haven't seen before, and then test you again to see if you remember it. But if you're talking about a knife or a gun, chances are we've all seen knives and guns, and so your brain might look like it's responding and it's familiar with the stimuli of a gun, but it doesn't mean that you were the one who committed the crime. It might look like your grandmother's gun, or it might look like a gun you saw on CSI. And so, you can't differentiate from the source, and that makes this very problematic.

MS. MURPHY:

The other disturbing thing about this particular technology is that it's now being deployed in two forensic labs in two different Indian states. We haven't seen any negative press or any negative data, judicial opinions, against this technology in particular. In fact, it was advocated saying, "It's so hard to get inside the criminal's mental state, especially if they're really clever and wanted to conceal it. So, we should use this more particularly in difficult cases." That's something that really concerns me.

MS. BROWN:

And we talked about the San Diego case; that father could have been thinking of India and ocean waves, or anything else, we don't know what he was thinking of. He could have been engaged in these things to try not to look stressed out when they were reading the report.

MALE 3:

Last week, when the California case was pending, Cleveland had beautiful weather, and we were also involved in a real life matter where the fellow sitting next to me, there was testimony being given that he was psychotic based on his behavior. And the psychiatrist said, "Psychosis, paranoid type." And the accused, if you will, said, "Fine. Give me a brain scan. And if it shows that my brain is unhealthy in this matter, I'll trust your judgment. Otherwise, I don't think it's accurate." I'm just curious, what's your response, not necessarily in an evidence sense, but in a scientific sense? How capable is the equipment of measuring the health of a brain?

MS. MURPHY:

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[18] *See supra* note 14.

That's a great question because one of the major deployments of this technology in the clinical setting is to try to get a handle on mental illness and the varied kinds of mental illness. It's for predictive purposes, for diagnostic purposes. And, particularly, one of the interesting sorts of secondary uses of that is to help people who have mental illness accept and realize mental illness and follow through with treatment.

We've done a couple of survey-based studies that show that people who have been diagnosed with major depression would like a brain scan. And, in fact, if they have a brain scan, they rate themselves of being much more likely to follow through with treatment. Because somehow it gets the neuroessentialism thing, it really makes it real for them. And in a strange way, it serves a purpose that I'm not comfortable with as a neuroscientist. It's not consistent but it serves this purpose saying, "Oh, it's not me, it's my brain." And in that case, you say, "Well, I need to take care of my brain. My brain is unhealthy."

But to get at your technical question, the use of brain scans to diagnose psychiatric illnesses is truly in its infancy, particularly flexible and acute states, like psychosis, things that come and go. You'd have to get somebody while they were acutely psychotic. We don't have a lot of people who are acutely psychotic who have been in, or who are willing to go into, scanners. The most robust clinical use is for gross lesions, diagnosing if someone had a major stroke or other sort of brain damage type thing, dead tissue versus ischemic tissue. In terms of mental illness, though, it's stickier. The data is really kind of all over the place. I wouldn't feel comfortable using it in a forensic capacity. But if it were in a diagnostic capacity, where it was really serving the purpose of compelling someone to get treatment, that's a grey area for me. As long as that person wasn't able to—

MALE 4:

The question is does it show up?

MS. MURPHY:

No. Well, it depends. I mean, it doesn't show up clearly. I don't think you could take that particular brain scan and say, you could not hand that to a radiologist and say, "Yeah, that person is psychotic."

MS. BROWN:

The question is: What do you compare this to? Then it gets back to that base-rate question of if the individual's brain looks different, is it because they're functioning differently? If you had had a baseline test even of them and not a group of normals or averages, what would it have looked like in comparison to that? It may have been, if you had a brain scan before they started presenting this psychosis, it might look the exact same as when they're psychotic. So, there are all sorts of problems of looking at the activation. Some of the points Emily brought up: if you have reduced functioning in one area of the brain, it might not indicate dysfunction at all. It might be that you're hyper-efficient and that you've just done something over and over again so that you're very skilled at it, as opposed to it being a deficit. So

there are all sorts of problems of using it for psychiatric diagnosis, one individual scan.

MALE 5:

Danny Wibers (phonetic) in 1986 using, I think it was 10, he showed hypofrontality in patients with schizophrenia. The problem is you get the same dorsolateral prefrontal cortex, you get the same thing that Mayberg has found with depression. So, you just cannot diagnose somebody. It's basically a diagnosis based on behavior and systems, behavioral symptoms, not on what's going on in the brain. And they tried a similar thing with the Unabomber based upon that cognitive test pattern. Defense wanted to say he had schizophrenia because he didn't want to acknowledge that he had a mental illness. And you can't do it whether it's cognitive test patterns, whether it's patterns in the brain scan. It has certain phenomenal logical symptoms, and that's the basis of the diagnosis.

MS. BROWN:

I think that might be exactly why certain attorneys want to use the brain images because it's really all entirely based on the psychological data and they're bringing in the brain image often just to prejudice the jury, for that purpose, which it is done. Because it doesn't do any extra explanatory work other than making it seem very concrete and objective. And a hypothesis is that juries are very reluctant or skeptical to receive psychological data and they think there's too much opportunity for malingering, and somehow the brain image is going to get around that. And it's so objective that you won't be able to detect malingering, but, in fact, there's so many steps in constructing—

MALE 5:

In fact, it can detect malingering, especially a higher degree of (inaudible). So I agree with them, that's behavioral. (Inaudible).

MS. BROWN:

The work being done in all these images is all for the behavior. And the image adds this pretty picture to sort of summarize what you already knew through the psychological exam.

MALE 5:

The testing will give you much more information that's relevant and what's going on.

MS. BROWN:

Psychological testing.

MALE 5:

Validity testing. It's a complicated area. But nonetheless, what they do is they look at contrasts. They have analogues considered malingering, they have a spare TBI, a model TBI, those are previously entailed in validity testing. And you compare those contrasts. There's nothing comparable to that in this whole area. And the test/retest, from my ability (inaudible).

MS. BROWN:

Depends upon which measure you're talking about.

MALE 5:

Basically, it's very low because they don't correlate cross measures, different scanners, different machines.

MS. BROWN:

Which is why cross-examination wouldn't take care of it.

MALE 5:

They give you different levels (inaudible). (Inaudible) is huge.

MALE 6:

Actually, I just wanted to ask a question. I'm assuming I kind of heard the answer more or less. I had a client a couple years ago who passed a polygraph with flying colors, and a few months later he confessed to the crime and he gave details that only he would know he did it. He passed the polygraph because he was psychotic. And honestly, at that point, he believed he didn't do it. There's no allowance for any of that here, is there?

MS. MURPHY:

No. Indeed, we have no data one way or the other to know whether or not brain scanning could say, "This guy might be passing the lie detector test, but it turns out he's psychotic." We have no way of knowing. And indeed, all the brain scan lie detector test studies—there are about two dozens that they've published—have been done with healthy, right-handed, age 18 to 40, individuals. So anyone outside of that range—anyone with mental illness, for example, or a history of addiction—we have no idea of the validity of the test for that kind of person.

MS. BROWN:

And if they convince themselves they really thought they were telling the truth, you might not see that.

MALE 5:

A large amount of your defendants are going to have mental issues.

MS. BROWN:

Exactly. And because we have no way to engage in better measures, you wouldn't know exactly what it is they're actually thinking when you measure their brain.

MALE 7:

You were mentioning earlier, getting into some of the constitutional implications, say self-incrimination, where do you think the judge would come down in terms of self-incrimination?

MS. BROWN:

I think in terms of the use again of what the stimuli is. Because if you're asking someone to make a statement as they were in the India case, in that case they were reading her statements and checking on the response.

So, Nida Farahani (phonetic), she's a professor at Vanderbilt, she has written on this -- I don't know if it's been published yet. It has? Okay. She has written a really great article looking at this very question, looking at other predicates and whether or not things were thought of as testimony in the past. Because you know there are many Supreme Court cases that allow for DNA testing, blood testing, *Schuber* and all those in that line of cases. So, if it's in analogy to that, then it's a 4th Amendment issue and not a 5th Amendment issue. But if you think of something about the fact that you're requiring the subjects to respond in some way, even if it's a brain activation in response to someone else's statement, if that's thought of as testimonials, then you could think of this as being a 5th Amendment issue and not being able to order a brain image. Although, for practical reasons, you wouldn't be able to order a fMRI scan now because the defendant would just need to move a tiny bit or breathe really heavily and move their tongue and swallow and it would invalidate the data. So, they're practical, probably compelling the test now, but at least theoretically they're very interesting questions about whether or not it might be considered testimony.

MS. BROWN:

Thank you very much.