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Julia Marshall March 31, 2015

The Mixed Effects of Neurological Information and Brain Images on Perceptions of Psychopathic Wrongdoers

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Abstract

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Although lawyers have increasing utilized neuroscience in the courtroom, relatively little is known about how people differentially evaluate equally valid neurological and psychological justifications of criminal behavior in a legal context. Previous studies have either exclusively examined how brain images affect ratings of a claim's scientific credibility or how mere neurological explanations alter such judgments. Relatedly, others have tested how brain-based information may influence judgments of criminal responsibility, culpability, and blameworthiness. These studies, however, have not tested how mock juror's individual differences in certain core philosophical beliefs may influence how people differentially assess neurological information in a courtroom setting. To fill this gap in the literature, the current study sought to examine how individual differences in mind-body dualism may affect how mock jurors evaluate a criminal's deserved punishment, treatability, dangerousness, and self-control when presented with informationally matched neurological or psychological research corroborating the psychopath's personality disorder. Across 761 participants, I found little evidence of a universal neuroscience bias. However, when taking into account self-reported dualism beliefs, minor differences in punishment tendencies emerged amongst highly dualist individuals. These results demonstrated that neuroscience likely does not possess the power to broadly transform all mock jurors' intuitions about deserved punishment, but the findings did lend credence to the idea that brain-based information may be disproportionality biasing people who already hold certain fundamental philosophical beliefs about the mind.

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The Mixed Effects of Neurological Information and Brain Images on Perceptions of Psychopathic Wrongdoers

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1. Introduction

In 1983, Brian Dugan kidnapped, raped, and killed ten-year-old Jeanine Nicarico in Naperville, Illinois. During the murder trial, his lawyers argued that Dugan suffered from psychopathy, a psychological condition associated with interpersonal and affective deficits in addition to impulsive behaviors (Hagerty, 2010; Hughes, 2010). In an effort to mitigate Dugan's punishment for his egregious acts, his defense lawyers argued that Dugan was unable to understand the moral depravity of murdering a young girl and, as a consequence, should not be sentenced to death. Rather than relying solely on psychological diagnostic information to make a determination about Dugan's impulsive tendencies, the legal defense team called upon psychologist Kent Kiehl of the University of New Mexico to present functional magnetic resonance imaging (fMRI) evidence to substantiate the claim that Dugan suffered from psychopathy. Dugan's case marked the first criminal trial in which jurors weighed data collected via fMRI methods to make a legal judgment about a criminal's deserved punishment (Hughes, 2010). Interestingly enough, the judge decided that scans of Dugan's actual brain should not be presented to the jury out of fear that the pictures may unduly bias the jurors (Hughes, 2010). Instead, Dr. Kiehl described the results of Dugan's fMRI and showed the jurors images of other psychopathic people's brains. Although the jurors' deliberation time exceeded what some presume to be a normal amount of time to decide a case similar to Dugan's, the brain information did not sway the jury; Dugan was sentenced to death (Miller, 2009).[1]

1.1. The Present Use of Neuroscience in the Courtroom and the Media

The Dugan case effectively illustrates one way in which neuroscience can and will be used in a courtroom setting in the future. Despite the questionable relevance of brain images in legal proceedings, information derived from fMRI about individuals is likely to continue to play

a growing role in legal disputes in the coming years (Baskin, Edersheim, & Price, 2007; Buckholtz & Faigman, 2014; Morse, 2005; Satel & Lilienfeld, 2013). In fact, since 2004, lawyers have invoked neuroscientific evidence in approximately 2,000 criminal cases for capital mitigation and for competency hearings (Davis, 2012). Because the standards for image admission are also low in the sentencing phase of capital trials, brain images are likely to find their way into the punishment phase of criminal trials more frequently than in the guilt phase (Moriarty, 2008). Lawyers and cognitive and developmental psychologists have also used neuroimages in addition to neuroscientific explanations to advance an argument for the creation of a separate adjudication system for adolescent criminals (Maroney, 2010). In addition, actual brain scans have recently been used in civil suits to measure degrees of pain in litigants (Reardon, 2015).

To attain a more updated status regarding the use of neuroscientific explanations in the courtroom, I undertook my own investigation of legal references to neuroscience on the Lexis Nexis search engine. To do so, I conducted three sets of searches using different terms related to neuroscience in the courtroom: (1) "neuroscience" and "brain," (2) "positron emission tomography" (PET), and (3) "functional magnetic resonance imaging." These searches were done within two legal content areas: (1) the law review search engine and (2) the federal and state cases search engine. I then logged the number of articles that appeared each year beginning in 1990 and created a graph to represent the change in the search returns until 2014. The total search hit numbers in 2014 should be interpreted with caution because these Lexis Nexis searches took place in early 2015 and all the relevant articles may not have been integrated into the Lexis Nexis database at that time. The results of these searches are displayed in Figure 1, Figure 2, and Figure 3.

Although references to neuroscience have fluctuated in the past 25 years, a trend is clear: neuroscience and the brain are increasingly referenced within legal briefs in federal and state cases in addition to law reviews. Interestingly, PET has been intermittently referenced in the legal literature in the past 25 years, whereas fMRI has only recently become a focus in legal discussions. This disparity demonstrates how varying neuroscientific technologies have infiltrated legal matters differently throughout the past decades. PET imaging may have been more popular in the 1990s, but, as fMRI gained more traction in the scientific realm, attorneys turned to this method to potentially aid in adjudicating legal issues. Ultimately, these graphs demonstrate the importance of examining how jurors, lawyers, and judges interpret neuroscientific information in the courtroom because of the brain's more recurring appearance in legal matters.

Beyond the courtroom setting, neuroscience has also been featured more often in scientific media reports and in academic papers (Jones, Wagner, Faigman, & Raichle, 2013; O'Connell, De Wilde, Haley, Shuler, Schafer, Sandercock, & Wardlaw, 2011). In an evaluation of media coverage of neuroscience findings, Racine and colleagues (2010) found that media portrayals of diagnostic and therapeutic technologies were hopeful about the future directions of neuroscience and did not include any discussion of the limitations of the original research. Another assessment of neuroscience in the media found that media reviews of applied neuroscience (e.g., lie-detection, neuromarketing) mentioned very few technical details of the original imaging studies (O'Connell et al., 2011). This recent increase of neuroscience in the courtroom and the media demonstrates the possibility that the general public will likely continue to learn about neuroscientific techniques from a relatively uncritical perspective.

I propose that neuroscience may be accorded prominence in the media and the courtroom because of the discipline's scientific appeal. To the general public, neuroscience captures more about behavior than "mere" psychological approaches that can also clarify the mysteries of the human mind (Janda, England, Lovejoy, & Drury, 1998). One reason for such a bias may be that people tend to view psychology as a less scientific enterprise than neuroscience, replete with subjective determinations of why people behave in certain ways (Lilienfeld, 2012). Put another way, people may think that neuroscience is "hard" evidence whereas psychology is "soft" evidence. For instance, psychological data, such as clinical interviews and self-report measures, may not be thought of as a truly "scientific" method of understanding human behavior. To illustrate this tendency, Munro and Munro (2014) asked people to evaluate magnetic resonance imaging (MRI) findings and cognitive testing results to determine whether a political leader should be allowed to continue serving in his position. They found that the participants deemed the MRI evidence as more favorable than comparable behavioral information. This effect was pronounced for people who identified with the political party of the personal in question and, as a result, had an ulterior motivation to believe the MRI evidence.

The way people conceptualize the mind-body distinction could also help to explain the potentially persuasive nature of neurological explanations of behavior. Because many people tend to think that the physical brain is separate from the mind, mind-body dualists may find neurological descriptions of action and fMRI images as counter-intuitive and surprising (Bloom, 2009; Demertzi et al., 2009). Paradoxically, although neuroscience research has played a pivotal role in disproving the mind-body distinction, differing dualist beliefs may be responsible for much of the allure of neuroscience images and explanations. This notion that mind-body dualists find brain images as unduly persuasive will henceforth be referred to as the "mind-body"

hypothesis. To test this idea, Hook and Farah (2013) examined the effect of dualism beliefs on scientific judgments and reported mixed results. In the experiment, participants rated scientific explanations with or without images (e.g., fMRI image) on a variety of outcome measures and responded to questions assessing dualism beliefs. In the analyses, Hook and Farah then separated the participants into three groups based on their dualism score: mind-body dualists, intermediate mind-body dualists, and physicalists. Hook and Farah failed to find differences in the surprising or interestingness of research findings accompanied by an fMRI image as a function of dualist beliefs. Nevertheless, they did find a significant effect of dualism on ratings of worthiness of funding and agreement with the conclusion, with physicalists giving higher ratings on both measures in comparison to people in the intermediate mind-body dualism belief group.

Both the heightened scientific status of brain data and the intuitiveness of dualist beliefs could play a role in legal decision-making as attorneys increasingly utilize neuroscientific explanations in the courtroom. In particular, legal scholars have noted that neuroscience has the potential to serve as a more objective tool in understanding criminal responsibility (Jones et al., 2013b). The idea that neuroscience unduly influences general audiences into accepting poorly supported claims about behavior has been called the "seductive allure" hypothesis (Weisberg, Keil, Goodstein, Rawson, & Gray, 2008). The seductive allure has also been witnessed first-hand in criminal cases: forensic neuropsychologist Dr. David Martell observed that when presented with images of an abnormal brain in the courtroom, people exhibited awe despite the images' inability to provide unparalleled insight into human behavior (Davis, 2012). With regard to the role of "mind-brain" hypothesis, Paul Bloom (2006) has also discussed how dualists' intuitions may continue to fuel a neuro-obsession: "Intuition tells us that our minds and our brains are very

different things. The pretty pictures of our brain at work will continue to seduce us in many insidious ways" (para. 11).

1.2. Overarching Methodological Issues of fMRI

Neuroscience may offer the possibility of understanding the mechanisms that underpin behavior at some point in the future, and neuroscientists have made remarkable progress in unearthing new information about the brain in the past two decades. However, as courts have turned toward neuroscience to weigh in on criminal justice questions, many psychologists and neuroscientists have fervently warned against using functional brain imaging data for adjudicating legal disputes because of the methodological limitations of current imaging technologies (Mayberg, 1992; Morse, 2005). Common criticisms of imaging generally take many forms and can arouse heated debate among neuroscientists and psychologists. Because the debate about the interpretability and relevance of some neuroscience is rather expansive and nuanced, I will avoid delving into the intricacies of this dispute because such a discussion is not directly relevant to the present paper. Nonetheless, I will discuss two primary criticisms that present a potential problem to lawyers who hope to utilize fMRI data in the courtroom: (1) the challenge of moving from group to individual and (2) reverse inference.

As was true of the Dugan case, the court is primarily interested in ascertaining information about an individual's mental state. However, the focus of many fMRI studies is to analyze aggregate differences in brain activation between groups of participants. Generalizing group data to an individual, as is the case in legal proceedings, is often an erroneous application of research findings (Buckholtz & Faigman, 2014). Second, brain-imaging data are susceptible to a reverse inference problem. Because cognitive states and brain activation do not correlate one-to-one, some research misattributes activation of a specific brain area to a function known to

activate an anatomical area, when the region in question is responsible for multiple brain functions. Because the law is concerned with mental states and neuroscience could provide a way to correlate brain states with complex mental activity, the reverse inference problem most certainly illustrates a way in which fMRI data may be unnecessarily prejudicial in a courtroom setting (Brown & Murphy, 2010). There are areas, however, in which engaging in reverse inference may provide insight into human beliefs above and beyond behavioral information, as was the case in a study assessing musical preference using fMRI methods (Ariely & Berns, 2010).

These common criticisms are not meant to discredit neuroscientific attempts to ascertain new information about behavior; rather, I discuss them to point out the potential problems with misguided or misinterpreted neuroscience and, more importantly, to demonstrate the difficulties in distilling the complicated caveats associated imaging methodologies to jurors. The stipulations I have outlined are also applicable to neuroscience explications of behavior that are derived from imaging analysis but do not rely explicitly on showing jurors brain images. Overall, both legal scholars and neuroscientists have crafted a persuasive argument to exclude neuroscience images from the courtroom based on much more than the two limitations I have described (Buckholtz & Faigman, 2014; Morse, 2005; Satel & Lilienfeld, 2013). However, a discrepancy continues to exist between what academics theorize about the relevance of neuroscience and what lawyers believe may bolster their legal case, as is demonstrated by the increasing use of brain images and neuro-explanations in the courtroom setting (Stix, 2013).

1.3. Philosophical and Legal Issues with Incorporating Neuroscience into the Courtroom

Aside from debates about fMRI's methodological limitations, an argument has also recently emerged regarding neuroscience's potential to raise questions concerning underlying

philosophical concepts and legal tenets. Some scholars have proposed that neuroscience could upend people's core philosophical beliefs about free will, which could in turn alter the way in which the court conceptualizes justice and punishment (Cashmore, 2010; Greene & Cohen, 2011). On the other side, law professor Stephen Morse (2014) has argued that neuroscience poses little challenge to current legal doctrine. He contends that elucidating the cause of a behavior does not alleviate someone of responsibility. Both sides of this debate point to the significance of assessing people's attitudes of biologically based causes of behavior in different ways that I will address in turn.

Those who believe that neuroscience could eventually usher in legal changes explicitly discuss the importance of evaluating people's intuitive beliefs about criminal punishment. Specifically, Greene and Cohen (2011) argued, "The legitimacy of the law itself depends on its adequately reflecting the moral intuitions and commitments of society. If neuroscience can change those intuitions, then neuroscience can change the law" (p. 1778). Indeed, the seductive allure research represents a route of inquiry that can speak to how people's beliefs about responsibility change after learning about the brain. For instance, recent scholarship suggests that people tend to punish wrongdoers less severely when presented with scientific information suggesting that free will does not exist (Shariff et al., 2014). This finding demonstrates how certain types of information (e.g., brain-based causes of behavior) have the potential to alter people's general intuitions about criminal punishment.

The second position stands to benefit from research on the seductive allure of neuroscience information in a different way. Specifically, research on the alluring nature of brain-based explanations speaks to the potentially prejudicial nature of neuroscience. It is through the probative/prejudicial distinction that psychologists can help lawyers to examine how

certain aspects of legal evidence may influence judgments. There are two particular questions that pertain to the probative/prejudicial debate of neuroscience evidence that psychology could help to answer: (1) Does brain information add additional value above and beyond psychological information? (2) Does brain information influence how potential jurors fundamentally think about moral responsibility in a way that could unduly change sentencing outcomes? The law intersects with both of these concerns by enforcing evidentiary standards that address concerns of wastefulness, unnecessary cumulativeness, and unfair prejudice under Federal Rule 403.[2] This paper, although not intended to render a final verdict on the value of neuroscientific explanations in all legal cases, hopes to provide insight into how potential jurors may differentially understand psychological and neuroscientific information.

To summarize, there are two major challenges to admitting neuroscience into the courtroom, one of which stems from limitations of the method itself and one of which posits that neuroscience is not relevant to the behavioral criteria of the law. There is a parallel line of scholarship that emphasizes the importance of understanding how neuroscience could change lay beliefs in criminal responsibility. These varying discussions of neuroscience and the law converge in meaningful ways and diverge significantly on others. Yet, all of these lines of argumentation stand to benefit from studying how people understand biological and psychological explanations of criminal behavior.

1.4. The Empirical Neuroseduction Debate

The present study attempts to elucidate how neuroscience evidence may prejudice jurors by assessing people's punishment determinations and beliefs about criminal justice after learning about equally valid brain-based or psychological-based explanations of psychopathic behavior. Fortunately, the prejudicial nature of neuroscience and neuroimages has been subject to

experimental testing previously; however, the findings from this body of literature have often been inconsistent. To begin, the literature surrounding the seductive nature of neuroscience has its origins in two seminal experiments that sought to assess the allure of neuro-information and neuroimages. Earlier research pertaining to the seductive nature of neuroscientific explanations and images did not directly interface with the legal realm and instead tested how people evaluated brain-based information and neuroimages in the context of basic explanations of behavior.

First, McCabe and Castel (2008) had participants read scientific articles with or without brain images and made judgments of scientific credibility. Some participants in the experiment looked at an fMRI image to support the scientific claim made in the article about whether watching television helps with mathematical ability or whether playing video games benefits attention, whereas others saw a bar graph supporting either of these two claims. The critical manipulation was the inclusion of an image because both conditions alluded to neuroscientific research. McCabe and Castel found that those who saw brain images tended to rate the article as *more* scientific than articles that only featured a bar graph. The authors concluded that the fMRI image provided participants with a tangible explanation for the scientific claim presented in the article and, in turn, influenced judgments of credibility.

Second, Weisberg and colleagues (2008) sought to assess how mere neuroscientific information bolstered flawed arguments. In the experiment, participants were presented with accurate or invalid explanations about behavior. Some of the good and bad explanations included relevant or irrelevant neuroscience. Participants were asked to evaluate the quality of the explanations. The researchers found that participants were able to discern between good and bad explanations; however, people were more satisfied with and persuaded by invalid explanations of

behavior when neuroscience information was included. Weisberg and colleagues found that the effect of neuroscience information on satisfaction persisted even for students who took a cognitive neuroscience course, but not for experts in neuroscience. The authors conjectured that the effect of neuroscience information may arise because (1) people interpret neuroscience information as a physical representation of more abstract behavior and that (2) neuroscience information was more surprising to people because it countered intuitive beliefs in mind-body dualism (the "mind-body" hypothesis). It is important to note, however, that one of several key differences between Weisberg et al.'s study and McCabe and Castel's (2008) is that the former did not ask participants to examine neuroimages.

Taken together, these two studies began to form an argument that neuro-information and neuroimages have the potential to bias people toward blindly believing neuroscientific findings. Both of these influential studies together have accumulated more than 750 Google scholar citations since their publication, and several researchers have attempted to find support for the seductive allure hypothesis as a result. Many of these efforts found neuroimages to *not* influence reports of scientific credibility. In one expansive replication attempt, Michael and colleagues (2013) attempted to replicate the effect of neuroimage inclusion on reports of scientific credibility. Across 10 experiments, they failed to corroborate the findings of the original McCabe and Castel study in a variety of samples (e.g., Amazon Mechanical Turk, undergraduate sample, and high school sample). In one of the 10 replication attempts, the authors also designed an experiment to maximize the "glitziness" of the image, and, as was the case in the other 9 experiments, no significant effect of image inclusion was found. The experimenters also conducted a meta-analysis of these 10 experiments and found no significant difference in judgments of persuasiveness in the brain image and graph conditions (Michael et al., 2013).

These failed replications clearly pose a problem for the notion that brain images are unduly seductive to general audiences. Two additional studies further examined the supposed persuasive power of brain images in a slightly different way. Gruber and Dickerson (2012) had participants evaluate news articles that featured different types of pictures, one of which was an fMRI image. The researchers found no significant difference in reader evaluations of the articles and concluded that images may not possess a special persuasive influence. Hook and Farah (2013) also demonstrated that neuroimages may not unjustifiably influence people to judge certain articles or arguments as more interesting, surprising, innovative, or worthy of funding. The authors of this study concluded, "When it comes to brain images, seeing is not *necessarily* believing" (Hook & Farah, p. 9, emphasis added).

Although the results of these studies seem to suggest that images themselves are *not* disproportionally influencing, it would be premature to conclude that the "seductive allure" hypothesis has been put to rest entirely. The lack of evidence for the seductive allure of neuroimages does not rule out the possibility that neuro-*explanations* may be unduly influencing to general audiences. In the aforementioned set of McCabe and Castel replication attempts, Michael and collaborators (2013) also sought to replicate the Weisberg et al. study (2008) and found that neuroscience *information* did have a marked effect on evaluations of persuasiveness. The authors posited that the findings regarding neuroscience explanations (as opposed to neuroimages) persisted because neuroimages possess the same persuasive elements as neuro-information. Consequently, the neuroscience article with an image may not portray any persuasive information above and beyond the information presented in the article's neuroscientific explanation itself (Michael et al., 2013). A more recent study also found support for the "selective allure" of neuroscience explanations (Scurich & Shniderman, 2014). The

researchers found that participants viewed neuroscience information as particularly credible when the explanation coincided with previous beliefs about issues (e.g., abortion).

Despite many studies that have found little effect of brain images on different outcome measures, Ikeda and collaborations (2013) reported that brain images influenced participant's meta-comprehension judgments of certain texts in two experiments. In the first, participants either read a text with neuro-information or a text with the same information and an image. In the second experiment, the readers examined a text with an accompanying bar graph or brain image. The researchers found that people in the first experiment rated their comprehension of the text with a brain image as higher even though scores on the comprehension test did not differ in either condition. The trend continued in the second experiment: people tended to think they comprehended the text with a brain image better than the text with a bar graph. Although this study does not directly replicate the McCabe and Castel (2008) study, it does demonstrate that images have the potential to influence people's subjective values of a text when a brain image is present.

The seductive allure research has also been applied to courtroom scenarios to further understand how neuroscience affects legal judgments. Several studies have devised experimental situations in which people are asked to evaluate a supposed criminal's guilt or punishment after interpreting and evaluating neuro-information or brain pictures with mixed results. Overall, the results from this body of research largely mirror the results from the research on more basic evaluations of brain-related information (Roskies, Schweitzer, & Saks, 2013). Specifically, the aggregate results of several studies suggest that brain images themselves have limited ability to sway determinations of guilt, whereas images often play a greater role in influencing sentencing (Roskies et al., 2013). With regard to mere explanations, several studies

replicated the effect of neuro-information on judgments of both guilt and sentencing (Roskies et al., 2013).

Building on the body of literature pertaining to the "seductive allure" hypothesis, Schweitzer, Saks, Murphy, Roskies, and Sinnott-Armstrong (2011) found that neuroimages played little role in verdicts or sentencing after conducting four experiments that tried to lower the burden on participants to render not guilty verdicts. The experimenters accomplished this goal by decreasing the severity of the hypothetical crime with each subsequent experiment. The researchers skillfully conceptualized several different control conditions (e.g., bar graph, generic courtroom image, mention of a brain scan) to compare the effect of the admission of a brain image on verdicts and sentences. Although the researchers found no significant effect of neuroimages on verdicts or sentences, they did find that people tended to judge expert evidence that appealed to neurological evidence as more persuasive than clinical psychological explanations of deviant behavior. A follow-up study found that participants rated a psychopathic criminal as less responsible for his actions when the defense included a neuroimage (Saks et al., 2014). Contrary to many previous findings, the most persuasive combination of evidence was neuroscientific expert testimony along with a brain image. This finding is worthy of attention considering that previous studies did not find that neuroimages added any additional persuasive power above and beyond the neuro-information (Hook & Farah, 2013).

Three other noteworthy studies examined the seductive allure of neuro-information as well. One study found that participants who evaluated hypothetical defendants who were (1) diagnosed with a psychotic disorder, (2) could demonstrate a lesion through MRI, and (3) had a history of brain injury were more likely to render a not guilty by reason of insanity verdict compared with defendants for whom no neurological evidence was presented (Gurley & Marcus,

2008). Second, Schweitzer and Saks (2011) did find that neuroscience-based evidence was more persuasive than psychological or family history evidence in an experiment that assessed the role of brain image evidence in insanity defenses. Finally, contrary to two previous studies, Greene and Cahill (2012) found no apparent change in sentencing preference as a function of the type of evidence. However, researchers found that neurological information and neuro-information decreased sentences for hypothetical defendants deemed at high risk for future dangerousness.

Taken together, the results of these neuroseduction studies paint a murky picture of the alluring influence of neurological and neuro-imaging evidence in evaluating criminal behavior. To navigate the mixed findings of these studies, I present three considerations that play a role in understanding how neuroimages and explanations influence legal decisions. The present study was conceptualized and designed with these three considerations in mind.

The first distinction relies on the important difference between an *explanation* and an *image*. I propose that brain images and neuro-explanations may influence people to change their judgments of responsibility for similar reasons. For instance, both fMRI images and neuro-explanations of brain abnormalities directly draw on "hard" scientific work and demonstrate the counter-intuitive concept that all actions are a result of mental machinery. Comparing one experimental condition in which people only read about a brain abnormality without an image with an identical condition that includes an fMRI image does not isolate the persuasive elements intrinsic to neuroscience generally. With that consideration in mind, a conceptually sound control condition cannot allude to brain-based causes whatsoever. Rather, the more methodologically sound contrast to neuro-information is a psychological explanation that draws on behavioral information, which is often derived from survey and interview methods.

Mock jurors may also justifiably believe that neuroscience information plays a probative role in evaluating evidence. That is, brain-based explanations accompanied by fMRI data may in fact provide mock jurors with relevant information above and beyond descriptions without a picture or with another type picture (e.g., bar graph, image of a courtroom). Farah and Hook (2013) applied this argument to the McCabe and Castel (2008) experiment by pointing out that the bar graph presented to participants was not informationally equivalent to the fMRI image insofar as the brain image provided further corroboration of the claim that a behavior is localized in the brain whereas the bar graph did not. If the image condition did actually provide additional relevant information, then the results would not support the "seductive allure" hypothesis; rather, the findings would demonstrate that the participants were correctly picking up on the additive value of the image in the picture condition. This line of argument could serve as an alternative explanation of the McCabe and Castel findings. Nevertheless, Farah and Hook's interpretation of the results does not explain why the image effect failed to replicate in subsequent studies.

The last distinction that carries weight in understanding the "seductive allure" hypothesis in the courtroom rests on the difference in evaluating guilt and punishment. Specifically, scientific explanations of behavioral causes do not affect determinations of guilt but may change people's judgments about punishment (Schweitzer et al., 2011). This finding is not wholly unsurprising because guilt determinations often more closely rely on whether someone did commit a crime ("actus reus"). As opposed to information corroborating an alibi that suggests a person could not have committed a crime, neuroscientific and psychological attempts to understand mental states may do little to influence judgments of guilt. Neuroscience and psychology may, however, play a larger role in challenging how people think about intention and mental state ("mens rea"). For instance, if brain-based information could *prove* that someone

killed another person as a consequence of inactivity in a specific area of the brain, then jurors may think that the criminal committed the crime but is not as responsible as someone without a brain abnormality.

1.5. The Present Study

In the present paper, I intended to test the hypothesis that invoking the brain in otherwise matched explanations of psychopathic behavior could alter judgments of a criminal's blameworthiness and treatability in addition to the quality of a scientific explanation. Second, I intended to ascertain whether individuals' philosophical beliefs in mind-body dualism interacted with the effect of images and biological information. To my knowledge, no study to date has examined both of these research questions in tandem.

To parse the differential effect of image inclusion and explanation type on judgments of criminal behavior and scientific persuasiveness, I developed a hypothetical criminal trial that mirrors the Dugan case described above and asked participants to sentence the psychopath, provide their reasons for rendering a specific sentencing decision, and rate their impressions of the criminal. Specifically, I conducted a 2 (visual imagery: with or without) x 2 (explanation type: psychological or neuroscientific) between-subjects experimental design to assess differential attitudes about a criminal's actions between people who learn about biological or psychological origins of psychopathic behavior with or without an image.

In contrast to previous experiments on the seductive allure of neuroscience, I made four changes to better assess the effect of brain-based information. First, I exclusively assessed sentencing and *not* judgments of guilt because the latter is not a sensitive proxy for measuring intuitions about culpability for the reasons described earlier. Second, to control for the possibility that the fMRI image provided relevant information above and beyond any of the other

conditions, both the brain-based and psychological-based explanations explicitly referenced the error rate of the measurement tool used to diagnose a criminal with psychopathy. By noting the validity and reliability of the hypothetical psychopathy measure, the different explanations did not vary in their scientific merit and left little room for participants to interpret the scientific quality of the hypothetical psychopathy diagnostic measure. Third, because recent evidence suggests that people evaluate scientific evidence differently based on previous beliefs (Munro & Munro, 2014; Scurich & Shniderman, 2014), I included a battery of individual difference measures to determine whether individuals' beliefs regarding mind-body dualism play a role in evaluating criminal behavior. Finally, participants responded to several other questions about the criminal's treatability, dangerousness, and level of control over his actions in addition to questions about the role of punishment in society to capture a more comprehensive picture of the factors that may influence mock jurors' sentencing decisions.

1.6. Predictions

I hypothesized that participants in the neurological explanation would view the criminal as less deserving of punishment and as more of a danger to others because the brain-information would provide convincing scientific evidence that corroborates the claim that the criminal was unable to withhold his impulses. As a consequence, mock jurors would believe that the defendant was less culpable for his behavior and participants would dole out lighter sentences. In addition, I predicted that mock jurors would view the defendant as more treatable after learning about a biological cause of an abnormal behavior because the origins of the problem lie in the physical brain and can thus be targeted for rehabilitation (Furnham, Daoud, & Swami, 2009). However, very little research, if any, has focused on how people differentially assess the treatability of psychopaths and, as a consequence, this particular investigation was included to provide

preliminary data about how lay people assess treatability as a consequence of learning a neurological explanation of maladaptive behavior. Furthermore, mock jurors would rate the neurological description as more scientifically sound because neuroscience information represents a "hard" scientific method to peer inside the human mind to general audiences. Psychological information about behavior, in contrast, may seem less scientifically credible.

With regard to the effect of image inclusion on similar judgments of criminal action, the predictions are more challenging to convincingly formulate given the mixed findings in this area of research (Michael et al., 2013). I predicted that participants would find explanations with images as more persuasive but not as indicative of diminished culpability, increased treatability, or future dangerousness primarily because the image would provide mock jurors with superfluous information to refer to when rating the quality of an explanation. However, the image itself would not provide mock jurors with an additional reason beyond the explanation itself to think the criminal is less deserving of punishment, more likely to be helped or cured by treatment, or more of a threat to other people.

In order to examine how explanation type and image inclusion affects broader judgments regarding the role of punishment in society, I asked mock jurors to report whether they believed their sentence choice was fair and whether their choice of sentence served as a deterrent value to other potential wrongdoers. These two questions were included as a way of testing the possibility that learning about biological origins of behavior can alter philosophical beliefs about the role of punishment in society more generally. In contrast to a previous study where participants read an article that suggested free will did not exist (Shariff et al., 2014), the current study merely presented a singular case in which an individual behaved abnormally due to his biology. No explicit remarks were made about the existence of free will. Because of this difference, I

predicted that neither the inclusion of an image nor explanation type would affect judgments of fairness or deterrence significantly.

Lastly, to test the "mind-body" hypothesis, I expected that mind-body dualists would find neurological explanations of criminal behavior as more impactful because the brain-related information provides evidence contrary to the belief that the mind and brain are distinct.

2. Method

2.1. Participants

All participants were recruited through Amazon's Mechanical Turk (M-Turk). Each participant was paid $1.50 for completing a survey that took on average 31 minutes to complete. The survey was limited to M-Turk workers of whom had performed greater than or equal to 1000 human interest tasks (HITs) and had an approval rating of greater than or equal to 95%. The HIT for this study was limited exclusively to United States residents. U.S. residency was monitored by asking participants to provide their zip codes. Because multiple HITs were published for this study over the course of 2 weeks in February of 2015, the experimenter ensured that each participant had taken the survey only once by tracking M-Turk identification numbers and rejecting M-Turk workers who took the study more than once.

Because the study required participants to read through a set of detailed court transcripts and to render verdicts on relatively complex matters, I included a set of 8 comprehension questions to assess each participant's level of attention to the subject matter. To maximize the likelihood that participants included in the analyses were attending to the material, I set a stringent cut-off for inclusion in analyses. Doing so resulted in eliminating 8.6% of the original sample (n = 833). The final sample (N = 761) included only participants who got a perfect score on the comprehension test (n = 578) or missed one question (n = 183). For each major analysis, I

also examined the analogous results when including all the participants and indicated noteworthy discrepancies.

Consistent with other data from M-Turk samples (Dai, Lin, & Weld, 2013), the final sample included more females (n = 413) than males (n = 342), ranging in age from 18 to 73 (M = 36.53, SD = 11.91). Each participant also noted his or her highest level of education. Of the people who answered the education question, 58.7% of participants reported earning a graduate degree. Of the remaining participants, .3% reported having some high school education, 8.9% indicated having finished high school, 32.1% noted having finished some of a college degree, and 41.9% specified having completed college.

The participants also responded to demographic questions assessing their levels of religiosity, political affiliation on three dimensions, and exposure to psychological research. For religiosity, participants answered a questionnaire indicating how often they attended religious events ranging from not at all to more than once a week. For political affiliation, participants rated their political orientation on a Likert-type scale with 1 indicating very liberal and 5 indicating very conservative. Participants also noted their social and economic political leanings on an analogous Likert-type scale as was used in the overall political affiliation question. Finally, participants answered a question asking whether they had taken a psychology course. Demographic information was then analyzed on these three demographic variables. 56.8% of people indicated that they never attended religious events, signifying an overwhelmingly non-religious sample. Most (n = 239) did not self-identify as very liberal or very conservative (M = 2.57, SD = 1.08). Similarly, the final sample was slightly more socially liberal (M = 2.33, SD = 1.13) and somewhat more economically conservative (M = 2.92, SD = 1.18). Of particular

importance, 540 participants (71%) indicated that they had taken a psychology course of some form.

2.2. Procedures

A link to a study entitled, "Science in the Courtroom," was published on M-Turk. Upon entering the M-Turk study, participants were directed to a survey that began with an approved Institutional Review Board document from Emory University. Participants who agreed to participate in the study were then directed to a description of a fictional criminal story. After reading through a fictional crime, participants were quasi-randomized into four conditions based on the last two digits of their preferred phone number. The four groups were as follows: (1) neuroscience explanation with fMRI image, (2) neuroscience explanation without image, (3) psychology explanation with graph, and (4) psychology explanation without image. People with phone numbers ending in 00-24 were assigned to group one. The other phone number groupings (25-50, 51-75, and 76-99) were randomly assigned to the remaining three conditions, respectively. Each participant then read one of four expert testimony transcripts and answered questions relevant to comprehension, sentencing, and reasoning about their particular punishment decision. Finally, each participant answered a battery of individual difference questionnaires (see Materials) concluding with demographic information.

2.3. Materials

The experiment included five parts: (1) a background story of a crime, (2) a fictional court transcript depicting a conversation between an attorney and a scientist, (3) 8 comprehension questions, (4) a set of questions designed to ask about the crime, and (5) a battery of individual difference measures that did not directly relate to the trial materials, but that were

deemed to be potentially relevant to the outcome variables. Figure 4 presents a visual representation of the experimental method.

2.3.1. Background story. To provide relevant contextual information regarding the hypothetical court transcript, the protocol included a 160-word description of a person who got into an argument with another person after a minor car accident. In the story, the criminal became angry and impulsively strangled the other person involved in the argument. Participants then learned that the fictional criminal was brought to trial for murder.

2.3.2. Transcript. Participants were assigned to carefully read one of four expert testimony transcripts (see Appendix). These transcripts depicted a conversation between a scientist and an attorney discussing the causes of the hypothetical criminal's actions. The neurological and psychological explanations differed in their content. Within the two explanation types, one of the transcripts was accompanied by an image, either a bar graph or an fMRI picture.

In the neurological expert testimony transcripts, a neuroscientist discussed his work on fMRI with psychopaths. Both transcripts referenced neuroscientific imaging work, but one of these included an fMRI image. The fMRI image was derived from the BrainTutor program and showed activation in two brain areas: the amygdala and the orbitofrontal cortex. These two regions were chosen because recent reviews of psychopathic personality have reported structural and functional abnormalities in these regions in people with psychopathy (e.g., Anderson & Kiehl, 2012). More specifically, in both of these testimonies, the neuroscientist discussed his research on psychopathy using a measurement technique that rated a person's psychopathic tendencies on a scale from 0 to 40. The psychopathy measure was characterized in this way to mirror the commonly referenced and highly utilized Hare Psychopathy Checklist-Revised (PCL-

R), whose scores also range from 0-40 (Hare, 1991/2003). The neuroscientist proceeded to explain the nature of psychopathy by describing psychopaths as people who exhibit distinctive behavioral, emotional, and interpersonal characteristics. The neuroscientist further noted that the psychopathy scale had an error rate between 30-35% and described the measure as moderately to highly valid. The neuroscientist then shared how he had scanned the brain of the defendant and placed the defendant at the 95% percentile on the psychopathy scale based on abnormal activation of the amygdala and orbitofrontal cortexes. In one of the transcripts, the fMRI image was displayed at this point. The neuroscientists concluded by arguing that the defendant would likely have had trouble withholding his impulses to strangle the victim.

The remaining two expert testimony transcripts described an exchange between a lawyer and a psychiatrist. As was the case with the neurological conditions, the psychological transcripts also differed only in their inclusion of an image. In both of the court transcripts, the psychiatrist described his clinical psychology diagnostic procedure of detecting psychopathy in individuals. Specifically, the psychiatrist said that he used a measurement technique that relies on a rigorous set of questions devised to rate and describe the behavior, thought, and feelings of a specific individual on two factors: (1) interpersonal and affective deficits and (2) lifestyle differences and antisocial tendencies. The psychiatrist proceeded to describe psychopathy in the same manner as in the neuroscience conditions. The lawyer then asked the psychiatrist to describe how he diagnoses someone with psychopathy and the psychiatrist explained how, after he interviews an individual, he places the person in question on a scale from 0 to 40. In this case, the measurement technique described to jurors was exactly analogous to the PCL-R (Hare, 1991/2003). The psychiatrist noted the error rate of this measurement tool and said that he placed the defendant at the 95% percentile on the 40-point scale. Here, in one of the two psychology

conditions, the participant saw a bar graph to illustrate the difference in the defendant's psychopathy score in comparison with average scores. The psychiatrist concluded the testimony by arguing that the defendant would have had difficulty withholding his impulses to strangle the victim given the defendant's high psychopathy score.

All four of the expert testimony transcripts were matched for content and word count as best as possible while still retaining clarity of explanation (again, see Appendix). The neurological explanation was 721 words, whereas the psychological explanation was 657 words. Between the two types of explanations, the description of psychopathy, the validity of the 40-point scale, the psychopathy diagnosis of defendant, and the proposed behavioral implications of the psychopathy diagnosis were identical. The two explanations differed in their description of their type of research, with the neuroscience explanation focusing exclusively on fMRI data and the psychological explanation focusing exclusively on clinical and self-report data. The neuroscience explanation was slightly longer than the psychological explanation because the neuroscientist referred to two brain regions and described their location, an element not relevant to the psychological explanation. This addition ensured that the image did not provide any additional information above and beyond the neurological explanation itself.

2.3.3. Comprehension questions. After reading the trial materials, participants responded to 8 recall questions. The questions included a series of true false and multiple-choice inquiries. These questions were administered to exclude participants who did not read the trial materials carefully or who had difficult comprehending these materials. For instance, one question asked what type of evidence the expert used in his testimony with the answer being functional magnetic resonance imaging in the neuroscience condition.

2.3.4. Sentencing and reasoning questions. The participants were instructed to answer two questions about the criminal's punishment. The first punishment question asked about where the fictional criminal should serve his sentence if found guilty. The answers to this question included supermax prison, maximum security prison, closed security prison, medium security prison, minimal security prison, and treatment facility. Descriptions of these facilities accompanied each answer choice to ensure that the participant understood how each answer choice differed. The responses to this punishment question were ranked on a scale from 1 to 6, with 1 representing a treatment facility and 6 representing a supermax prison.

The second sentencing question inquired about how long the criminal should serve if found guilty. The participant was instructed to enter a certain amount of years. An image was presented alongside the question that illustrated the common sentence lengths for crimes of differing levels of severity to serve as a visual guide for the participants. The low end of the image was labeled "mild" and was tied to 15 months. The high end of the image was labeled "extreme" and was tied to 100+ years (see Appendix). Twenty participants responded to the sentencing question by writing "100+" or "Life." These responses were recoded to "100" in the analyses to retain sentencing judgments as a continuous variable.

After completing the sentencing questions, participants were instructed to answer 11 questions about their reasoning for their sentencing decisions and thoughts about the criminal. The questions assessed different considerations that could be potentially relevant to the participant's understanding of the psychopath's behavior and of the role of punishment in society generally. One of the questions asked about the extent to which the participant was swayed by the psychiatrist's or neuroscientist's argument. Four questions assessed whether the defendant could be helped or cured by treatment, brain surgery, or medicine. Another question examined to

what extent the participant thought the defendant was in control of his actions when he committed murder. For a full list of questions, see the Appendix. The participant responded to these questions on a 4-point Likert-type scale with 1 representing "not at all" and 4 representing "very much."

2.3.5. Individual difference measures. Participants completed five questionnaires of varying lengths assessing individual differences in beliefs regarding neuroscience and psychopathy. Of the five measures, only the 27-question (Cronbach's $\alpha = .90$) mind-body dualism measure (Stanovich, 2001) was directly relevant to the hypotheses in question for this report. This questionnaire assessed differing dualist beliefs and was used in a previous study that evaluated the effect of dualist beliefs on the interpretation of neuroscientific images (Hook & Farah, 2013). Questions included statements such as "The mind is not a part of the brain but it affects it" and "Minds are in principle independent of bodies, to which they are only temporarily 'attached.'" Respondents answered the questions on a 5-point Likert-type scale. A composite dualism score was calculated by summing the responses to each item on the scale. Higher scores on the measure reflected dualist beliefs and lower scores reflected stronger physicalist beliefs.

The survey concluded with the demographic questions described earlier. Finally, the participants were debriefed with a brief explanation of the experiment.

3. Results

To test the hypotheses that neurological explanation type and image inclusion would affect participant judgments of deserved punishment and relevant beliefs about criminal behavior, five two-way (explanation type, image inclusion) multivariate analysis of variance (MANOVAs) tests were conducted. Prior to performing the MANOVA tests, a factor analysis of the 11 reasoning questions was completed to ascertain the dimensions that underlie the reasoning

questions and to group these questions into empirically related sets for subsequent analyses in order to reduce both Type I and Type II errors. Using this factor structure of the reasoning questions as a guide (see "Factor Analysis"), 4 separate MANOVAs were performed. In addition, differences in responses to the two sentencing variable questions (e.g., length and place) were also examined using a MANOVA analysis. Finally, to test the "mind-body" hypothesis, dualism scores were included as a covariate in five separate three-way (explanation type, image inclusion, dualism score) multivariate analyses of covariance (MANCOVA) analyses. This set of tests was utilized to examine the interaction between dualism score, image inclusion, and explanation type on judgments of conceptually related outcome variables that measured perceptions of psychopathic behavior and criminal responsibility. One final MANCOVA was performed to test the effect of dualism beliefs, explanation type, and image inclusion on judgments of deserved punishment. Each of these analyses are described in turn.

3.1. Inclusion and Data Preparation

All analyses were conducted including only the people who scored highly on the comprehension test. Each of the following tests was also re-conducted with the entire data set, and no meaningful differences were found. In addition, even though less than 1% of data were missing from the 2 sentencing questions and 11 reasoning questions, the missing data were multiply imputed five times to increase the power to detect an effect. For each of the analyses above, no meaningful differences emerged among the multiply imputed data sets, so the original data were used in all analyses.

3.2. Factor Analysis

To better understand the differential features of people's beliefs about criminal behavior and justice, the factorability of the 11 reasoning questions was examined. A Principal Axis

Factor Analysis with an oblique (Promax) rotation was performed; oblique rotations were used given that I anticipated that many of the dependent measures would be at least moderately correlated. Using the Kaiser (eigenvalues >.1) criterion, the analysis yielded a four factor solution with eigenvalues of 2.62, 1.9, 1.4, 1.1, .84, and .68. The first factor explained 23.77% of the variance. The remaining factors explained 17.28%, 12.33%, and 10.41% of the variance for the second, third, and fourth factors, respectively. Using a cutoff value of .4, 3 items loaded on the first factor, 2 on the second, 3 on the third, and 2 on the fourth. Because there was no clear break ("elbow") in the scree plot of eigenvalues, both a three factor and five factor solution were also examined. The four factor solution was ultimately preferred because of the difficulty in interpreting the three and five factor solution and the insufficiency of primary loadings above .4 in either the three or five factor solution. The factor structure for the final solution is presented in Table 1. Another factor analysis was conducted using the standardized scores of the 11 outcome variables. The factor analysis was not different in any meaningful way; hence, I relied on the results of the analyses using raw (unstandardized) scores.

Factors were interpreted by determining commonalities among the items that loaded onto each factor. The first factor was interpreted as a "Treatability" factor, as the positively loading items (see Table 1) referred to the extent to which the participant believed the defendant could be helped or cured by treatment or should be prescribed medicine. The second factor was interpreted as a "Dangerousness" factor because the two items that loaded highly on this factor referred to how much of a threat the defendant poses to the general public or to people in prison. The third factor was interpreted as a "Defendant Self-Control" factor because the two items on the factor explicitly referenced the criminal's control or impulsivity. The remaining question regarding persuasiveness of the expert's explanation can also be thought of as relating to self-

control because the majority of the testimony was an attempt to corroborate the claim that the defendant was a psychopath and, as a result, could not control his impulses. The final factor was interpreted as the "Punishment Efficacy" factor because the two items that loaded highly on this factor asked about how fair the participants' viewed their choice of punishment and how effective such a punishment choice would be for others who commit the same crime as the defendant.

Because the reasoning questions were intended to examine people's justifications for their sentencing choice, the two sentencing questions ("How long should [the criminal] be punished if found guilty?" and "Which [place] do you think is an appropriate place for [the criminal] to serve time?") were not included in the final factor analysis. A factor analysis was conducted with the punishment items included; they loaded negatively on the first ("Treatability") factor. The sentencing items, however, were excluded from the final factor analysis because the inclusion of the punishment items rendered the first factor much less interpretable from a conceptual standpoint.

Most items loaded on only one factor. Nevertheless, both treatment items ("Do you think [the criminal] could be cured by treatment?" and "Do you think [the criminal] could be helped by treatment?") loaded onto both the first ("Treatability") and second factor ("Dangerousness"). Because the loading of both treatment-related items was much higher for the first factor, the treatment items were placed there. These treatment-related items also were most conceptually related to the medicine item ("Do you think [the criminal] should be prescribed medicine to help with his condition?") rather than the public and prison threat items. No other items cross-loaded onto different factors. One item—" Do you think [the criminal] should receive brain surgery to

help with his condition?"—did not load highly on any factor and was not used as a dependent variable in later MANOVA analyses.

3.3. MANOVAs

Before conducting the main analyses, the four conditions were collapsed into image and non-image contrasts in addition to the neurological and psychological contrasts to parse the unique effect of neuroimages and neuro-explanations rather than examining differential responses amongst the outcome variables across all four conditions. Additionally, instead of conducting 13 one-way analyses of variance (ANOVAs) for both the image and explanation contrasts, a two-way MANOVA test (image group, type of explanation) was conducted to determine the effect of image inclusion and neurological explanation on each of outcome measures within the four factors described above: Treatability, Dangerousness, Defendant Self-Control, and Punishment Efficacy. In addition, a two-way MANOVA was performed separately to examine differences in both of the sentencing questions for reasons described earlier. Statistical interactions between the image and explanation condition were also examined for each MANOVA.

3.3.1. Reasoning questions. Four MANOVAs were carried out to examine differential responding on reasoning items within each of the factors (Treatability, Dangerousness, Defendant Self-Control, and Punishment Efficacy) between the image/no image and neurological/psychological explanation contrasts. Interactions between the inclusion of an image and explanation type were examined to see if the image and neurological explanation had a multiplicative effect on outcome measures. The results of conducting four two-way MANOVAs were mostly contrary to predictions and non-significant. I present the findings from each of the analyses in the order of the aforementioned factor structure, beginning with Treatability and

ending with Punishment Efficacy. To view the means and standard deviations of all the dependent variables between groups, view Table 2.

3.3.2. Treatability. There was surprisingly no effect of image type, $F(3, 749) = .40$, $p = .77$; Wilk's $\lambda = .99$, partial $\eta^2 = .00$, and no effect of neurological explanation, $F(3, 749) = 1.20$, $p = .32$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$, on the three treatment-related questions. There was also not a statistically significant interaction found between the two conditions on this set of items, $F(2,749) = 1.35$, $p = .26$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$. These findings indicate that people did not find the criminal as more or less likely to benefit from treatment after learning about biological or psychological origins of abnormality. The same interpretation applies for the inclusion of an image.

3.3.3. Dangerousness. Contrary to my hypothesis, no significant effect was found for either image, $F(2, 740) = .67$, $p = .52$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$, or for neurological explanation, $F(2, 740) = .40$, $p = .13$; Wilk's $\lambda = .99$, partial $\eta^2 = .13$, on Dangerousness items. There was also no significant interaction between both conditions, $F(2, 740) = 1.34$, $p = .26$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$, on factor 2 item responses. In other words, learning about neurological origins of behavior or viewing an image to support a claim did not alter how threatening mock jurors thought the criminal was to the public or to inmates.

3.3.4. Self-control. In line with predictions, there was a significant effect of neurological explanation on the Defendant Self-Control items, $F(3,743) = 3.14$, $p < .05$; Wilk's $\lambda = .99$, partial $\eta^2 = .01$. There was also a marginally significant effect of image inclusion on responses to the items included in factor 3, $F(3, 743) = 2.41$, $p = .07$; Wilk's $\lambda = .99$, partial $\eta^2 = .01$. However, no significant interaction was present between both conditions on Defendant Self-Control items, $F(3,743) = .90$, $p = 44$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$. These results suggest that there was an

effect of explanation type on the items on Defendant Self-Control factor, but the inclusion of an image did not have a multiplicative effect on the same set of outcome variables.

Univariate follow-up analyses indicated that explanation type only had a significant effect on responses to the persuasiveness question, $F(1,745) = 4.52$, $p < .05$, and the impulsiveness question, $F(1,745) = .24$, $p < .05$ (View Table 1 to see the exact wording of these items). Interestingly, persuasiveness responses were higher in the psychological condition ($M = 3.11$, $SD = .82$) than in the neurological condition ($M = 2.98$, $SD = .88$, Cohen's $d = 0.15$). This finding suggests that mock jurors found the psychological explanation more persuasive than neurological findings, contrary to predictions. Similarly, participants reported that the criminal's inability to withhold his impulses played more into their sentencing decision in the psychological condition ($M = 2.79$, $SD = 1.02$) than in the neurological condition ($M = 2.62$, $SD = 1.03$, Cohen's $d = 0.16$). These results indicate that participants felt that the expert's description of the defendant's impulsivity problem weighed more heavily on mock jurors who learned about psychological origins of behavior.

3.3.5. Punishment efficacy. As predicted, there was no effect of neurological explanation, $F(2, 746) = .50$, $p < .05$; Wilk's $\lambda = .99$, partial $\eta^2 = .00$, on Punishment Efficacy. There was a marginally significant effect of image inclusion, $F(2,746) = 2.76$, $p = .06$; Wilk's $\lambda = .99$, partial $\eta^2 = .01$, on responses on items probing the deterrence and fairness value of punishment. However, no statistically significant interaction was found between image inclusion and neurological description on factor 4 variables, $F(2,746) = .17$, $p = .84$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$. These findings suggest the neither showing participants an image nor explaining a disorder in biological terms significantly changed beliefs in whether mock jurors thought

punishment could deter people from acting in a deviant manner or in how fair participants' viewed the act of sentencing a criminal.

3.3.6. Sentencing. I hypothesized that participants in the neurological condition would sentence the defendant less harshly on both sentencing questions. I also predicted that the responses in the image condition would follow a similar pattern of less severe punishing. Prior to testing these hypotheses, punishment length responses above 100 years were discarded as outliers due to five very aberrant and severe punishment lengths of 360, 240, 200, 125, and 105 years.[3] A two-way MANOVA (explanation type, image inclusion) was then conducted to test whether participants punished the hypothetical criminal more severely across groups. In contrast to the predictions, a two-way MANOVA revealed no significant effect of image type, $F(2, 743) = .94$, $p = .39$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$, and no effect of neurological explanation, $F(2, 743) = .47$, $p = .62$; Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$, on punishment choices. Furthermore, there was no significant interaction between image inclusion and neurological explanation, $F(2,743) = .25$, $p = .78$, Wilk's $\lambda = 1.00$, partial $\eta^2 = .00$. To see the means and standard deviations of the scores in these conditions, view Table 3.

3.4. Mind-Body Dualism

To test the "mind-body" hypothesis, five multivariate analyses of covariance (MANCOVAs) were conducted. Although I predicted that higher dualists would find neuroscience more impactful, no directional predictions were made with regard to how dualist-leaning mock jurors would make different determinations amongst the outcome variables of interest. Thus, the following analyses were strictly exploratory. Because I hypothesized that high dualists would evaluate neuro-explanations and neuro-images differently in comparison to low

dualists, I focused exclusively on examining the interaction between group (image/no image and neuro-explanation/psych-explanation) and dualism score.

The analyses of the interaction between image inclusion or explanation type and dualism score on the four sets of reasoning questions (Treatability, Dangerousness, Defendant Self-Control, and Punishment Efficacy) are reported first. The analysis of this same interaction on the two sentencing outcome variables (punishment length and punishment place), while also including dualism as a covariate, is reported second.

3.4.1. Reasoning questions. When including mind-body dualism scores as a covariate in the MANCOVA analysis amongst the three items in the "Treatability" factor, there was no significant interaction between either image inclusion or explanation type and dualism score (see Table 3). Non-significant interactions for both image inclusion and explanation type were also found for the other three groupings of reasoning dependent variables: Dangerousness, Defendant Self-Control, and Punishment Efficacy (see Table 4 for results; see Table 5 for the means and standard deviations of the dependent variables of interest across groups). Consistent with the MANOVA results, these findings suggest that, when including dualism as a covariate, judgments of criminal behavior do not vary significantly across groups.

3.4.2. Sentencing. Because mind-body dualism beliefs may be related to judgments of deserved punishment as measured by two sentencing questions, a MANCOVA was conducted to examine how dualist beliefs interact with image inclusion and type of explanation. The results indicated that there was a significant interaction between image inclusion and dualism score across the groups on sentencing items, $F(2, 660) = 3.56$, $p < .05$; Wilk's $\lambda = .99$, partial $\eta^2 = .01$. View Table 6 for the means and standard deviations of the sentencing variables. Follow-up analyses indicated that there were significant differences amongst responses to punishment

length judgments, $F(1, 666) = 5.63$, $p < .05$, and punishment place judgments, $F(1, 666) = 3.93$, $p < .05$, when including dualism score as a covariate in the analyses.

This finding suggests that dualist beliefs influence judgments of punishment across groups. To determine in which direction dualist beliefs were influencing punishment judgments, I created two dualism groups, low and high dualists, via a median split at a score of 77 and then conducted four separate one-way ANOVAs.[3] The low dualists had a dualism score of 0 – 76 and the high dualists had a dualism score of 77 – 126. First, I examined the effect of explanation type on punishment length, selecting only for low dualists. Of these people, those in the neuro-explanation group ($n = 171$) punished less severely ($M = 29.88$, $SD = 20.04$) than those in the psychological explanation group ($n = 156$, $M = 35.37$, $SD = 29.31$, Cohen's $d = .22$). The results of this ANOVA also indicated a significant effect of explanation type on punishment length judgments amongst the low dualists, $F(1, 325) = 3.97$, $p < .05$. Second, I examined the effect of explanation type on punishment length, selecting only for high dualists. Of this set of participants, those in the neuro-explanation group ($n = 183$) punished more severely ($M = 35.99$, $SD = 28.26$) than those in the psychological explanation group ($n = 163$, $M = 32.20$, $SD = 22.78$, Cohen's $d = .15$). However, explanation type did not significantly affect punishment length judgments, $F(1,344) = 1.85$, $p = .17$. Nonetheless, these findings suggest that the statistically significant interaction in the aforementioned 3-way MANCOVA assessing differences in punishment length is disordinal. View Figure 5 to see a graph of the differences in means for punishment length across explanation type groups.

The same set of analyses was conducted to better assess the directionality of the dualism and explanation type interaction on punishment place judgments. First, for low dualists, those in the neurological explanation ($n = 169$, $M = 3.93$, $SD = 1.50$) punished the defendant similarly to

those in the psychological explanation (n = 156, M = 3.92, SD = 1.66). An ANOVA test of the effect of explanation type on punishment place judgments for only the low dualists was not significant, $F(1, 323) = .01$, $p = .94$. Selecting for high dualists, those in the neurological explanation (n = 181) punished slightly more severely (M = 4.35, SD = 1.47) than those in the psychological explanation group (n = 163, M = 4.03, SD = 1.54, Cohen's d = .21). The effect of explanation type on punishment place judgments was marginally significant, $F(1, 342) = 3.53$, $p = .06$. This finding is consistent with the finding for punishment length, as highly dualist participants in the neurological condition punished more severely. The source of the statistically significant dualism and explanation type interaction appears to lie in the combination of high dualism and neurological explanation, with high dualist participants punishing the defendant more harshly.

3.5. Summary of Findings

Contrary to my hypotheses, neither explanation type nor image inclusion had an effect on judgments of deserved punishment or treatability. In line with predictions, both manipulations did not affect participants' beliefs about the criminal's dangerousness or the efficacy of punishment. In addition, neurological explanation type did have an effect on responses to the Defendant Self-Control items. However, a follow-up ANOVA test indicated that people found the psychological explanation more persuasive, contrary to my prediction that mock jurors would find neurological explanations especially scientific.

To examine how mind-body dualism beliefs interacted with both image inclusion and explanation type, five separate MANCOVAs were conducted. When dualism beliefs were included as a covariate in the analyses of the effect of image inclusion and explanation type on relevant outcome variables, only the sentencing variables statistically differed across groups.

Further investigation of this interaction via follow-up ANOVAs suggested that, for punishment length judgments, participants in the high dualism-neurological explanation group punished more harshly and that participants in the low dualism-neurological explanation group punished more leniently. Finally, the results of two other ANOVAs indicated that people in the high dualism group were especially punitive when making punishment place judgments, although the same sentencing judgments of the low dualists were not different across groups.

4. Discussion

Because explanation type and image inclusion did not affect judgments of deserved punishment, treatability, dangerousness, or punishment efficacy, the current results pose a challenge to the idea that all mock jurors always view neuroscience as excessively persuasive. In fact, these findings provide virtually no evidence for the universal neuroscience biasing effect insofar as the only significant finding revealed that people found the psychological explanation to be a more persuasive account of the defendant's self-control deficit. The study reported here demonstrated that mock jurors did not find the "my brain made me do it" defense any more persuasive than the "my psychological disorder made me do it" when the explanations were matched for content and scientific quality.

Of all the results, the most surprising was the lack of effect of neuro-explanations on punishment and treatability outcome variables. These findings stand in apparent contrast to many previous studies that have consistently found an effect of explanation type on punishment outcome variables (Roskies et al., 2013; Saks et al., 2014; Schweitzer et al., 2011). One of the potential reasons that perceptions of justified punishment and treatability did not differ across explanation types may be due to the scientific equivalence of the explanations. In other words, by matching the explanations for content, I may have actually eliminated the effect of

neurological information on relevant outcome variables. However, the results do not necessarily demonstrate that neuroscience is never perceived as unduly persuasive in certain circumstances because the current experiment ensured that the psychological and neurological explanations were equally valid. Thus, the results lend credence to the idea that perhaps neuroscience's allure derives from perceptions of its higher validity.

In addition to ensuring that the explanations were comparable, the court testimony included detailed descriptions of the diagnostic procedure (e.g., fMRI or clinical interview), the nature of psychopathy, and the implications of the research. By doing so, the explanations may not have left much room for interpretation of scientific quality. Further, the findings suggest that when experts discuss psychological or neurological diagnostic techniques in greater depth, mock jurors may find them to be similarly scientific. The results support this interpretation insofar as the mean of the persuasiveness variable across all groups (see Table 2) indicated that people found the explanations fairly persuasive.

Although the null findings of this experiment may initially appear to contradict previous results, the study's methodological differences from prior work may account for the counter-intuitive results. Weisberg and colleagues (2008) found that people tended to rate *invalid* explanations with unrelated neuroscience as more favorable than other valid explanations without images. The current study, in contrast, did not include a good and bad version of both types of explanations. The neuroscientific and psychological explanations were both seemingly reasonable examples of how psychological and neuroscientific evidence is presented in the courtroom. As a result, the null findings in this study do not disprove the potential that irrelevant neuroscience could bolster unrelated scientific claims. Rather, the findings indicate that neuroscientific measures are not especially alluring compared with psychological measures of

comparable quality. The current study does not rule out the possibility that people find poorly explained neuroscience unduly persuasive or interesting.

Potentially, the most significant contribution of the current paper stems from the consistent lack of effect of image inclusion on any of the outcome variables (sentencing or reasoning). The predictions regarding the inclusion of the image were initially uncertain due to the failure of several studies to find any effect of brain images on ratings of legal judgment outcomes (Farah & Hook, 2013; Gruber & Dickerson, 2012; Michael et al., 2013). The image condition was included in this study because of a recent finding that images do affect perceptions of blameworthiness (Gromet, Goodwin, Tang, Nadelhoffer, & Sinnott-Armstrong, in press). The present results, however, found no evidence for the contention that images unduly bias mock jurors. In the context of the courtroom, the findings corroborate Farah and Hook's (2013) contention that seeing a brain image does not render people utterly convinced of a scientific claim.

What explains this consistent lack of effect of image inclusion on legal judgments? Because brain images are featured more frequently in the media, people may be inured to the novelty of fMRI. Brain images simply may not be thought of as impactful in the eyes of the public as the images once were when the technology was in its infancy. Further, a neuro-skeptic literature has recently emerged in an attempt to elucidate some of the limitations of brain imaging (Rachul & Zarzeczny, 2012). Perhaps the null effect of image inclusion could be partially attributed to this emerging body of literature's success in exposing some of the flaws of neuroscience. Further research, however, is needed before making any resounding conclusions about how the lay public interprets and values neuroscience generally.

Alternatively, it could also be the case that brain images are rather complicated and challenging for general audiences to interpret. For instance, those who are especially well versed in the intricacies of fMRI may understand the limitations of the measurement technique, whereas those who are unfamiliar with fMRI may not be able to interpret the image in any meaningful way. I attempted to mitigate this issue by including a brief snippet explaining the scientific method of fMRI techniques in the neurological transcript and by labeling unfamiliar areas in the brain (See Appendix). However, the details of fMRI are hardly reducible to a two-sentence explanation, and this attempt at clarifying the imaging method may not have assuaged participants' unfamiliarity with the scientific procedure.

The significant effect of explanation type on evaluations of the defendant's self-control is perhaps the most perplexing, considering that mock jurors rated the defendant as more impulsive in the psychology condition. Previous research found that participants tended to find neurological descriptions of behavior as more persuasive and of higher scientific quality compared with psychological explanations (Michael et al., 2013; Weisberg et al., 2008). A potential reason for this finding is that mock jurors may have found the psychological information easier to understand and more plausible compared with the neuroscience explanation. Interestingly, the neuroscience explanation was not descriptive of a commonly used diagnostic procedure. Psychological methods of diagnosing someone with a personality disorder, such as psychopathy, are much more commonplace and perhaps thought of as more standard in diagnostic practice. To that end, an explanation for this finding could be that people are more accustomed to hearing about psychological methods of diagnosing a criminal with a personality disorder and the transcript provided an especially strong example of one, whereas mock jurors were unsure of how to interpret the neurological explanation.

The current study's examination of mind-body dualism beliefs demonstrates the importance of evaluating individual differences when assessing how mock jurors interpret brain-based information. The divergences in punishment judgments across groups, when mind-body dualism beliefs are taken into account, suggest that individual differences in attitudes ought to be examined when assessing how people evaluate neuroscience. The findings suggest that highly dualist participants tend to punish *more* harshly when presented with neurological explanations of a defendant's behavior. Perhaps people who tend to think that the mind is separate from the brain find neurological information about behavior indicative of a biologically hardwired abnormality. That is, because something is wrong with the criminal's *brain*, people may think the defendant cannot overcome his psychopathic predilections and should be punished more severely than someone suffering from a personality disorder. Ultimately, this dualist intuition in conjunction with biological evidence may translate into especially punitive behavior.

This explanation, while quite noteworthy, carries important caveats and should be interpreted with caution for two reasons. First, no differences were seen across other conceptually relevant outcome variables when dualist beliefs were included in analyses. For instance, mock jurors did not rate the defendant's treatability any differently. This lack of finding is especially unusual given the aforementioned explanation of the punishment findings. That is, if a dualist mock juror punishes a defendant suffering from a biological disorder more severely because the abnormal behavior is grounded in unchangeable neural processes, one would think that this same person in the neurological condition would judge the defendant as *less* likely to get better via treatment or medicine. Second, the lack of significant interaction between image inclusion and dualism beliefs presents a bit of a challenge for the explanation of the punishment results as well. If high dualists tend to punish harshly because they view brain information as a

marker for hardwired behavior or a biologically demonstrable disorder, this same set of people would likely punish similarly when presented with an image. However, the data in the current study did not indicate a difference in punishment behavior as a function of image inclusion.

Taken together, the dualism results indicate that future research most certainly should include an analysis of individual differences in beliefs about potentially relevant philosophical concepts that could be related to how people evaluate neuroscience. For instance, an examination of differential beliefs in scientific determinism, free will, and the purpose of criminal punishment could vary well play in role in how mock jurors understand and evaluate information about the brain and behavior. Further, as the current study demonstrates, parsing apart how these philosophical beliefs shape and inform legal judgments can begin to shed light on why the results in the neuro-seduction literature diverge in many respects.

The consistent lack of significant findings across all of the analyses could be a consequence of people's strong intuition that wrongdoers ought to be punished regardless of the origins of their mental abnormality. Even though the transcript crafted a persuasive argument for the defendant's self-control problem, participants may not have known how to interpret that information in a legally relevant way and may have reverted to their intuitions about deserved punishment as a result. The same could be said of the psychological explanation: mock jurors could have thought the information about the defendant's psychological problem was noteworthy, but may have also been unsure as to how such information translates into a legal decision regarding deserved punishment. This explanation is also in line with research that has indicated that people tend to focus on the severity and perceived heinousness of a crime rather than other relevant factors (e.g., the future dangerous of the criminal, the deterrence value of punishing) when punishing a wrongdoer (Darley, Carlsmith, & Robinson, 2000). To minimize

the possibility that people would punish on the basis of a strong retributive intuition, I limited the punishment judgment to sentencing instead of guilt because sentencing is thought of as a more sensitive measure for aforementioned reasons. Still, the current results indicate that people's inflexible intuitions to punish wrongdoers may play a larger role in sentencing than originally predicted.

This study's findings have interesting implications for the philosophical debate surrounding neuroscience's potential impact on legal decision-making. Taken together, the results demonstrate that people's attitudes about criminal punishment were not especially threatened by mechanistic explanations of criminal behavior. Instead, mock jurors consistently judged the criminal similarly regardless of image inclusion or explanation type. In fairness, the current study never explicitly presented participants with evidence for or against the existence of free will, as was the case with another study that tested the perseverance of retributive beliefs (Shariff et al., 2014). To that end, the current study's findings are not directly analogous to those that have tested how malleable people's intuitions about criminal justice are when learning about free will. Nonetheless, the findings challenge the notion that the neuroscience can readily dislodge peoples' intuitions about the necessity of punishment.

The current results also suggest that the argument for the exclusion of neuroimages in the courtroom on the basis of their prejudicial potential may be premature. In a similar vein, the results also demonstrate that neuroscience information serves no additional benefit when it comes to explaining the causes of behavior for legal purposes because people punished similarly across groups. Thus, legal attempts to corroborate the existence of a mental disorder via brain imaging techniques may not be more effective than simply describing the psychological disorder in psychological terms. However, the current results do not suggest that attorneys should be

given free rein to utilize brain imaging techniques in the courtroom, given that there are other credible reasons to exclude neuroscience from legal disputes (for a more in-depth discussion, see Buckholtz & Faigman, 2014 and Satel & Lilienfeld, 2013).

4.1. Limitations

The present results must be interpreted in the context of several methodological limitations. One such limitation stems from the nature of the sample. Because the experiment was administered online, the sample represents a subset of people who are relatively technologically literate and presumably interested in psychological research. In turn, the participants may have already had sufficient exposure to neuroscientific ideas. The demographic information supports this explanation insofar as the sample was highly educated and familiar with psychological research. Secondly, the participants may not have paid adequate attention to the trial materials, as some M-Turk workers may go through the experimental materials carelessly and quickly. I tried to safeguard against this possibility by including a set of comprehension questions and excluding those who did not perform well. Nonetheless, the questions were relatively easy and were primarily used as a mechanism to exclude those who were who merely skimmed the material as opposed to those who were carefully attending to the transcript. Future studies could include a set of more difficult comprehension questions in the protocol to better assess participants' level of attentiveness.

Second, taking a survey on M-Turk does not directly mirror the jury experience. In a murder trial, the jury would see the neuroscientist or psychiatrist in person and learn more about the diagnostic process beyond the limited information gleaned from reading an abbreviated hypothetical transcript. Especially considering that people in the experiment rendered their legal judgments immediately after reading the transcript, the M-Turk setting did not reflect the true

nature of a trial because usually days if not weeks pass between when a juror sees a brain image or hears a neurological explanation and the moment a juror makes a sentencing decision. It could be true that the image may stand out in mock jurors' memories amongst all of the legal arguments at the *end* of a criminal case even if the image is not exceptionally impactful in the short term. Further, in a real trial, the prosecution would often bring in an expert to discuss the limitations of the imaging data and the prosecution would get the opportunity to cross-examine the expert. Ultimately, there are always ecological validity concerns when trying to measure behavior that could be swayed by factors that cannot feasibly be brought into a "one shot" experimental paradigm. To remedy this problem, researchers could develop a more sophisticated experimental protocol that includes a video of a defense attorney cross-examining an expert on issues pertaining to a criminal's mental state.

Lastly, although information was gathered about the participants' political leanings, mock jurors in this study did not report their feelings about other relevant ideas, such as attitudes toward the death penalty, that could influence punishing tendencies. Given that people often hold very strong intuitions about the death penalty, the nature of punishment, and the role of punishing in society, this information could have potentially aided in elucidating the overwhelmingly null findings of this study. Future studies ought to include such measures to examine whether people's beliefs about punishment override any potential influence neuroscience could have in influencing punishment decisions.

4.2. Future Directions

Despite finding no effect of image inclusion in this study, further examination of how people interpret neuroscientific images is still needed. McCabe and Castel's (2008) original study, which found an effect of image inclusion on measures of scientific quality and

persuasiveness, cannot be disregarded when evaluating the influence of fMRI pictures. It very well could be that the timing of this study captured a cultural moment in United States history where neuroscience ventured beyond basic research and into the realm of application to law, treatment, and everyday life. Unsurprisingly, the media followed the development of these ideas and disseminated them to the public (O'Connell et al., 2011). As a consequence, neuroimages may have originally been quite striking in comparison with other methods of ascertaining information about the brain and now people have been habituated to their increasing presence in the media. Keeping in mind that 26 years have passed since President George Bush designated the 1990s the "Decade of the Brain," neuroscience and brain images may simply not be as surprising or impactful as they once were. This may be especially true given that neuroscientists have increasingly engaged with the public through the media in recent years and the public has welcomed neuroscience with engagement (Racine, 2015). Perhaps the findings of the McCabe and Castel study were not due to methodological mistakes (cf., Farah & Hook, 2013) or Type I error, but a consequence of a then scientifically naïve American sample. Future studies on the effect of brain images may be well served to focus on cross-cultural populations. Studying groups that have not been inundated with neuroscience should provide a valuable picture of how people who have not been previously exposed to extensive brain-based information evaluate it.

Second, it is also be important to test how people understand other neuroscientific applications other than neuroscientific diagnostic techniques. As the development of neurolaw has demonstrated, the intersection between the law and neuroscience serves additional purposes beyond merely diagnosing mental disorders in people (Jones et al., 2013a). For instance, imaging has been touted as a method of ascertaining whether a person has lied, is in pain, or is remorseful about his or her crimes. Future studies could examine how mock jurors understand these other

applications of neuroscience in the courtroom. Additionally, even within the realm of diagnostic imaging explanations, researchers could parametrically manipulate the scientific validity of both the neurological and the psychological diagnostic measure to determine how people evaluate psychology and neuroscience at differing levels of presumed validity. For example, participants may still overestimate the power of low quality neuroscience while discounting psychology of lesser scientific value. Further, other elements of the experiment could be altered to better understand the nuances of people's beliefs about neuroscience. Such changes could include manipulating the nature of the crime and the personality disorder of the defendant. Perhaps people would judge a more premeditated or volitional crime differently than an impulsive one. Similarly, mock jurors may perceive an adolescent or person with a structural abnormality in the brain differently than a psychopath.

Lastly, a more comprehensive assessment of how people evaluate the study of the brain more generally would be helpful in tracking changes in the general public's understanding of neuroscience. To date, many studies have examined the incorporation of neuroscience in the media, but none has tested how people understand neuroscience and psychology generally. Doing so would be enormously helpful in grounding some of the explanations of divergent neuro-seduction findings empirically. For instance, do lay people value neuroscientific findings more so than psychological research? Do mock jurors think that neuroscience is more scientific than personality research? Once more information is gathered about lay perceptions of neuroscience and punishment, this research could help psychologists, lawyers, and neuroscientists to better understand why the public makes either valid or invalid legal judgments.

To conclude, the waters of the neuro-seduction literature are filled with mixed results and can be challenging to navigate at times. However, the current study emphasizes and illustrates

the importance of evaluating individual differences in philosophical beliefs amongst lay people when attempting to assess how people differentially evaluate neuroscience in legal contexts. Because mock jurors tend to hold deep intuitions about the nature of the mind and the purpose of punishment, the null results of this study may reflect the operation of differing belief systems amongst mock jurors across all groups. To make matters more complex, the use of neuroscience can also be thought of as a double-edged sword. On one hand, some people may believe that criminals with brain-based disorders ought to be punished less severely because a criminal cannot be held responsible for his or her brain malfunctions. On the other hand, some mock jurors may believe that a brain-based ailment indicates that a defendant should be locked up for life because a brain problem cannot be eradicated. The current study's findings begin to support the latter claim for highly dualist mock jurors. However, future research is necessary to uncover other relevant factors that may influence how people evaluate neuroscience. Ultimately, however, "the brain made me do it" defense may simply not weaken mock jurors' intuitions to punish any more than merely discussing a personality disorder in psychological terms.

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Footnotes

[1] Dugan's death sentence was never carried out because Illinois abolished the death penalty shortly after his trial. Dugan is now serving a life sentence in Stateville Correctional center.

[2] The court may exclude relevant evidence if its probative value is substantially outweighed by a danger of one or more of the following: unfair prejudice, confusing the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence (Saltzburg, Martin, & Capra, 1998).

[3] The three most severe punishment lengths were in the psychology no-image condition. All major analyses were initially done with the extreme punishment lengths included, and the results were not different. When all the punishment lengths were included, the standard deviation of the punishment lengths in the psychology condition was two times the standard deviation of the neuroscience, image, and no-image groups, which provided further justification for the excluding the extreme values in the major analyses.

[4] Other studies (Hook & Farah, 2013) have opted to create dualism groups (physicalists, intermediate mind-body dualists, high dualists) and to utilize this categorization as a factor in MANOVA analyses. I decided not to analyze differential beliefs in this manner, as doing so could have washed out variability in dualism beliefs.

Tables and Figures

Table 1.
Factor Loadings Based on a Principal Axis Factor Analysis with Promax Rotation for 11 Reasoning Questions

Item	1	2	3	4
To what extent did you find Dr. Morgan's argument persuasive?	.17	.10	**.69**	-.05
To what extent did Dr. Morgan's argument regarding Brock's ability to withhold his impulses play into your decision about sentencing?	.25	.02	**.78**	-.03
Do you think that [the criminal] could be helped by treatment?	**.79**	-.41	.13	-.04
Do you think [the criminal] could be cured by treatment?	**.77**	-.46	.13	-.04
Do you think [the criminal] should receive brain surgery to help with his condition?	.30	.03	.23	-.10
Do you think [the criminal] should be prescribed medicine to help with his condition?	**.44**	.05	.23	-.10
Do you think that [the criminal] was fully in control of his actions when he committed the murder?	-.35	.06	**-.47**	.19
Do you think [the criminal] poses a threat to the general public?	-.32	**.74**	.04	.16
Do you think [the criminal] could be a risk to others in prison?	-.21	**.75**	.10	.06
Do you think your punishment of choice is an effective way to deter other people from committing similar crimes in the future?	.02	.01	.00	**.55**
Do you think your choice of sentence is a fair way for others to punish people like Brock in the future?	-.14	.21	-.05	**.65**

Note. The highest loading items are bolded.

Table 2.
Means and Standard Deviations for Reasoning Questions Between Groups

Factor 1: Treatability items						
	Treatment help		Treatment cure		Medicine	
	M	*SD*	*M*	*SD*	*M*	*SD*
Neuro-explanation, *n* = 393	2.40	.98	1.83	.85	3.12	1.01
Psych-explanation, *n* = 362	2.28	.97	1.73	.85	3.11	.97
Image, *n* = 383	2.32	1.01	1.78	.89	3.09	1.03
No image, *n* = 372	2.38	.94	1.78	.82	3.14	.95

Factor 2: Dangerousness items				
	Public threat		Prison threat	
	M	*SD*	*M*	*SD*
Neuro-explanation, *n* = 387	3.61	.62	3.44	.71
Psych-explanation, *n* = 358	3.67	.58	3.53	.64
Image, *n* = 379	3.62	.61	3.49	.68
No image, *n* = 366	3.66	.59	3.48	.68

Factor 3: Defendant Self-Control items						
	Persuasiveness		Impulsiveness		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*
Neuro-explanation, *n* = 388	2.98	.88	2.62	1.03	2.67	.94
Psych-explanation, *n* = 361	3.11	.82	2.79	1.02	2.71	.90
Image, *n* = 381	3.04	.88	2.65	1.04	2.64	.92
No image, *n* = 368	3.04	.82	2.75	1.01	2.75	.92

Factor 4: Punishment Efficacy items				
	Deterrence		Fairness	
	M	*SD*	*M*	*SD*
Neuro-explanation, *n* = 393	2.58	.99	3.32	.73
Psycho-explanation, *n* = 358	2.63	1.00	3.37	.69
Image, *n* = 382	2.52	1.02	3.32	.75
No image, *n* = 369	2.69	.97	3.37	.67

Table 3.
Means and Standard Deviations of Sentencing Dependent Measures Between Groups

	Punishment length		Punishment place	
	M	*SD*	*M*	*SD*
Neuro-explanation, *n* = 387	32.57	24.80	4.07	1.54
Psycho-explanation, *n* = 361	33.60	25.68	4.01	1.62
Image, *n* = 382	32.01	25.30	3.98	1.66
No image, *n* = 366	34.17	25.16	4.10	1.49

Table 4.

Interaction Effects of Either Image Inclusion or Explanation Type and Dualism Score on Reasoning Question Responses

Factor	Interaction	Wilk's λ	*F*	*df*	Error *df*	partial η^2	*p*
Treatability	Image * Dualism Score	1.00	.68	667	3	.00	.56
	Explanation Type * Dualism Score	1.00	.55	667	3	.00	.65
Dangerousness	Image * Dualism Score	1.00	.84	659	2	.00	.43
	Explanation Type * Dualism Score	1.00	.30	659	2	.00	.74
Defendant self-control	Image * Dualism Score	.99	1.84	659	3	.01	.14
	Explanation Type * Dualism Score	1.00	.11	659	3	.00	.96
Punishment Efficacy	Image * Dualism Score	.98	1.12	664	2	.00	.33
	Explanation Type * Dualism Score	1.00	.25	664	2	.00	.78

Table 5.
Means of Dependent Variables When Including Dualism Score as a Covariate

			M	*SD*	*N*
Factor 1: Treatability					
Treatment help	Image	Neuro	2.31	.98	175
		Psych	2.27	1.00	167
	No image	Neuro	2.47	.98	180
		Psych	2.30	.88	153
Treatment cure	Image	Neuro	1.76	.84	175
		Psych	1.75	.94	167
	No image	Neuro	1.83	.82	180
		Psych	1.72	.79	153
Medicine	Image	Neuro	3.04	1.06	355
		Psych	3.14	.99	320
	No image	Neuro	3.22	.94	175
		Psych	3.03	.98	167
Factor 2: Dangerousness					
Public threat	Image	Neuro	3.62	.61	173
		Psych	3.61	.62	165
	No image	Neuro	3.63	.61	176
		Psych	3.74	.51	152
Prison threat	Image	Neuro	3.46	.68	173
		Psych	3.51	.68	165
	No image	Neuro	3.45	.71	176
		Psych	3.58	.60	152
Factor 3: Defendant Self-Control					
Persuasiveness	Image	Neuro	3.02	.92	173
		Psych	3.08	.85	166
	No image	Neuro	2.96	.84	176
		Psych	3.13	.77	152
Impulsiveness	Image	Neuro	2.57	1.06	173
		Psych	2.70	1.02	166
	No image	Neuro	2.63	1.02	176
		Psych	2.82	1.02	152
Control	Image	Neuro	2.57	.95	173
		Psych	2.73	.90	166
	No image	Neuro	2.79	.94	176
		Psych	2.71	.90	152

[continued on next page]

Factor 4: Punishment Efficacy			*M*	*SD*	*N*
Deterrence	Image	Neuro	2.51	1.01	174
		Psych	2.54	.99	167
	No image	Neuro	2.65	.96	180
		Psych	2.73	.98	150
Fairness	Image	Neuro	3.29	.78	174
		Psych	3.35	.71	167
	No image	Neuro	3.38	.65	180
		Psych	3.41	.67	150

Table 6.

Means of Sentencing Variables When Including Dualism Score as a Covariate

Sentencing	Image Inclusion	Explanation Type	*M*	*SD*	*N*
Punishment length	Image	Neuro	32.25	24.39	174
		Psych	32.05	26.53	167
	No image	Neuro	33.65	24.98	175
		Psych	35.19	25.30	151
Punishment place	Image	Neuro	4.15	1.55	174
		Psych	3.89	1.71	167
	No image	Neuro	4.14	1.46	175
		Psych	4.06	1.53	151

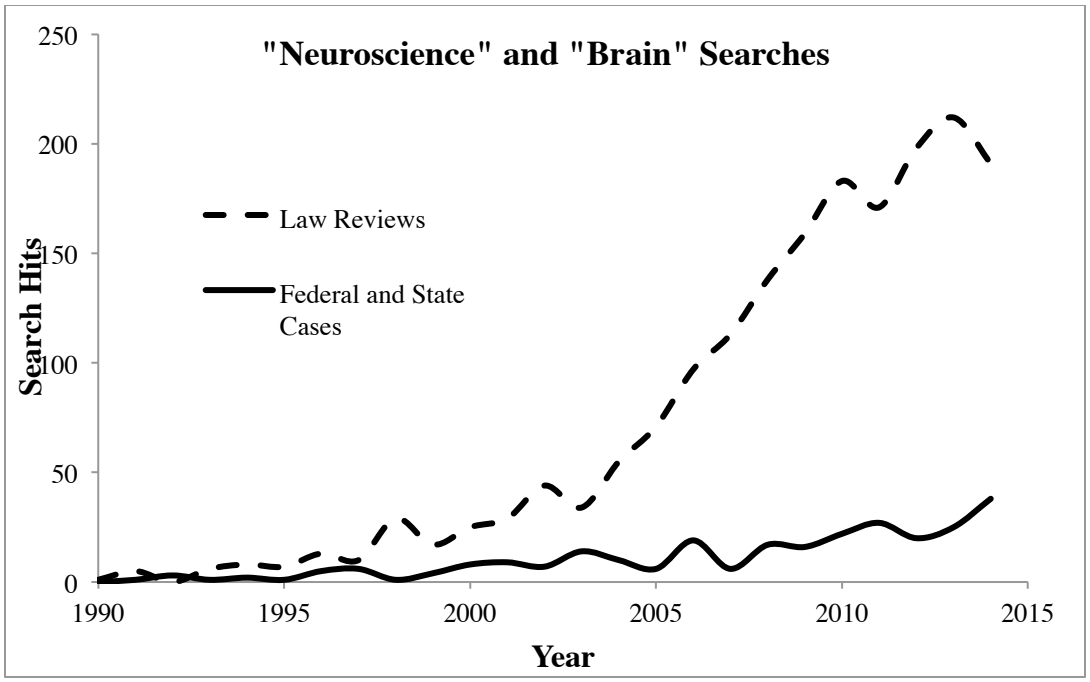


Figure 1. Lexis-Nexis search hits for "neuroscience" and "brain."

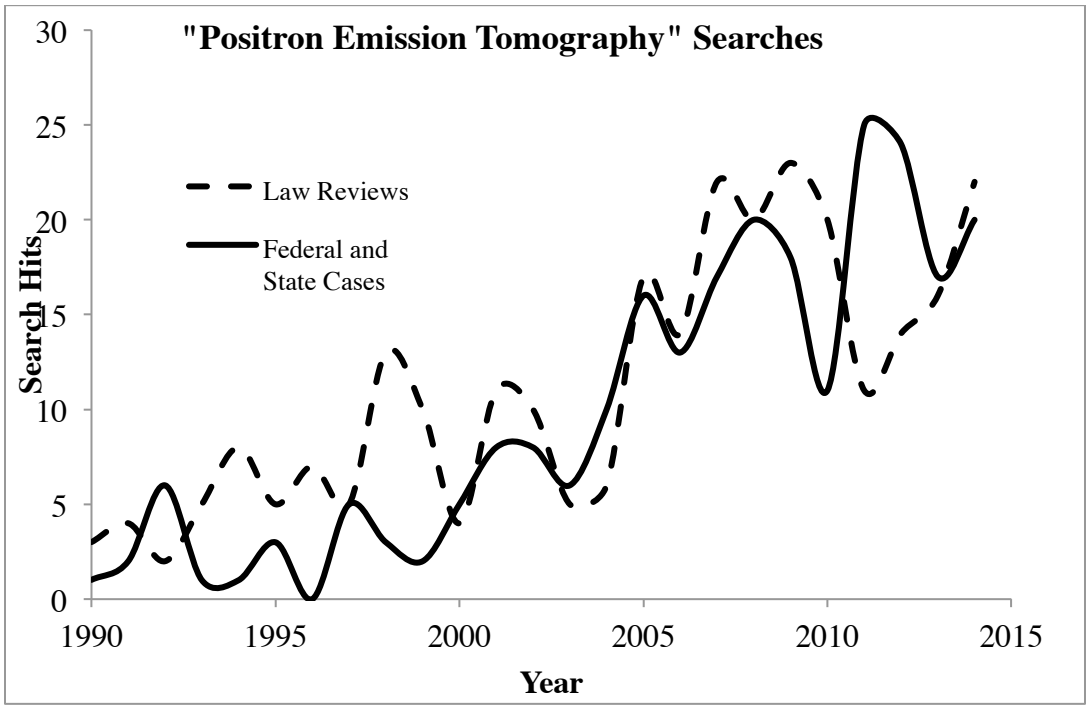


Figure 2. Lexis-Nexis search hits for "positron emission tomography."

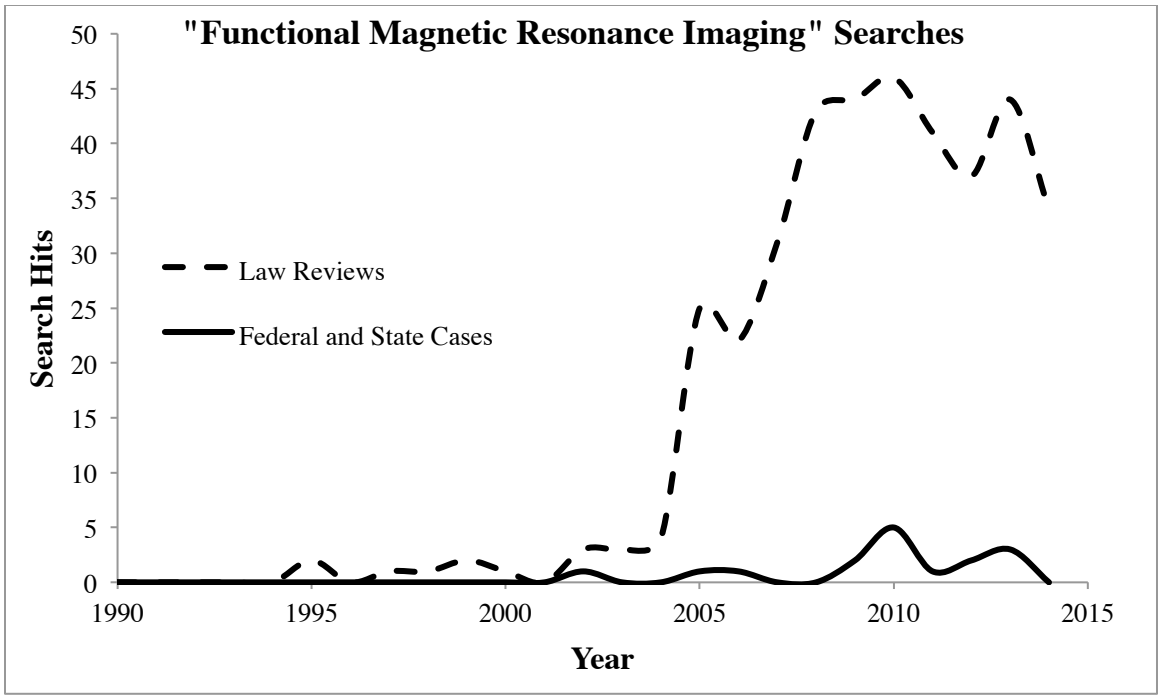


Figure 3. Lexis-Nexis search hits for functional magnetic resonance imaging."

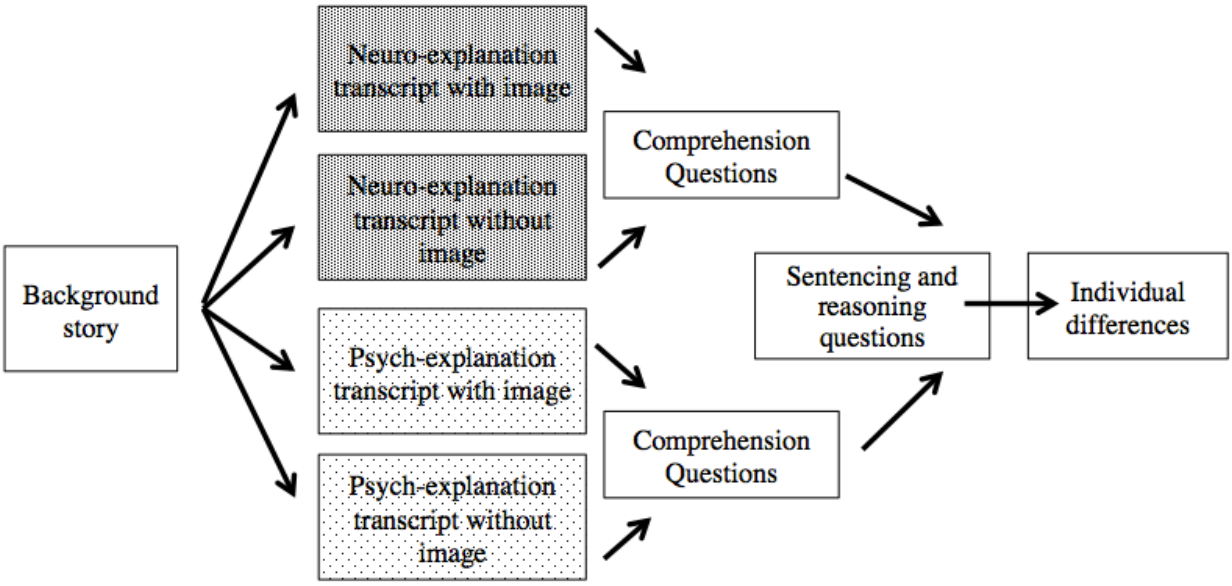


Figure 4. Visual representation of experimental method.

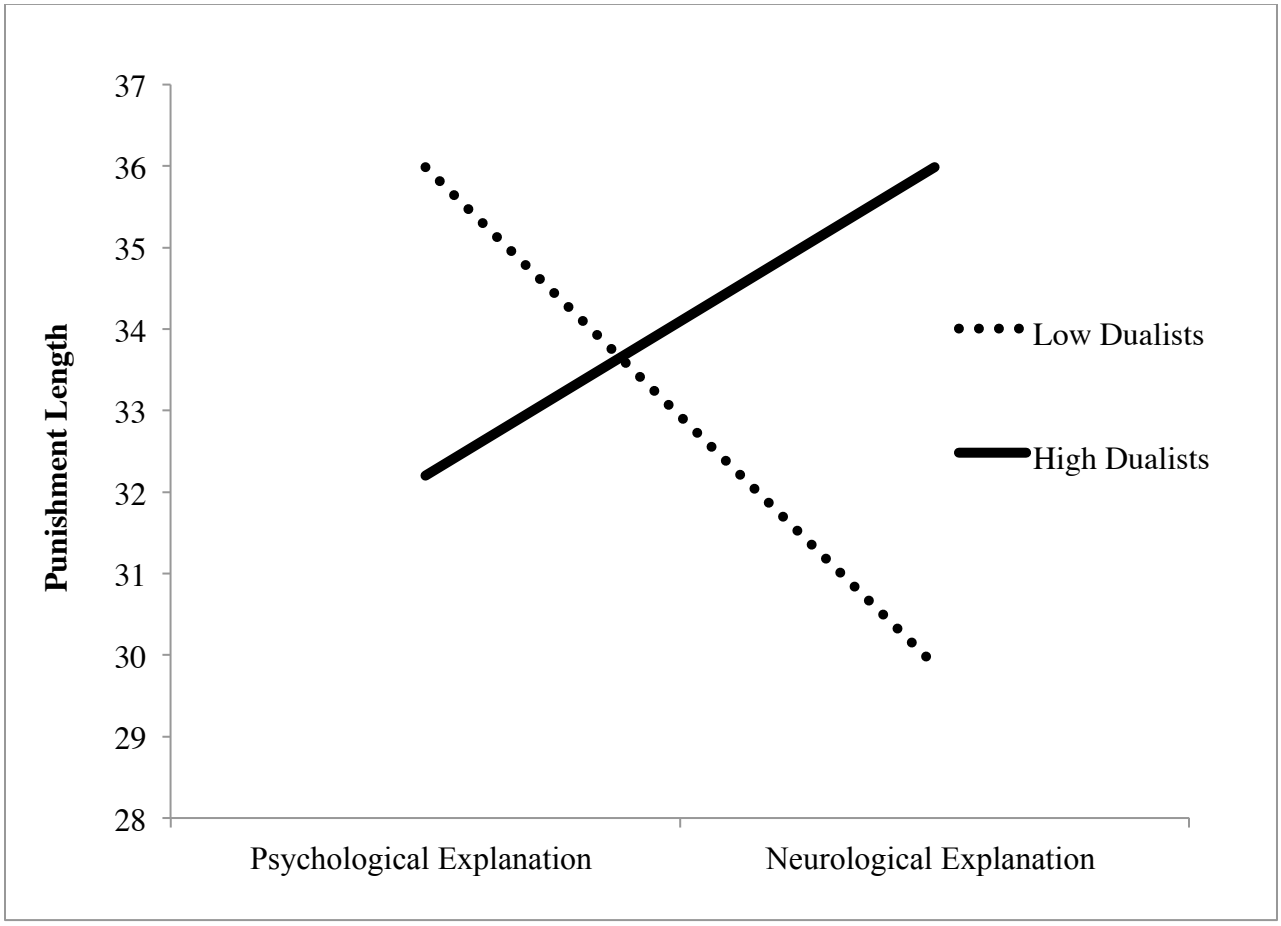


Figure 5. Means of the punishment length variable across groups for low and high dualists.

Appendix

A.1. Pre-trial Materials

Directions: Please read through the following trial materials as carefully as possible. You will be asked a series of questions after reading through the court transcript regarding the described case. You will not be able to consult the materials in answering the questions.

The information presented in this study is fictional and not based on real-life events.

Tyler Brock was driving on a highway when Joseph McCallaster inadvertently cut off Brock while he merged onto the interstate. In the incident, McCallaster's vehicle slightly swiped Brock's car after which both men pulled to the shoulder to discuss the incident. Brock started yelling at McCallaster, and said, "You could have caused an accident! What were you thinking?" McCallaster made a snide face in response to Brock's accusations and gave him the finger. Brock, in a fury, lunged toward McCallaster and began to punch McCallaster in the face repeatedly and strangled McCallaster within seconds.

Due to these events, Brock was put on trial for the murder of McCallaster. During the course of the trial, the prosecution presented persuasive evidence that linked Brock to the scene of the crime. Particularly, Brock's fingerprints were found on McCallaster's neck. Additionally, there were two eyewitnesses that testified that they both had seen Brock punch and subsequently strangle McCallaster while they were driving on the same highway.

A.2. Neurological Explanation

Note. Italicized sections are different from the psychological explanation. Bolded sections were added for the neurological explanation with an image.

Directions: Please read the following hypothetical transcript of a criminal court case regarding the crime committed above.

Lawyer: Dr. Morgan, you are known for your work with *a technology called functional magnetic resonance imaging, or fMRI for short*. Could you describe how this *technology* works using nontechnical language?

Dr. Morgan: *fMRI is a technological procedure used to detect changes in blood flow in a person's brain*. Essentially, this widely used technique uses *a powerful magnet to link blood flow with increased brain activity. The procedure then renders an image that highlights areas of the brain that are more active than others. It does so by using differing colors, with redder areas reflecting higher activation and bluer areas representing lower activation*.

Lawyer: If I recall your work correctly, you tend to *scan the brains* of a particular type of person. What are the qualities these people possess that distinguish them from "normal" people?

Dr. Morgan: I have spent the majority of my career working with a subset of the population known as psychopaths. Psychopaths typically exhibit markedly different behavioral, emotional, and interpersonal characteristics including lack of impulse control, irresponsibility, lack of empathy, dishonesty, superficial charm, and persistent violation of social norms. They tend to make a good first impression on other people, but their poor impulse control and inadequate judgment often lead them to make serious mistakes. In some cases, they even commit violent crimes.

Lawyer: Please describe what *your fMRI research* on psychopaths has demonstrated.

Dr. Morgan: Because psychopaths often *exhibit extreme impulse control problems*, I use *fMRI to look at areas in the brain that have been linked to impulsivity. I then compare the brain images of psychopaths with those of nonpsychopaths*.

In my line of work, I and my collaborators in other laboratories have found that psychopaths *demonstrate differential activation in two key areas: the amygdala, a small structure buried deep within the brain, and the orbitofrontal cortex, toward the front of the head. These findings*

supplement previous studies that have found the amygdala to be linked to emotion, especially to fear. The same is true for the orbitofrontal cortex, which is associated with emotional decision-making. People with low activation in these two brain areas may have an especially difficult time controlling their impulses to engage in crimes. For example, when angered by other people, they may find it difficult to resist becoming aggressive to them.

Lawyer: After you *scan* psychopaths' *brains*, what do you do with that information?

Dr. Morgan: After I *scan a brain*, based on *the levels of activation of the amygdala and the orbitofrontal cortex,* I can calculate an approximate psychopathy score. Our novel *fMRI method* yields a psychopathy score ranging from 0 to 40. People with scores of 30 or higher are considered psychopathic. Because impulse control deficits are common to psychopaths, it is safe to assume that someone who scores 30 or above on this measure may exhibit marked difficulties with controlling his or her impulses.

Lawyer: What is the error rate for your measure? In other words, how often does this test incorrectly diagnose a person as a psychopath who is not, and vice-versa?

Dr. Morgan: The error rate for my psychopathy measure is between 30-35%. That means that 30-35% of the time, someone may receive a high psychopathy score when he or she is not psychopathic or someone may receive a low psychopathy score when he or she is psychopathic. Overall, this method of detecting psychopathy has been found to be moderately to highly valid, meaning that it successfully detects most people as psychopathic.

Lawyer: Now that I understand how your technique works, could you describe what you found when you scanned Brock's brain?

Dr. Morgan: After scanning Brock's brain, I placed Brock at the 95% percentile on the 40 item scale I discussed previously. *The scans showed that several areas in Brock's brain areas, especially the amygdala and orbitofrontal cortex,* were quite different from those of a nonpsychopathic person's *brain*. **You can view the results of my investigation in the displayed picture.**

Lawyer: Dr. Morgan, do you think Brock could have acted differently in the circumstances of the crime given what you know about his *brain*?

Dr. Morgan: Given Brock's extremely high score on the psychopathy scale, I think that Brock may not have been able to inhibit his impulses to strangle the victim. Many people with similarly high scores find it difficult to inhibit their behavior.

A.3. Psychological Explanation

Note. Italicized sections are different from the neurological explanation. Bolded sections were added for the psychological explanation with an image.

Directions: Please read the following hypothetical transcript of a criminal court case regarding the crime committed above.

Lawyer: Dr. Morgan, you are known for your work *with standardized interview methods in the psychiatry profession*. Could you describe how this *interview process* works using nontechnical language?

Dr. Morgan: *Psychological interviews are used to assess a person's particular personality characteristics and behavioral tendencies*. Essentially, this widely used measurement technique *provides an experienced mental health clinician with a rigorous set of questions devised to rate and describe the behavior, thought, and feelings of a specific individual*.

Lawyer: If I recall your work correctly, you tend *to interview* a particular type of person. What are the qualities these people possess that distinguish them from "normal" people?

Dr. Morgan: I have spent the majority of my career working with a subset of the population known as psychopaths. Psychopaths typically exhibit markedly different behavioral, emotional, and interpersonal characteristics including lack of impulse control, irresponsibility, lack of empathy, dishonesty, superficial charm, and persistent violation of social norms. They tend to make a good first impression on other people, but their poor impulse control and inadequate judgment often lead them to make serious mistakes. In some cases, they even commit violent crimes.

Lawyer: Please describe what *your research* on psychopaths has demonstrated.

Dr. Morgan: Because psychopaths often *exhibit specific behavioral deviations*, I use an *interview procedure specially designed to assess those differences. Using the results from this interview and other relevant file data, I then diagnose a person as a psychopath*.

In my line of work, I and my collaborators in other laboratories have found that psychopaths tend to *demonstrate differential behavioral patterns that fall into two factors: (1) interpersonal and affective deficits and (2) lifestyle differences and antisocial tendencies. These findings supplement previous studies that have found that psychopaths tend to be pathological liars, lack empathy, and act impulsively. Specifically, psychopathic people* may have an especially difficult time controlling their impulses to engage in crimes. For example, when angered by other people, they may find it difficult to resist becoming aggressive to them.

Lawyer: After you *interview and assess psychopathic people*, what do you do with that information?

Dr. Morgan: After I *interview a person*, based on *differential behavioral tendencies*, I can calculate an approximate psychopathy score. This novel interview method yields *a psychopathy score* ranging from 0 to 40. People with scores of 30 or higher are considered psychopathic. Because impulse control deficits are common to psychopaths, it is safe to assume that someone who scores 30 or above on this measure may exhibit marked difficulties with controlling his or her impulses.

Lawyer: What is the error rate for your measure? In other words, how often does this test incorrectly diagnose a person as a psychopath who is not, and vice-versa?

Dr. Morgan: The error rate for my psychopathy measure is between 30-35%. That means that 30-35% of the time, someone may receive a high psychopathy score when he or she is not psychopathic or someone may receive a low psychopathy score when he or she is psychopathic. Overall, this method of detecting psychopathy has been found to be moderately to highly valid, meaning that it successfully detects most people as psychopathic.

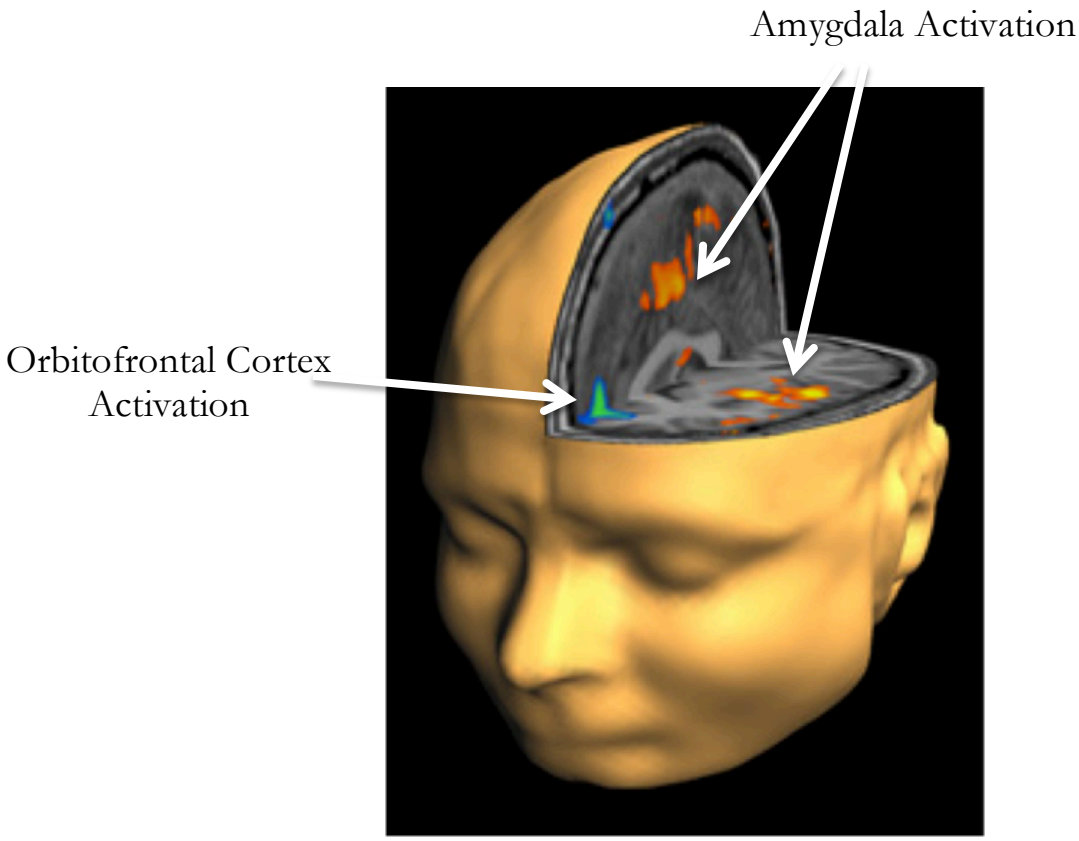
Lawyer: Now that I understand the more theoretical aspects of your measure, could you describe what you found when you assessed Brock?

Dr. Morgan: After interviewing Brock, I placed Brock at the 95% percentile on the 40 item scale I discussed previously. The results of the *interview* showed that several of Brock's *behavioral tendencies, especially his lack of impulse control and feelings of guiltlessness*, were quite different from those of a nonpsychopathic person's *behaviors*.

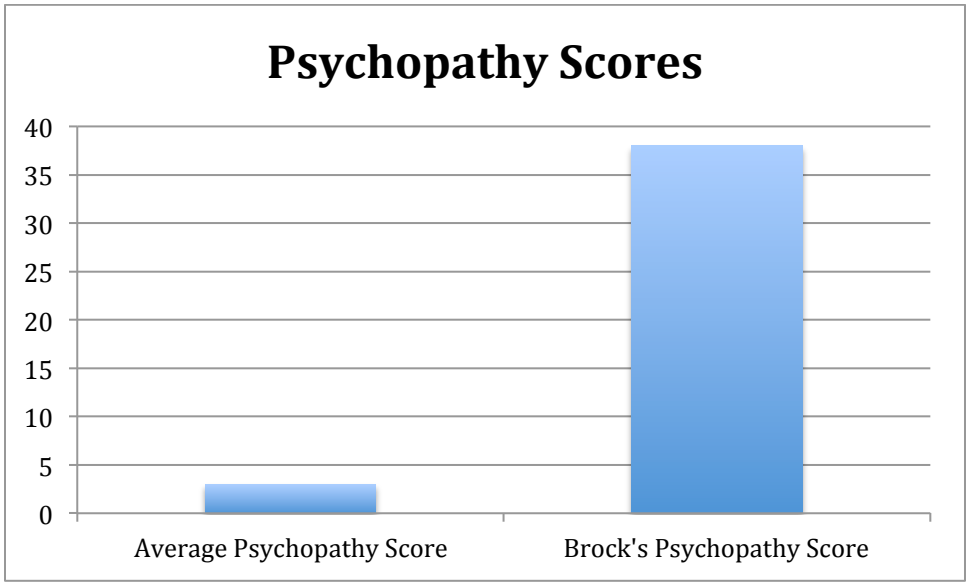
Lawyer: Dr. Morgan, do you think Brock could have acted differently in the circumstances of the crime given what you know about *him*?

Dr. Morgan: Given Brock's extremely high score on the psychopathy scale, I think that Brock may not have been able to inhibit his impulses to strangle the victim. Many people with similarly high scores find it difficult to inhibit their behavior.

A.4. Neurological Image



A.5. Psychological Image



A.6. Neurological Condition Comprehension Questions

1. How did Brock kill McCallaster?
    a. Stab
    b. Strangle
    c. Poison
    d. Shot
2. No one saw Brock kill McCallaster. True or False.
3. Where did the crime occur?
    a. Grocery store
    b. Brock's home
    c. Highway
    d. Parking lot
4. What is the name of the technology Dr. Morgan used to examine Brock's brain?
    a. Functional magnetic resonance imaging (fMRI)
    b. Positron emission tomography (PET)
    c. X-Ray
    d. DNA tests
5. Dr. Morgan examined the brains of what type of individual?
    a. Schizophrenic
    b. Depressed
    c. Psychopathic
    d. Autistic
6. The measure developed by Dr. Morgan was found to have a high error rate. True or false.
7. Dr. Morgan placed Brock high on the psychopathy scale. True or false.
8. Psychopathic people are typically considered to be:

a. Guiltless
b. Chronically sad
c. Overly analytical
d. Paranoid

A.7. Psychological Explanation Comprehension Questions

1. How did Brock kill McCallaster?
    a. Stab
    b. Strangle
    c. Poison
    d. Shot
2. No one saw Brock kill McCallaster. True or False.
3. Where did the crime occur?
    a. Grocery store
    b. Brock's home
    c. Highway
    d. Parking lot
4. How did Dr. Morgan derive his information about Brock's mental state?
    a. Clinical interview
    b. Functional magnetic resonance imaging
    c. DNA tests
    d. Lie detection devices
5. Dr. Morgan examined the brains of what type of individual?
    a. Schizophrenic
    b. Depressed
    c. Psychopathic
    d. Autistic
6. The measure developed by Dr. Morgan was found to have a high error rate. True or false.
7. Dr. Morgan placed Brock high on the psychopathy scale. True or false.
8. Psychopathic people are considered
    a. Guiltless
    b. Chronically sad
    c. Overly analytical
    d. Paranoid

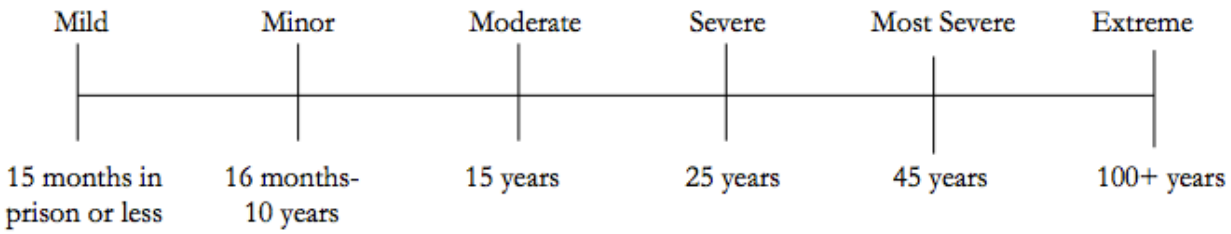
A.8. Sentencing Questions

Directions: After a jury determines the verdict of a case, they move into the sentencing phase of the trial. During this phase, the members of the jury determine the length and type of punishment the Brock deserves based on a variety of factors.

1. If Brock is found guilty, which of the following do you think is an appropriate punishment for his crime:
    1) Supermax prison: provides the highest level of prison security. These facilities often hold violent gang members, high-profile murders, and other dangerous inmates. These prisons usually allow minimal to no social contact and prisoners are confined to cells without another person.

2) Maximum security prison: prisoners are only allowed out of their security cell one hour out of the day. The prison cell is monitored at all times and only one person is in each cell.
3) Close security prison: prisoners often share a cell with one other inmate. Inmates are often allowed to leave their cell for designated assignments. A fence with a lethal current surrounds the prison.
4) Medium security: Inmates sleep in dormitories. These facilities have communal areas and bathrooms. Patrol officers watch the perimeter of the prison.
5) Minimal security: Inmates sleep in less-secure dormitories. Correctional officers watch the perimeter of the prison. Some of these facilities may not have fences around them.
6) Treatment facility: Inmates are often required to attend therapy sessions to remedy the prisoners' mental health issue. The facilities typically provide appropriate drug treatments, substance abuse programs, and educational classes. Inmates usually share a room with another person in the program.

2. If Brock is found guilty, how long do you think Brock should be punished? _____



A.9. Reasoning Questions

Directions: The following questions are unrelated to determining Brock's verdict or sentence. However, please take into consideration the trial materials when answering the following questions. Answer the questions with regard to the following number scheme to the best of your ability:

1: Not at all **2**: Not Really; **3**: Somewhat **4**: Very Much

1. To what extent did you find Dr. Morgan's argument persuasive?
2. To what extent did Dr. Morgan's argument regarding Brock's ability to withhold his impulses play into your decision about sentencing?
3. Do you think that Brock could be helped by treatment?
4. Do you think Brock could be cured by treatment?
5. Do you think Brock should receive brain surgery to help with his condition?
6. Do you think Brock should be prescribed medicine to help with his condition?
7. Do you think that Brock was fully in control of his actions when he committed the murder?
8. Do you think Brock poses a threat to the general public?
9. Do you think Brock could be a risk to others in prison?

10. Do you think your punishment of choice is an effective way to deter other people from committing similar crimes in the future?

11. Do you think your choice of sentence is a fair way for others to punish people like Brock in the future?

A.10. Demographic Information

1. Age: ___
2. Gender: ____
3. Please rate each of these questions based on the following Likert scale:

1	2	3	4	5	6	7
Very Liberal						Very Conservative

   a. What is your general political orientation? ___
   b. In terms of social issues, do you consider yourself: ___
   c. In terms of economic issues, do you consider yourself: ___

4. Please rate your level of education on the following scale to the best of your ability: ____
   1 – Completed some high school
   2 – Completed high school
   3 – Completed (or in the process of completing) a two year or technical college program
   4 – Completed some college at a 4-year college
   5 – Completed a bachelor's degree program at a 4-year college
   6 – Completed some of a master's degree program
   7 – Completed a masters program
   8 – Completed some of a graduate or professional degree
   9 – Completed graduate or professional degree
5. Please rate the frequency in which you attend religious-related events on the following scale: ___
   1 – Never
   2 – A few times a year
   3 – Often
   4 – Once a week
   5 – One or more times a week
6. I have taken a psychology course previously: Yes or No