Opposing Experts, Relative Judgments, and the Reemergence of the Neuroimage Bias

by

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ABSTRACT

There is conflicting evidence regarding whether a biasing effect of neuroscientific evidence exists. Early research warned of such bias, but more recent papers dispute such claims, with some suggesting a bias only occurs in situations of relative judgment, but not in situations of absolute judgment. The current studies examined the neuroimage bias within both criminal and civil court case contexts, specifically exploring if a bias is dependent on the context in which the neuroimage evidence is presented (i.e. a single expert vs. opposing experts). In the first experiment 408 participants read a criminal court case summary in which either one expert witness testified (absolute judgment) or two experts testified (relative judgment). The experts presented neurological evidence in the form of functional magnetic resonance imaging (fMRI) data and the evidence type varied between a brain image and a graph. A neuroimage bias was found, in that jurors who were exposed to two experts were more punitive when the prosecution presented the image and less punitive when the defense did. In the second experiment 240 participants read a summary of a civil court case in which either a single expert witness testified or two experts testified. The experts presented fMRI data to support or refute a claim of chronic pain and the evidence type again varied between image and graph. The expected neuroimage bias was not found, in that jurors were more likely to find in favor of the plaintiff when either side proffered the image, but more likely to find for the defense when only graphs were offered by the experts. These findings suggest that the introduction of neuroimages as evidence may affect jurors punitiveness in criminal cases, as well as liability decisions in civil cases and

overall serves to illustrate that the influence of neuroscientific information on legal decision makers is more complex than originally thought.

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Introduction

Neuroscience is a general term that encapsulates the study of the structure and function of the nervous system, and specifically of the brain. Over the past two decades, neuroscience, and the representation of it in the form of neuroimaging, has moved beyond just being of interest to the scientific and academic communities to being engrossing to both policymakers and to the public. Specifically, functional magnetic resonance imaging (fMRI) has piqued the interest of the media as a means to get a glimpse at how human brains function and to perhaps give insight into what people are thinking or feeling. For instance, a 2007 article in the *New York Times* touted the ability of fMRIs to assess undecided voters' opinions of presidential candidates. However, the article gave merely a vague explanation of what an fMRI is and of its true capabilities, yet made claims of being able to assess swing voters' empathy and anxiety levels regarding particular candidates. This is grossly misleading both of the capabilities of fMRIs and of other brain imaging technologies and the inferences that can be drawn from neuroimages.

Traditional magnetic resonance imaging (MRI) is used to show the structure, as well as abnormalities of the structure, of the brain. This is essentially achieved through pictorializing changes in water density throughout the brain structure. Expanding upon the capabilities of MRIs, fMRI's use much of the same techniques, however they expand on them to create images that depict changes in blood-oxygenation levels in the brain, suggesting that increased or decreased neuronal activity is taking place (Gore, 2003).

In 2015, Shifferman published a scathing critique of the use and interpretations of neuroimages, specifically of those produced from fMRIs. Shifferman pointed out the

many physiological and methodological shortcomings of fMRI's stating that scientists well versed in the technological underpinnings of fMRI's are unethically allowing for laymen to perceive a definitive link between brain activity and behavior.

Due to the rise in the use of fMRI scans, and anecdotal evidence about their use affecting court case outcomes, the legal community became wary of them. Kulynych (1997) pointed out that fMRI scans are not simply snapshots of the brain that directly show function, rather they are composites of data which are subject to an expert's interpretation. Because of this, she argued, neuroimages have potential for misinterpretation and as such may be unduly prejudicial and she warned of the potential for misuse of this technology in the courtroom. Dumit (1999) explicated on this argument noting that neuroimages may not only be subject to misinterpretation but there may be something inherently persuasive about them due to their flashiness. As a possible remedy, Dumit made an argument for not showing neuroimages in the courtroom as evidence, rather having an expert simply describe the findings. In a later commentary, Feigenson (2006) suggested that a better remedy may be to show more, different neuroimages in order to provide competing representations, thus forcing jurors to evaluate the images (and what they represent) more critically.

On the surface, it may appear that neuroscience can be unduly persuasive and two well-known studies in 2008 examined this assumption. Across three experiments, McCabe and Castel paired fictitious and real news articles summarizing studies of cognition and neuroscience with a graphic that summarized the findings. The graphic was presented as either brain images, a bar graph or a map representing brain activation. Participants who viewed the brain images rated the scientific credibility of the articles as

higher than those in all of the other conditions did. The researchers argued that one explanation for this might be that images provide a more palpable representation of brain activity than the other types of graphics do and as such, the images are thought to be more credible.

Similarly, Weisberg, Keil, Goodstein, Rawson, & Gray (2008) conducted three experiments with participants of varying neuroscience knowledge. Novices, beginning neuroscience students and neuroscience experts read a short paragraph about a psychological phenomenon that was followed by either a good or a bad scientific explanation which contained either irrelevant neuroscience information or no neuroscience information. Both the groups of the novices and the students judged the explanations that contained the neuroscience to be more satisfying than the explanations that did not contain neuroscience, suggesting that laypeople are unduly influenced by a neuroscientific explanation—even when it is irrelevant or has faulty reasoning behind it.

These early findings on the prospective persuasive impact that neuroscience and neuroimages may have on laymen consumers, along with the concerns about a neuroimage bias occurring in the courtroom, led to research on the potential influence that neuroscience may have on the legal system generally and on jurors' decision-making in particular. The first such study was done by Schweitzer et al. (2011) who across four experiments tested for a prejudicial effect of neuroimagery as evidence for a mens rea (lack of intent) defense. The authors varied the severity of a criminal case and measured various outcomes including verdict, sentencing recommendations and responsibility. Essentially no biasing effect of neuroimages on mock jurors was found. Subsequent studies examining a neuroimage bias generally found similar results. A follow-up study

by Schweitzer & Saks (2011) found that the presence of a neuroimage did not influence mock jurors' ratings of a criminal defendant to be not guilty by reason of insanity. Additionally, Greene & Cahill (2012) found that the presence of neuroimages did not have an additional influence above that of an expert verbalizing test results, on mock jurors' impressions of the defendant nor on their sentencing decisions.

Outside of the legal system setting, a study by Gruber & Dickerson (2012) found no effect of fMRI images on participants' judgments of credibility of a fictitious news article, and Fernandez-Duque et. al (2015) found no specific influence of neuroimagery on participant's judgments of credibility of articles relaying findings of studies on psychological phenomena over and above the effect of a neuroscientific explanation without accompanying images.

In an attempt to clarify if the findings from the early studies that supported a neuroimage bias were spurious, Michael, Newman, Vuorre, Cumming and Garry (2013) attempted to directly replicate the McCabe and Castel 2008 study. Across 10 experiments and in a meta-analysis, which included the McCabe and Castel original data, the researchers found little to no effect of neuroimages on participant's level of agreement with a news article. Michael et al. pointed to the influence that study design might have on the appearance of this biasing effect. In fact, most of the conflicting studies in the literature on whether or not a neuroimage bias truly exists have employed between-subjects designs. However, there has been some support for the bias effect emerging when repeated-measures designs have been used. For instance, Schweitzer, Baker & Risko (2013) conducted a series of five experiments with mixed results. The first four experiments employed between-subjects designs and found no evidence of neuroimages

affecting the persuasiveness of scientific articles. However, their fifth experiment employed a within-subjects design and did find a significant effect of neuroimagery on the believability of a research summary. The authors suggested that a neuroimage bias may be dependent on context—that it emerges in situations where there is a non-image that can serve as a basis for comparison. This is a particularly noteworthy finding as many real-world scenarios offer more than one source of information for us to make judgments from. This finding is suggestive of a neuroimage bias being akin to a contrast effect—that is neuroimages may only have undue persuasiveness in conditions where people have a basis for comparison that they perceive or judge to be inferior.

Contrast effects fall under the umbrella of context effects within social judgment theory. Context effects can account for differences in attitude changes within people when they are presented with various stimuli. Specifically, the persuasiveness of a stimuli is inversely related to the accompanying stimuli. (Sherif & Hovland, 1961; Sherman, Ahlm, Berman & Lynn, 1978). So, the persuasiveness of a neuroimage may differ depending on the context—if there is an accompanying stimuli, such as a graph that can serve as a contrasting, less intriguing stimuli, the persuasiveness of the image may be enhanced. This type of situation calls on the use of relative judgments—contrasting two stimuli to each other and deciding which is more persuasive in relation to the other. Accordingly, if there is not an accompanying stimuli to judge a neuroimage against, it creates a situation of absolute judgment and thus no contrast effect would occur.

Neuroimages as Evidence

The potential undue persuasiveness of neuroimages is particularly relevant to the legal community. Although it is impossible to know the exact number of criminal and

civil cases that contain neurological evidence in the United States, it is evident that the use of this type of evidence has been increasing in recent years. In a comprehensive review of all judicial opinions in criminal cases across the U.S. from 2005 to 2012, Farahany (2015) found that roughly five percent of murder trials, and approximately 25 percent of death penalty trials, included some form of neurobiological information. It is important to note that these estimates included a broad scope of evidence of differing qualities (i.e. neuroscience including, but not limited to, neuroimages and behavioral genetic evidence) and that trials that are settled before a jury verdict, as well as those that are decided by jury verdict and not appealed, are not included in the Westlaw database, thus the data available for analysis may be over- or under-representative of the nature and quantity of trials that include neuroscientific evidence. In spite of the methodological limitations, Farahany's overview does appear to indicate that the use of neuroscience and neurological based evidence is increasing within criminal cases in the legal system.

While the body of empirical research on the use of neuroscience in criminal case contexts continues to grow, very little if any research has been done in civil case contexts. Specifically, attempts to locate any social science research on a possible neuroimage bias in civil jurors has been unsuccessful. The use of neurological evidence in civil cases is ripe for exploration though, as the use of neuroimaging, and fMRI scans in particular, appear to be on the rise in civil court—specifically in personal injury cases as a means to buttress plaintiff's claims of chronic pain. According to Davis (2016) plaintiffs in personal injury cases are beginning to seek out fMRI scans of their brains to support their assertion that they are experiencing chronic pain. However, Davis points out that neuroscientists are conflicted about whether or not fMRI scans can truly address the

issue of pain, and even if it is possible, it is unclear if the results are consistently accurate enough to be used as reliable evidence in court.

When exploring the possibility of a neuroimage bias in both criminal and civil cases, it is important to consider that differences in the standard of proof between the two may impact the emergence of a neuroimage bias. In criminal cases the burden of proof lies with the prosecution, given that they must show beyond a reasonable doubt that the defendant is guilty. This could translate to the introduction of a neuroimage by the defense creating just enough doubt in the jury to have an influence on verdict or on sentencing recommendations. In civil cases however, the burden lies with the plaintiff in that they must prove their case by a preponderance of the evidence. In other words, the plaintiff's evidence has to show that it is more likely than not that their claim is true. It is possible that if a jury is favoring the defense, that the introduction of a neuroimage by the plaintiff may not be given enough weight by the jury to sway them to the plaintiff's side. Conversely, if the jury is leaning toward the plaintiff, or views the opposing sides relatively equally, it is possible that the introduction of a neuroimage may be just persuasive enough to convince them that the plaintiff's case is at least 51% likely.

Due to the rise in the use of neuroimagery in court cases, as well as the conflicting evidence in the literature of whether or not a neuroimage bias exists, it is of importance to investigate this relationship further. If a neuroimage bias emerges when it involves a task where relative judgment is used, rather than absolute judgment, it is of import to the legal community specifically. Jurors often employ relative judgments, as they are typically exposed to competing sources of information, in the form of evidence and opposing expert testimony from both the prosecution/plaintiff and from the defense.

The Present Studies

The purpose of the present studies was to asses if a neuroimaging bias could be found among mock jurors in both criminal and civil cases, and if such bias is dependent on the context in which the neuroscientific evidence is presented (i.e. from a single expert versus an opposing expert). Specifically, in Study 1 hypotheses were tested to both replicate past research that a neuroimage bias is not evident in cases when one expert witness provides a neuroimage, and to extend this line of research to mimic more realistic scenarios by testing to see if a neuroimage bias appears in cases with relative comparisons (opposing experts). In Study 2, hypotheses were tested to explore these same questions, but in the as yet unstudied arena of the neuroimage bias within a civil court case.

Study 1

Study 1 consisted of participants reading a trial summary of a mock criminal assault case. The defense argued that the defendant's actions were due to his having decreased frontal lobe functioning and offered an expert witness with either an accompanying brain image or a graph to support this claim. The prosecution argued the defendant had normal brain functioning and offered an expert witness that had an accompanying brain image or graph to support this assertion. The various combinations of one expert and two experts, as well as of the types of evidence presented from either side, resulted in six conditions. A seventh condition was added as a control in which no experts testified from either side. Several hypotheses were tested:

One-Expert Hypotheses. The participants that were exposed to only one expert are expected to employ absolute judgments and in an effort to assess if a neuroimage bias

is present in situations of absolute judgments, these two conditions were compared to each other. Consistent with past findings it is predicted that between them there will not be any significant differences in verdict choice, punitiveness or responsibility.

Two-Expert Hypotheses. The participants in the conditions that were exposed to two experts are expected to employ relative judgments and thus a contrast effect is expected to occur. So, in an effort to determine if a neuroimage bias occurs in situations of relative judgments, the two conditions that were exposed to two experts were compared to each other. Although this is a between-subjects analysis, the comparison of these two conditions mimics a repeated-measures design. If study design has an impact, as previous research has suggested, it is expected that between these two conditions there will be significant differences in verdict choice, punitiveness and responsibility. Specifically, it is predicted that the condition in which the prosecution proffers the neuroimage will produce more guilty verdicts and higher ratings of punitiveness and responsibility than the condition in which the defense proffers the neuroimage.

Study 1 Method

Participants

Through Amazon's Mechanical Turk, a sample of 439 participants was recruited online to complete the mock criminal trial. Participants who completed the task in less than 100 seconds (n = 8) were excluded from analyses, as well as those who scored below 75% on a manipulation check quiz (n = 23), making the final sample size 408 (56.1% male; 79.9% White/Caucasian, 6.6% Hispanic/Latin, 6.1% Black/African American, 5.9% Asian/Pacific Islander and 1.5% Other; M_{age} = 33.05 years, SD = 10.67). Participants were compensated $1.10 for their participation.

Procedure

Participants were randomly assigned to one of seven conditions in which they read a short vignette of a fictitious criminal court case trial summary involving an assault between two neighbors. The trial summary included a general overview of the alleged crime, the prosecution's case, the defense's case and jury instructions. Participants were then asked to complete a series of dependent variable measures, demographic information questions and manipulation check questions (See Appendix A for full trial summary and measures).

Materials and Measures

Trial Summary. The general summary included background information of an assault case. The defendant physically assaulted his neighbor in an unprovoked attack, striking him on the head and rendering him unconscious. The victim recovered from his injuries. The defense claim is that the defendant has decreased functioning in the frontal lobe of his brain that results in uncontrollable behavior and therefore he should not be held accountable for his actions, whereas the prosecution's argument is that the defendant does not have decreased brain functioning and therefore should be held accountable for his behavior. The defense's case consisted of a neurologist expert witness testifying that a fMRI scan of the defendant's brain was performed and the results indicated that he had decreased functioning in his frontal lobe, suggesting that this decrease could cause the defendant to lose control over his behavior. The expert was accompanied by a pictorial exhibit of the fMRI results that were varied across conditions to be either in graphical or brain image format. The prosecution's case consisted of either no expert or a neurologist expert witness testifying that an independent fMRI scan of the defendant's brain

indicated normal levels of functioning in his frontal lobe, suggesting that he does not suffer from a condition that would influence his behavior. The fMRI results were varied across conditions to be either in graphical or brain image format. A control condition consisted of no expert witness testifying from either side. The jury instructions included a brief explanation of the possible verdicts.

Verdict. Participants were asked to render a verdict in the case and were given the following four choices with accompanying descriptions: Guilty of first-degree assault (*Occurs if a person acts with the intended purpose of causing physical injury to another person*), guilty of second-degree assault (*Occurs if a person doesn't intend to cause physical injury, is aware that his/her actions will almost certainly result in physical injury to another person*), guilty of third-degree assault (*Occurs if a person is aware that there is some possibility that his/her actions may cause physical injury, but nevertheless engages in risky conduct*), or not guilty (*If you do not believe that any of the above charges fit this case*).

Punitiveness. Participants (including those whose verdict choice was not guilty) were asked two questions regarding punishment recommendations: How severely the defendant should be punished on a 7-point scale ranging from 1 (*He should be punished to minimum extent possible*) to 7 (*He should be punished to maximum extent possible*) and the primary purpose for imposing that sentence on a 10-point scale ranging from 1 (*Punishment*) to 10 (*Isolation from the public*).

Responsibility. Participants were asked on a 10-point scale how criminally responsible the defendant was ranging from 1 (*Not at all responsible*) to 10 (*Fully responsibl*e), how morally responsible he was ranging from 1 (*Not at all responsible*) to

10 (*Fully responsibl*e) and how in control of his actions he was ranging from 1 (*Not at all in control*) to 10 (*Fully in control*).

Study 1 Results

One-Expert

To test the hypothesis that there would be no significant differences between participants who were exposed to one expert (image *versus* graph) on verdict decision, an ordinal logistic regression was performed. Participants chose one of four verdicts: not guilty, guilty of 1st degree assault, guilty of 2nd degree assault or guilty of 3rd degree assault. As predicted, there was no significant effect of condition, Wald = 2.45, $p = .118$.

To test for a biasing effect of evidence type on measures of punitiveness, two one-way between-subjects ANOVAs were conducted. As expected, they were not significant; Punishment severity ($F(1, 111) = 0.12$, $p = .729$, $\eta_p^2 = .001$); punishment purpose ($F(1, 111) = 0.05$, $p = .829$, $\eta_p^2 < .001$).

To test for a biasing effect of evidence type on measures of defendant responsibility, a series of one-way between-subjects ANOVAs were conducted. As expected, they were not significant: Criminal responsibility ($F(1, 113) = 0.07$, $p = .788$, $\eta_p^2 = .001$), moral responsibility ($F(1, 113) = 0.68$, $p = .412$, $\eta_p^2 = .006$), controllability ($F(1, 113) = 0.01$, $p = .916$, $\eta_p^2 < .001$).

Two-Experts

To test the hypothesis that there would be significant differences between participants who were exposed to two, competing experts (image *and* graph) on verdict decision, an ordinal logistic regression was performed. Participants again chose one of four verdicts: not guilty, guilty of 1st degree assault, guilty of 2nd degree assault or guilty

of 3rd degree assault. No significant effect of condition was found, Wald = 1.59, $p = .207$.

To test for a biasing effect of the neuroimage on measures of punitiveness, two one-way between-subjects ANOVAs were conducted. Punishment severity was significant $F(1, 120) = 7.58$, $p = .007$, $\eta_p^2 = .06$ indicating that participants were swayed by the side that used the neuroimage (mean punishment when neuroimage offered by the defense = 3.70, $SD = 1.55$; mean punishment when neuroimage was offered by the prosecution = 4.47, $SD = 1.49$). Punishment purpose ($F(1, 119) = 0.01$, $p = .936$, $\eta_p^2 < .001$) was not significant (See Table 1 for statistics).

To test for a biasing effect of the manipulation on measures of defendant responsibility, a series of one-way between-subjects ANOVAs were conducted. Criminal responsibility was significant ($F(1, 120) = 4.89$, $p = .029$, $\eta_p^2 = .039$), indicating that participants were swayed by the side that used the neuroimage (mean criminal responsibility when the neuroimage was offered by the defense = 7.67, $SD = 2.49$; mean criminal responsibility when the neuroimage was offered by the prosecution = 8.53, $SD = 1.72$; Higher scores indicated more responsibility). Moral responsibility ($F(1, 121) = 0.52$, $p = .474$, $\eta_p^2 = .004$) and controllability ($F(1, 121) = 1.24$, $p = .267$, $\eta_p^2 = .01$) were not significant (See Table 2 for statistics).

Brief Discussion

The comparison of the conditions in which participants were exposed to only one expert was carried out in an attempt to replicate previous findings of no neuroimage biasing effect in between-subjects designs that offer no basis for comparison. These results support the absence of a biasing effect under these circumstances. No significant differences were found in verdict choices, with 92.7% choosing guilty of assault to some

degree (46.8% guilty of 1st degree assault; 30.6% guilty of 2nd degree assault; 15.3% guilty of 3rd degree assault; 7.3% not guilty). Additionally, participants were no more or less punitive when they saw a neuroimage versus a graph, nor were they more or less inclined to hold the defendant morally or criminally responsible. These results are indicative of a neuroimage bias not being present in situations of absolute judgment.

The comparison of the conditions in which participants were exposed to two experts was carried out in an attempt to clarify if a biasing effect of neuroimages emerges in conditions of relative judgment. Significant differences were not found on verdict decision with 97.6% choosing guilty of assault to some degree across both conditions (53.2% guilty of 1st degree assault; 30.1% guilty of 2nd degree assault; 14.3% guilty of 3rd degree assault; 2.4% not guilty). This is likely due to the nature of the case summary, as it was written in such a way that the defendant's guilt was quite clear.

A significant effect of the manipulation was found on a measure of punishment severity. Participants wanted to punish the defendant more severely when the prosecution used the neuroimage and less severely when the defense did. Although punishment purpose was not found to be significantly different between conditions, this could be due to the method of measurement or to the nature of the mock case in general.

A neuroimage bias also appeared to impact how criminally responsible participants felt the defendant is (or should be) for his crime. Participants wanted to hold the defendant more criminally responsible when the prosecution had the neuroimage and less responsible when the defense had it. The defendant's moral responsibility for the crimes, as well as the perceived level of control he had over his actions, did not appear to be impacted by a neuroimage bias.

These results suggest that neuroimage evidence can, in certain circumstances, have a biasing effect on juror punitiveness. Although no biasing effect was present in the conditions of absolute judgment, it was evident in the conditions where relative judgments were employed.

Study 1 was conducted in an effort to replicate previous findings regarding a neuroimage bias in the courtroom, and specifically to explore if a bias emerges when competing experts provide jurors with a relative basis for judgment. Although not all hypotheses were supported, the most relevant measures did appear to be affected by the neuroimage bias (i.e. punishment severity and criminal responsibility) specifically in the instances when there were opposing experts. Due to these significant findings, as well as a lack of research on the neuroimage bias within civil juries, Study 2 was developed to further the understanding of the relationship between neuroimagery and juries.

Study 2

Study 2 consisted of participants reading a mock trial summary of a civil personal injury case. The plaintiff asserted that the defendant's actions directly caused him to have a lasting leg injury with chronic pain. The defense argued that the plaintiff was malingering and suffered from no lasting injuries or pain. The plaintiff offered an expert witness who claimed an fMRI of his brain showed that he was experiencing pain. The expert was accompanied by either a graph or an image of the fMRI results. The defense argued the plaintiff was not experiencing chronic pain and offered either: no expert witness testimony, or testimony from an expert witness who interpreted the same fMRI differently and was accompanied by either a brain image or graph to support these claims. The various combinations of the type of evidence presented from either side, and

either one or two experts testifying, resulted in four conditions. A fifth condition was added as a control in which experts from both sides offered graphs as exhibits. Several hypotheses were tested:

One-Expert Hypotheses. The conditions that were exposed to only one expert are expected to be exercising absolute judgments, so consistent with past findings and with the results of Study 1, it is predicted that a comparison of these two conditions to each other will not result in any significant differences on measures of verdict or on measures of damages.

Two-Expert Hypotheses. The conditions that were exposed to two experts are expected to employ relative judgments and a contrast effect is anticipated, resulting in a neuroimage bias. Consistent with previous research findings of a bias with repeated-measures designs and consistent with the results of Study 1, it is predicted that a comparison of the two conditions that were exposed to two experts, will reveal significant differences on measures of verdict and on measures of damages. Specifically, the condition in which the plaintiff's expert proffers the neuroimage will result in an increase in verdict decisions in favor of the plaintiff, as well as in higher damage awards. The condition in which the defense's expert proffers the neuroimage will result in a decrease in verdict decisions in favor of the plaintiff, as well as a decrease in damage awards.

Study 2 Method

Participants

Through Amazon's Mechanical Turk, a sample of 275 participants was recruited online to complete the mock civil trial. Participants who completed the task in less than 180 seconds (n = 8) were excluded from analyses, as well as those who scored below

75% on the manipulation check quiz (n = 27), making the final sample size 240 (61.3% male; 78.8% White/Caucasian, 9.6% Asian/Pacific Islander, 5% Black/African American, 4.6% Hispanic/Latino, and 2% Other; M_{age} = 33.75 years, SD = 10.31). Participants were compensated $1.00 for their participation.

Procedure

Participants were randomly assigned to one of five conditions in which they read a short trial summary of a fictitious civil court case wherein the plaintiff claimed to suffer from ongoing medical problems as a result of a car accident caused by the defendant. The trial summary included a general overview of the case, the plaintiff's case, the defense's case and jury instructions. Participants were then asked to complete a series of dependent variable measures, demographic information questions and manipulation check questions (See Appendix B for full trial summary and measures).

Materials and Measures

Trial Summary. The general summary included background information of the personal injury case—the parties were in a car accident, which was the fault of the defendant, and the plaintiff claims to suffer from persistent injuries and pain in his leg as a result from the accident, and is thus seeking financial compensation from the defendant. The defendant claims that the plaintiff has no lasting injuries and therefore he should not be held responsible any further. The plaintiff's case consisted of a neurologist expert witness testifying that an fMRI scan of the plaintiff's brain was performed and that the accompanying pictorial exhibit of the fMRI results indicated a strong sensation of pain in his leg was being experienced. The fMRI results were varied across conditions to be either in graphical or brain image format. The defendant's case consisted of either no

expert or a neurologist expert witness testifying that independent review of the fMRI scan indicated that pain sensation was within the normal range. The fMRI results were varied across conditions to be either in graphical or brain image format. The jury instructions included a brief explanation of the burden of proof in a civil case (i.e. preponderance of the evidence).

Verdict. Participants chose a verdict (for the plaintiff or for the defendant), were asked how certain they were about the outcome of the case on a 10-point scale ranging from 1 (*Fully certain the plaintiff should win*) to 10 (*Fully certain the defendant should win*), and were asked to imagine if this were a real trial, what would be the probability that they would find in favor of the plaintiff (0 to 100% chance they would find for the plaintiff).

Damages. Participants whose verdict choice was for the plaintiff were asked a series of questions about awarding damages. They were given the option to award any amount they deemed fit in the following categories: medical expenses (estimated to be $24,500.00), pain and suffering (the plaintiff asked for $2,000,000.00) and punitive damages (no suggested amount was given). A separate, scaled measure of pain and suffering was also used in which participants were asked to think of the concept in an abstract way and to make a choice on a 10-point scale of how much money the plaintiff should be awarded ranging from 1 (*As little as possible*) to 10 (*As much as possible*).

Study 2 Results

One-Expert

To test the hypothesis that there would be no significant differences between participants who were exposed to one expert (image *versus* graph) on simple verdict

choice, a binary logistic regression was performed and revealed no effect, Wald = 0.42, p = .518.

To test the remaining measures of verdict, a series of one-way between-subjects ANOVAs were performed. A measure of verdict certainty ($F(1, 93) = 0.93$, $p = .336$, $\eta_p^2 = .01$) was not significant, nor was a measure of the probability of finding for the plaintiff were this a real trial ($F(1, 92) = 0.30$, $p = .583$, $\eta_p^2 = .003$).

To test for a neuroimage biasing effect on measures of damages, a series of one-way between-subjects ANOVAs were conducted. The three monetary measures of damages were not found to be significant; medical expenses ($F(1, 78) = 2.07$, $p = .155$, $\eta_p^2 = .026$), pain and suffering ($F(1, 77) = 1.81$, $p = .183$, $\eta_p^2 = .023$) and punitive damages ($F(1, 80) = 2.10$, $p = .151$, $\eta_p^2 = .026$). The continuous measure of pain and suffering was found to be marginally significant ($F(1, 80) = 3.96$, $p = .05$, $\eta_p^2 = .048$) indicating that participants who saw the neuroimage believed the plaintiff should be awarded more for pain and suffering than those who saw a graph ($M_{Image} = 6.26$, SD = 2.13, $M_{Graph} = 5.36$, SD = 1.94).

Two-Experts

For participants who were exposed to two experts (image *and* graph), a binary logistic regression was performed to determine if condition was related to simple verdict choice and revealed no effect, Wald = 0.39, p = .53.

To test the remaining measures of verdict, a series of one-way between-subjects ANOVAs were performed. Verdict certainty was not significant ($F(1, 91) = 0.22$, p = .624, $\eta_p^2 = .002$) nor was verdict probability ($F(1, 91) = 0.10$, $p = .755$, $\eta_p^2 = .001$).

To test for a biasing effect on measures of damages, a series of one-way between-

subjects ANOVAs were conducted and none were found to be significant; medical expenses $F(1, 61) = 1.21$, $p = .276$, $\eta_p^2 = .02$), pain and suffering $F(1, 60) = 0.64$, $p = .428$, $\eta_p^2 = .011$), punitive damages $F(1, 61) = 1.29$, $p = .26$, $\eta_p^2 = .021$) and pain and suffering continuous $F(1, 61) = 1.66$, $p = .203$, $\eta_p^2 = .027$. (See Table 3 for statistics).

Two-Experts vs. Control

Due to the nonsignificant results between the conditions of two, competing experts additional analyses were conducted between the groups who were exposed to two experts (image and graph) and the control group who was exposed to two experts (graph and graph). A binary logistic regression, with condition dummy coded so that the control condition was the reference group, was performed to determine if condition was related to simple verdict choice and was found to be significant. When the plaintiff had the image and the defense had the graph, participants were 0.35 times more likely to find in favor of the defense than those in the control condition, Wald = 7.10, $p = .008$, OR = 0.35. When the plaintiff had the graph and the defense had the image, participants were 0.26 times more likely to find in favor of the defense than those in the control condition, Wald = 8.85, $p = .003$, OR = 0.26. In other words, those in the two conditions in which they saw a neuroimage (regardless of which side proffered it) were more likely to find in favor of the plaintiff than those in the control condition in which they saw graphs from both of the experts. See Figure 1.

A series of one-way ANOVAs were performed to assess the continuous verdict measures. Verdict certainty was found to be significant ($F(2, 145) = 4.47$, $p = .013$, $\eta_p^2 = .059$). Post hoc tests using the Bonferroni correction revealed that the control group was statistically different than the group in which the plaintiff had the brain image ($p = .049$)

and from the group in which the plaintiff had the graph (p = .027), indicating that those in the control group were more certain that the defendant should win than those in either of the two competing expert conditions ($M_{CONTROL}$ = 6.06, SD = 2.72; $M_{PLAINTIFF/IMAGE}$ = 4.87, SD = 2.46; $M_{DEFENSE/IMAGE}$ = 4.63, SD = 2.36). Verdict probability was not found to be significant ($F(2, 145) = 1.70$, p = .186, η_p^2 =.023) See Table 4.

An additional series of one-way ANOVAs were conducted between the groups who were exposed to two experts (image and graph) and the control group on all measures of damages. None were found to be significant; Pain and suffering continuous ($F(2, 82) = 1.43$, p = .246, η_p^2 =.034), monetary pain and suffering ($F(2, 81) = 0.53$, p = .591, η_p^2 =.013), medical expenses $F(2, 82) = 0.92$, p = .402, η_p^2 =.023) and punitive damages $F(2, 82) = 0.78$, p = .461, η_p^2 =.019).

Brief Discussion

The comparison of the conditions in which participants were exposed to only one expert was carried out in an attempt to replicate the findings from Study 1. The findings support the absence of a neuroimage bias in situations of absolute judgment, with no significant differences being found in verdict choices or on damage measures. Participants found in favor of the plaintiff 84% of the time in the neuroimage condition and 88.6% of the time in the graph condition. Additionally, the manipulation had no effect on how certain participants were that the plaintiff should win, or on the probability that they felt they would find for the plaintiff if this were a real trial. These results indicate that evidence from one expert (regardless of type) has no biasing effect on verdict decision.

Whether participants saw a graph or saw a neuroimage did not significantly

impact measures of monetary damages. Suggested monetary awards for medical expenses, pain and suffering and punitive damages were not significantly impacted by evidence type.

Contrary to expectations, pain and suffering, as measured continuously, was found to be marginally significant. Participants who saw the neuroimage believed the plaintiff should be awarded more for pain and suffering than those who saw a graph did. It appears that while there may have been a small effect of the neuroimage bias on how mock jurors abstractly decide pain and suffering damages (The plaintiff should get as little, or as much as possible) it does not appear to translate to their actual decision of monetary amounts of damages. Taken together, these findings support the absence of a neuroimage biasing effect in conditions of absolute judgment in a civil case setting.

The comparison of the conditions in which participants were exposed to two experts was carried out in an attempt to determine if the neuroimage bias found in Study 1 would translate to, and emerge in, a civil case setting. Given that the burden of proof is less in a civil case than it is in a criminal one, verdict was expected to be impacted, yet it was not (when the plaintiff had the neuroimage, 64.8% found for the plaintiff; when the defense had the neuroimage, 71.1% found for the plaintiff). This is indicative of evidence type having had no biasing effect on verdict decisions. Additionally, verdict certainty and verdict probability showed no effect of the manipulation. This absence of a neuroimage bias was unexpected. One possible explanation could be the skepticism effect, a theory in which jurors who are exposed to conflicting expert witness testimony become skeptical of both of the experts regardless of the content or quality of their testimony (Levett & Kovera, 2008).

The neuroimage was expected to impact the magnitude to which the participants believed the plaintiff was suffering, thus effecting measures of damages, but no significant differences were found. Due to the nature of the case, and that no basis amount was given, it was not entirely surprising that punitive damages were not significantly affected by the manipulation. However, the absence of an effect on pain and suffering damages, as well as on medical expense damages, is less easily explained. One possible reason may be that the neuroimage was not persuasive enough to meet the preponderance of the evidence requirement for civil juries, so it did not hold enough weight to significantly influence their damage decisions. Together, these findings do not support the presence of a neuroimage biasing effect in conditions of relative judgment in a civil case setting.

Due to the unexpected, nonsignificant results just described, additional analyses were conducted. These revealed some significant differences between the groups who were exposed to two experts (image and graph) and the control group who was exposed to two experts (graph and graph). Here, verdict choice was noticeably different in that participants in the control group were more likely to find in favor of the defendant (61.1%) than those in the conditions that were exposed to two experts in which one had a graph and the other had an image (regardless of which opposing side presented which type of evidence; 35.2% and 28.9%). Verdict certainty was found to be significant in that those in the control group were more certain that the defendant should win than those in either of the other two competing expert conditions.

None of the measures of damages were found to be significant. This was not completely unexpected, as damages are only compared for those who found in favor of

the plaintiff, thus even though verdict was impacted it is not surprising that damages were not.

These results are contradictory to the results of Study1. Here, a neuroimage bias was not found to be present in conditions of opposing experts, yet the presence of the image did appear to be beneficial to the plaintiff, when compared to a context where only graphs were used by the competing experts.

General Discussion

Previous research on a neuroimage bias has produced conflicting results, yet has trended toward the nonexistence of such bias. While the first wave of research supported the presence of a bias (McCabe & Castel, 2008; Weisberg et al., 2008), a second, larger wave found little to no bias present (e.g. Gruber & Dickerson, 2012; Schweitzer & Saks, 2011), but some raised the possibility that a bias can occur in situations of relative judgment (Schweitzer et al., 2013). The present studies aimed to further explore and clarify if and when a neuroimage bias emerges in such situations.

The results of Study 1 indicate that in situations of relative judgment, a neuroimage bias can emerge. When faced with opposing experts, mock jurors' punitiveness followed whichever side presented the neuroimage. Specifically, they wanted to punish the criminal defendant more severely, and hold him more criminally responsible, when the prosecution used the neuroimage and less so when the defense offered it. This serves to support the emergence of a neuroimage bias in conditions of relative judgment generally, and specifically in criminal court case contexts. This finding may be explained by the contrast effect, where the neuroimage may appear to be more sophisticated and thus more persuasive, but only when it is compared to a graphical, less

intriguing, representation of the same data. A contrast effect would indicate that the persuasiveness of the fMRI image, and with it the persuasiveness of the accompanying expert testimony, is unduly enhanced by function of the presence of a less credible piece of evidence (the graph). This could also explain the lack of a statistically significant difference among the remaining five conditions, as among them participants could only judge the neuroimage against another equally intriguing neuroimage or against no evidence offered from the prosecution.

The results of Study 2 diverge from those of Study 1 and paint a more complex picture of the neuroimage bias, particularly in a civil case setting. A bias did not emerge in the expected manner in situations with opposing experts when one had an image and the other had a graph. Regardless of which side presented the neuroimage, the majority of jurors found in favor of the plaintiff. This could be attributed to the skepticism effect—the mere presence of an opposing expert may induce jurors to be more skeptical of both of the experts overall, regardless of the content or quality of their testimony/evidence (Cutler & Penrod, 1995; Levett & Kovera, 2008). That is, jurors were more skeptical of the implications of the fMRI scan because two experts in the field could not agree on the meaning and so they ignored the evidence, thus jurors defaulted to siding with the plaintiff. This would only be the case though if the jurors were already inclined to believe the plaintiff prior to the introduction of the neuroscience evidence. However, this does not fully explain the significant differences found between these two conditions and the control condition on verdict measures (i.e. the higher likelihood of jurors finding for the defense in the control condition). Expectation would be that the skepticism effect would be seen universally across all three conditions, and that is not the case. The finding that

the two conditions with neuroimages were together more likely to find for the plaintiff than the control condition may be explained by a variation of the skepticism effect. The presence of a neuroimage as evidence from one of the experts (regardless of which side proffers it) may serve to increase the credibility of the science (the fMRI scan being able to show pain) and thus of the case presented by the plaintiff overall. That is, jurors are more skeptical of non-image neuroscience evidence than they are of neuroimages and accordingly the presence of a neuroimage serves to lend credibility to the whole proceeding, which in turn bolsters the plaintiff's claim. When both experts only have non-images, jurors' may be equally skeptical of them and their perceptions of the overall severity of the plaintiff's injury may be lower than it would be if one or both of the experts were to have a neuroimage. Consequently, the jurors are more likely to find in favor of the defendant.

Another possible explanation for these differences may be found in the burden of proof, considering that in both of the conditions with opposing experts, regardless of which side presented the neuroimage, the participants found in favor of the plaintiff roughly 70% of the time. It is possible that the plaintiff's case may have simply appeared strong enough (more likely than not to be true) with or without the neuroevidence, thus making the introduction of it have no additional impact on verdict decisions. However, the materials were written in such a way that the plaintiff's case was not intended to appear stronger than the defense's case; rather it was intended to be ambiguous. Additionally, this explanation does not adequately explain why the participants in the control condition, who saw graphs from both experts, only found in favor of the plaintiff roughly 40% of the time.

Implications. In a criminal legal setting, it is unlikely that a neuroimage would be presented as evidence from the defense without the prosecution rebutting it in some way. As such, it is important to consider that a biasing effect of a neuroimage was present when there was a basis of comparison (a graph) for the jurors and that this bias occurred both when the prosecution presented the image, as well as when the defense presented it. Considering that the facts of the case and the content of the expert witness testimony were held constant across these conditions, with the only difference being what type of picture they had to support their claims, these findings have important applied significance, supporting that a neuroimage bias effect can occur in settings of relative judgment. Jurors may be unduly influenced by a neuroimage if they have a non-image as a basis of comparison.

In civil legal settings, the use of neuroimages, specifically as a means to bolster claims of chronic pain, is starting to become a hotly debated topic. The question of whether a neuroimage bias emerges in civil cases settings is thus an important, and yet to be explored one. Although the neuroimage bias emerged differently than expected, it is still notable. Jurors may be more skeptical of competing experts and thus default to find in favor of the defense, but only when neither side uses a neuroimage. Conversely, if one of the competing experts offers a neuroimage as evidence, jurors may feel that it lends legitimacy to the plaintiff's claim and thus find in their favor. It is important to note that this occurred regardless of which side used the neuroimage. Past research may lead one to believe that if it is the defense's expert who has the neuroimage, jurors may tend to believe that side more, but the results of this study would caution that assumption.

Limitations and Future Directions. The differences between criminal and civil cases are numerous; the nature of the case, the burden of proof requirements and so on. While these differences themselves may not impact the way in which a neuroimage bias presents itself in jurors, it is possible they might have an effect. As such, the differences between the case summaries used in Study 1 and in Study 2 make it difficult to explain why their results are inconsistent. Additionally, there are procedural differences between theses two studies that limit the ability to compare them. In Study 1, each expert had not only the neuroimage/graph of their independent fMRI scan results of the defendant, but they also had a comparison scan of a "normal" brain in an effort to make the similarities or differences between the defendant and a person with average frontal lobe functioning apparent to the jurors. This comparison was not replicated in Study 2, where instead each expert had only one image/graph and they were interpreting the results of the same fMRI scan. These differences between the two studies make it difficult to explain why neuroimage biasing effects emerged so differently between them and make it so that a direct comparison of the two is not advised.

Although a significant effect of neuroimagery was found in Study 1, it is important to note that the difference found in mock jurors' level of punishment severity was relatively small. It is possible that this difference could be magnified or lessened if the context of the crime/case were different. The trial summary used was written in such a way that the defendant's guilt was quite clear, thus it would be beneficial to explore differing types and severities of criminal cases, as well as situations where the defendants' guilt is questionable and thus verdict decisions may be more likely to be at risk for biasing.

Although Study 2 produced different results than expected, it was somewhat exploratory in nature as it is the first known to examine the neuroimage bias in a civil court case, and as such the results should be interpreted with caution. The question regarding in what situations a neuroimage bias might emerge, appears to have a complex answer. Study 2 should serve as a basis to further explore this question, particularly within the civil litigation arena.

One possible limitation of the present studies is that they were both conducted using online participants. There have been several calls to move away from the traditional use of college student samples to community based samples, although findings on differences between these two samples have been mixed (See Wiener, Krauss & Lieberman, 2011 for overview). The use here of online samples should help to alleviate some of this concern and contribute to the external validity of these studies.

Another area of debate regarding mock jury research has surrounded the inclusion or exclusion of the deliberation process and what effect, if any, it may have on the external validity of a study. Results and opinions on this topic have been mixed (See Diamond, 1997 for overview), but the prevailing thought has been that deliberation has little effect. However, a further review by Salerno & Diamond (2010) did make an argument for the deliberation process to potentially have an effect on juries' decision-making processes. In light of this, it would be beneficial to replicate the present studies and include an interactive deliberation process among the mock jurors.

Conclusions

The introduction of neuroimages as evidence can, under certain circumstances, have an undue influence on jurors' decision-making. In situations where there are opposing expert witnesses, if one produces a neuroimage to support their claim and the other does not, it may produce an image bias. However, the extent of the bias may be dependent on the legal setting. In a criminal case, jurors may be unduly persuaded by whichever side presents a neuroimage. In civil cases however, jurors may be more persuaded by the plaintiff when a neuroimage is produced, even when it is the defense that presents it. A neuroimage bias may affect punitiveness in criminal cases, as well as liability decisions in civil cases.

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APPENDIX A

STUDY 1 MATERIALS AND MEASURES

Case Summary (No Experts)

Donny Adams, age 32, is charged with assaulting his neighbor, 59 year-old Robert Samuels. Mr. Samuels had been working in his yard when his lawnmower launched a small stone into the defendant's window, cracking it. The defendant immediately ran from his house and punched Mr. Samuels, causing him to fall to the ground unconscious. The emergency room physician, Dr. Alexander Melman, found that Mr. Samuels had been knocked out by a single blow to his head, and suffered minor additional injuries when he fell to the ground. Mr. Samuels has now fully recovered from those injuries.

Two witnesses saw Mr. Samuels working in his yard with a lawnmower, and heard a loud noise as if the lawnmower had hit a stone. After a few seconds, Mr. Adams emerged from his house and ran directly at Mr. Samuels while screaming and swinging his fists. Mr. Adams struck Mr. Samuels in the face, and Mr. Samuels collapsed to the ground. At that point, Mr. Adams ran back into his house and closed the door. Additional interviews revealed that the defendant had recently moved alone into his house, and that Mr. Adams and Mr. Samuels had never met or interacted prior to this incident.

The prosecution argues that the defendant, Mr. Adams, simply became enraged when the stone from the victim's lawnmower cracked his window, and, in retaliation, attacked Mr. Samuels, intending to cause him harm. The defense attorney argues that Mr. Adams suffers from a disorder which caused him to act irrationally, and thus is not fully responsible for his actions. The defense attorney claims that Mr. Adams believed that his house was being "attacked" by Mr. Samuels, and the only way to stop the attack was to "neutralize" Mr. Samuels.

The prosecution concluded by reminding the jurors that everyone has "bad days," but not everyone reacts violently and beats up their neighbor. Mr. Samuels was simply mowing his lawn when Mr. Adams became enraged in response to a total accident, and, in retaliation, he attacked Mr. Samuels. The prosecution argued that the defense was trying to distract the jurors by claiming that the defendant's behavior was due to some sort of "disorder," when, in reality, he had no disorder and merely over reacted.

In contrast, the defense attorney argued that Mr. Adams does, in fact, suffer from a disorder that caused him to act irrationally. Mr. Adams's disorder makes it difficult for him to control his behavior -- he never would have hurt his neighbor had it not been for this disorder. Therefore, the defense concluded that Mr. Adams should not be held responsible for his actions.

Case Summary (Defense Image/Prosecution No Expert)

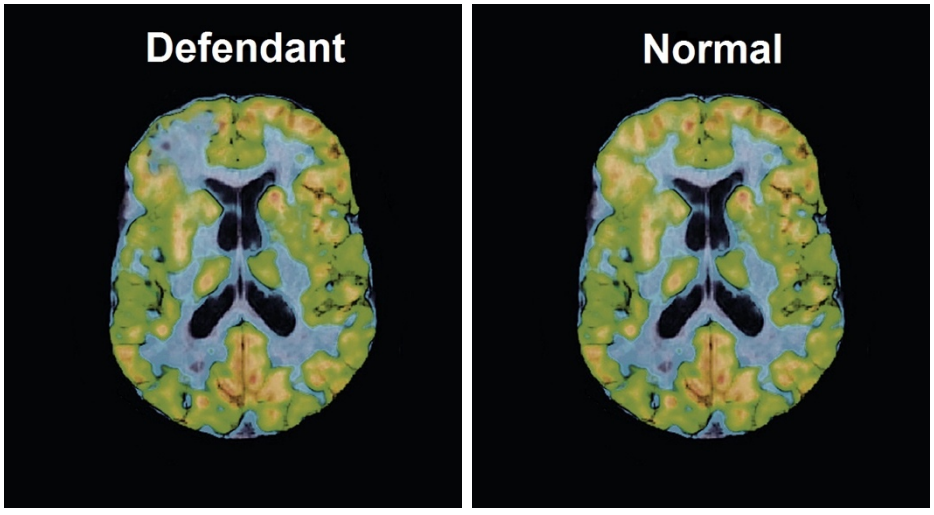
Donny Adams, age 32, is charged with assaulting his neighbor, 59 year-old Robert Samuels. Mr. Samuels had been working in his yard when his lawnmower launched a small stone into the defendant's window, cracking it. The defendant immediately ran from his house and punched Mr. Samuels, causing him to fall to the ground unconscious. The emergency room physician, Dr. Alexander Melman, found that Mr. Samuels had

been knocked out by a single blow to his head, and suffered minor additional injuries when he fell to the ground. Mr. Samuels has now fully recovered from those injuries.

Two witnesses saw Mr. Samuels working in his yard with a lawnmower, and heard a loud noise as if the lawnmower had hit a stone. After a few seconds, Mr. Adams emerged from his house and ran directly at Mr. Samuels while screaming and swinging his fists. Mr. Adams struck Mr. Samuels in the face, and Mr. Samuels collapsed to the ground. At that point, Mr. Adams ran back into his house and closed the door. Additional interviews revealed that the defendant had recently moved alone into his house, and that Mr. Adams and Mr. Samuels had never met or interacted prior to this incident.

The prosecution argues that the defendant, Mr. Adams, simply became enraged when the stone from the victim's lawnmower cracked his window, and, in retaliation, attacked Mr. Samuels, intending to cause him harm. The defense attorney argues that Mr. Adams suffers from a disorder which caused him to act irrationally, and thus is not fully responsible for his actions. The defense attorney claims that Mr. Adams believed that his house was being "attacked" by Mr. Samuels, and the only way to stop the attack was to "neutralize" Mr. Samuels.

Dr. David McCarthy, a board-certified neurologist with substantial experience in diagnosing brain injuries, testified for the defense that the frontal lobe of Mr. Adams's brain does not function properly. Dr. McCarthy conducted a functional magnetic resonance imaging (fMRI) scan of the defendant's brain. Dr. McCarthy presented the results of the fMRI displayed below suggesting decreased functioning in the left side of the defendant's frontal lobe. Dr. McCarthy testified that "the frontal lobe enables us to control our impulses and actions, so that people with frontal lobe brain damage often lose control over their own behavior and are prone to certain types of 'rage' attacks".



The prosecution concluded by reminding the jurors that everyone has "bad days," but not everyone reacts violently and beats up their neighbor. Mr. Samuels was simply mowing his lawn when Mr. Adams became enraged in response to a total accident, and, in

retaliation, he attacked Mr. Samuels. The prosecution argued that the defense was trying to distract the jurors by claiming that the defendant's behavior was due to some sort of "disorder," when, in reality, he had no disorder and merely over reacted. In contrast, the defense attorney argued that Mr. Adams does, in fact, suffer from a disorder that caused him to act irrationally. Mr. Adams's disorder makes it difficult for him to control his behavior -- he never would have hurt his neighbor had it not been for this disorder. Therefore, the defense concluded that Mr. Adams should not be held responsible for his actions.

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The prosecution argues that the defendant, Mr. Adams, simply became enraged when the stone from the victim's lawnmower cracked his window, and, in retaliation, attacked Mr. Samuels, intending to cause him harm. The defense attorney argues that Mr. Adams suffers from a disorder which caused him to act irrationally, and thus is not fully responsible for his actions. The defense attorney claims that Mr. Adams believed that his house was being "attacked" by Mr. Samuels, and the only way to stop the attack was to "neutralize" Mr. Samuels.

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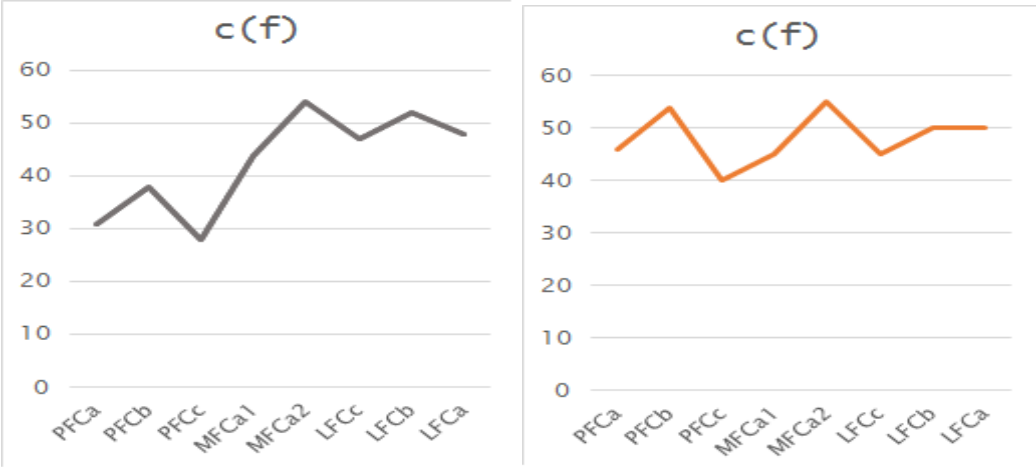

Defendant **Normal**

The prosecution concluded by reminding the jurors that everyone has "bad days," but not everyone reacts violently and beats up their neighbor. Mr. Samuels was simply mowing his lawn when Mr. Adams became enraged in response to a total accident, and, in retaliation, he attacked Mr. Samuels. The prosecution argued that the defense was trying to distract the jurors by claiming that the defendant's behavior was due to some sort of "disorder," when, in reality, he had no disorder and merely over reacted.

In contrast, the defense attorney argued that Mr. Adams does, in fact, suffer from a disorder that caused him to act irrationally. Mr. Adams's disorder makes it difficult for him to control his behavior -- he never would have hurt his neighbor had it not been for this disorder. Therefore, the defense concluded that Mr. Adams should not be held responsible for his actions.

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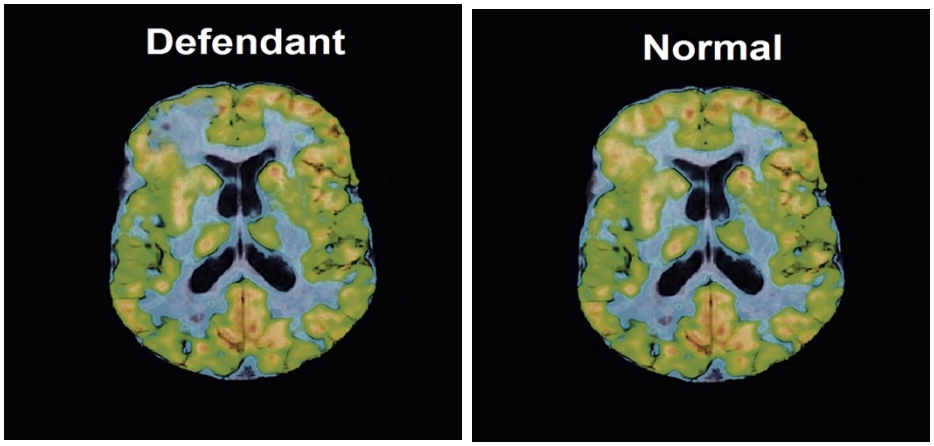

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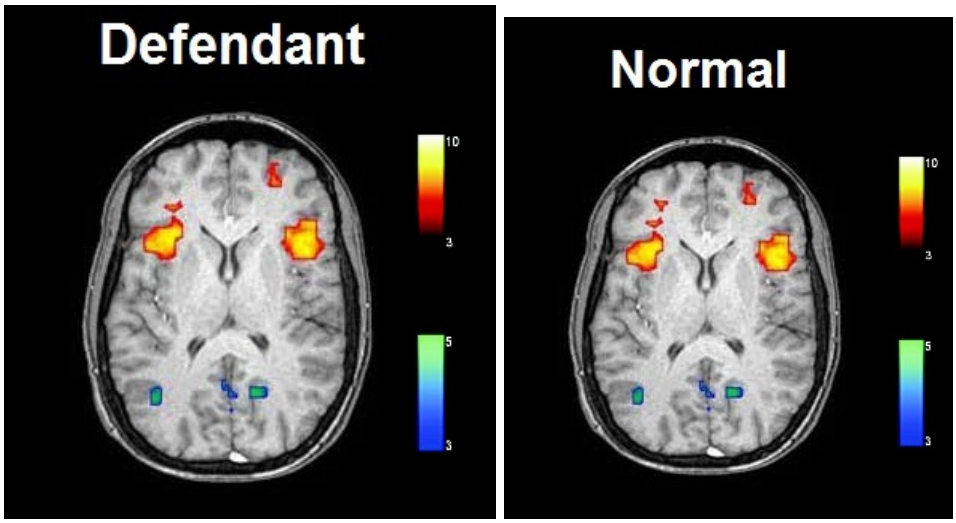

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In contrast, the defense attorney argued that Mr. Adams does, in fact, suffer from a disorder that caused him to act irrationally. Mr. Adams's disorder makes it difficult for him to control his behavior -- he never would have hurt his neighbor had it not been for this disorder. Therefore, the defense concluded that Mr. Adams should not be held responsible for his actions.

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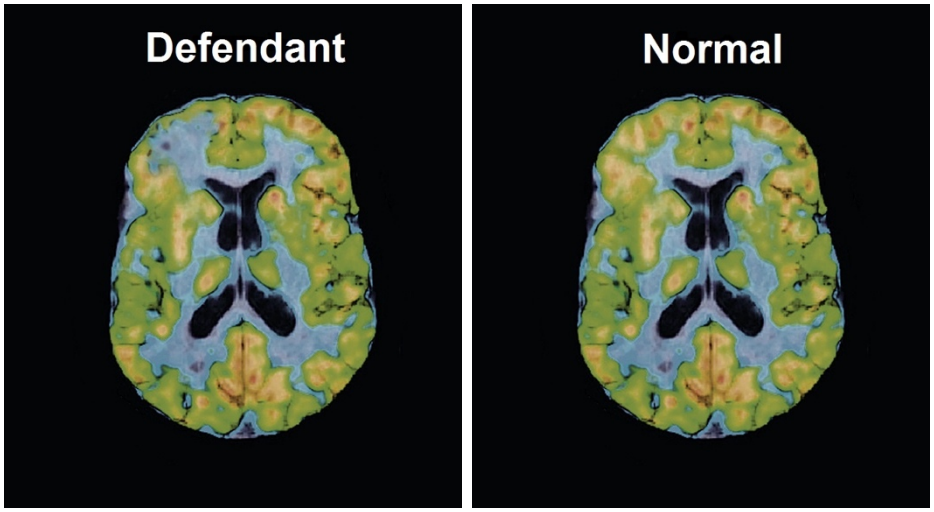

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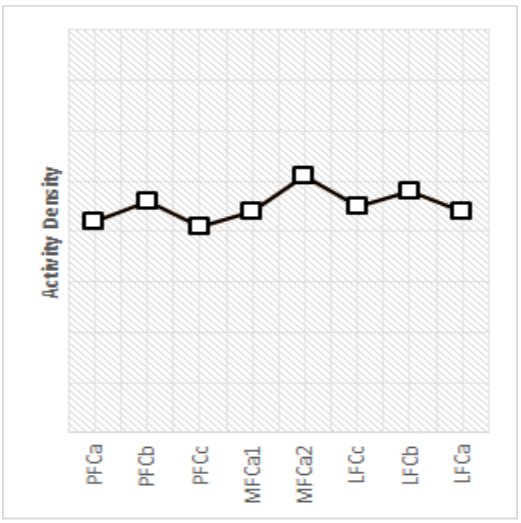

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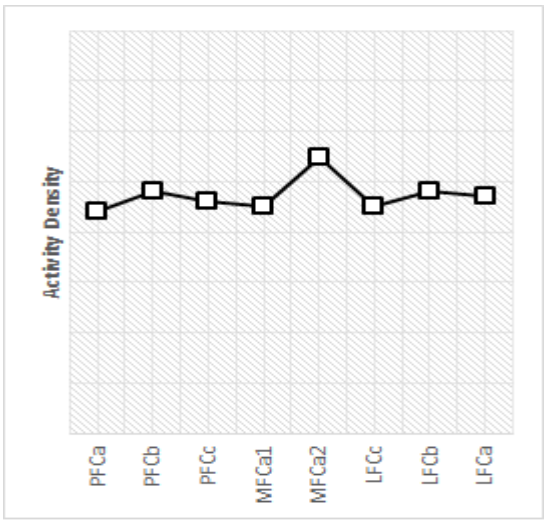

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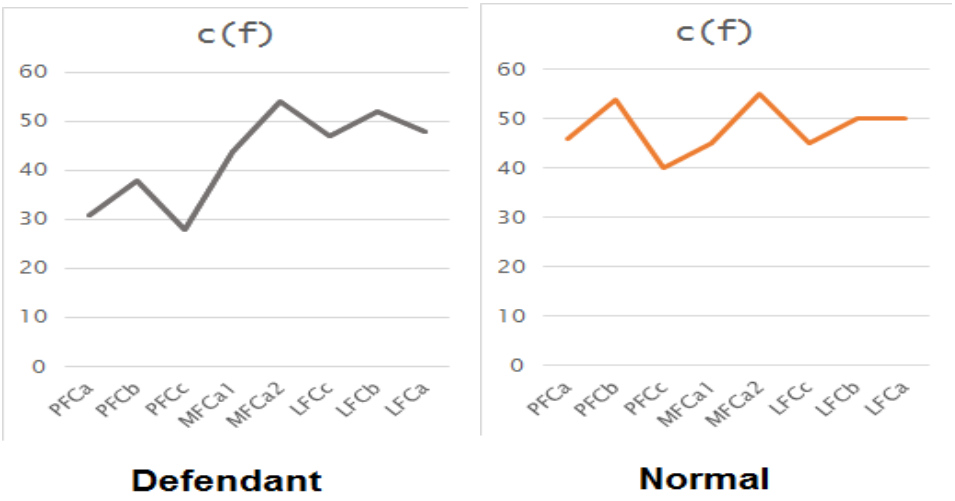

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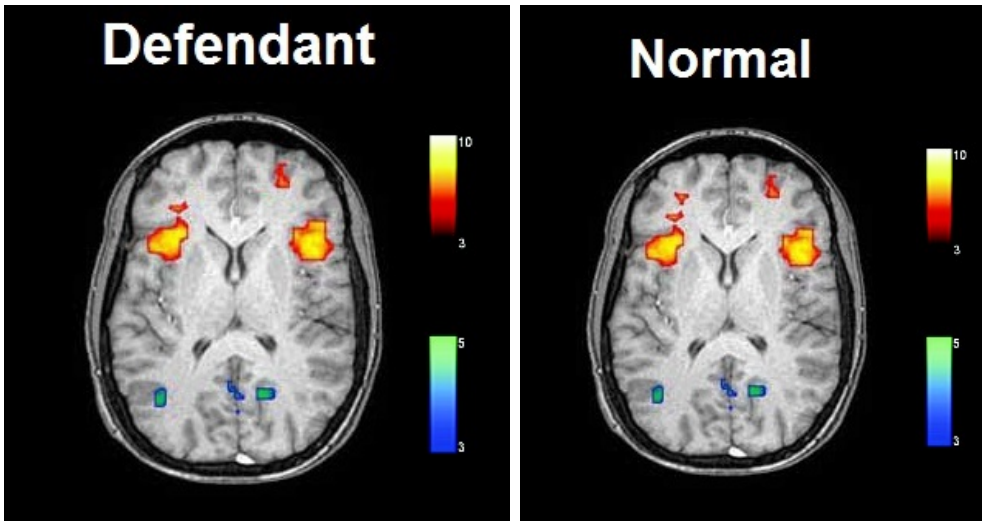

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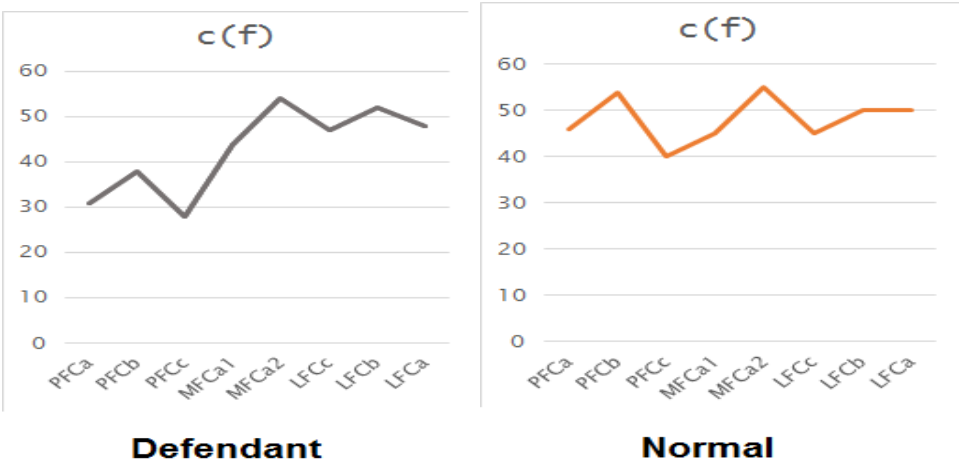

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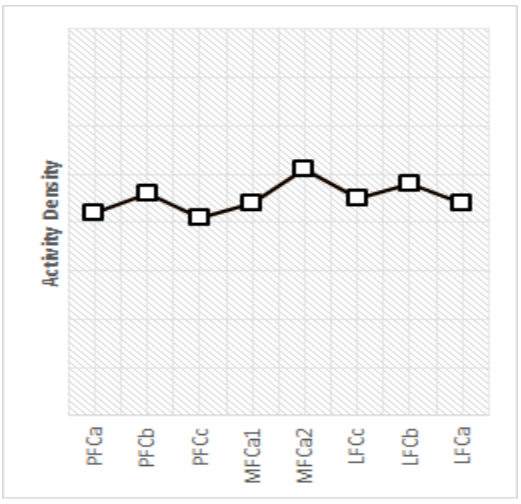

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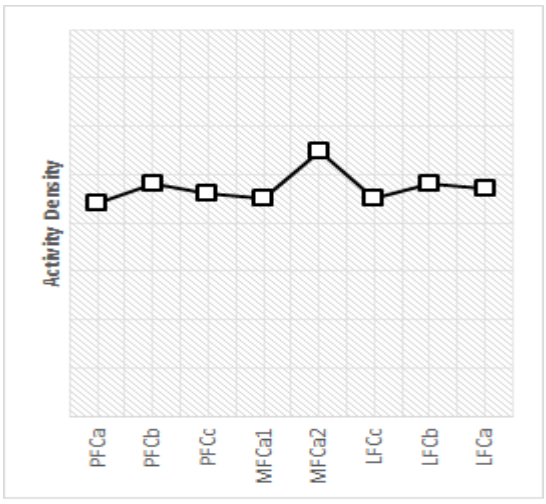

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Jury Instructions

Imagine you are a juror in the case described. The judge gives you and your fellow jurors the following instructions:

It is now time for you to decide upon a verdict and a punishment recommendation. You need to decide whether the defendant should be held responsible for the crime of assault and, if so, to what degree of seriousness.

In this particular case, you are asked to judge the defendant's actions against three different criminal charges:

First-Degree Assault occurs if a person acts with the intended purpose of causing physical injury to another person

Second-Degree Assault occurs if a person doesn't intend to cause physical injury, is aware that his/her actions will almost certainly result in physical injury to another person.

Third-Degree Assault occurs if a person is aware that there is some possibility that his/her actions may cause physical injury, but nevertheless engages in risky conduct.

If you do not believe that any of the above charges fit this case, then you are to choose **Not Guilty**.

What would your verdict be as a juror in this case?
Note: Take your time in deciding your verdict. Once you move past this page, you cannot return to change your verdict.

- ○ GUILTY of FIRST-DEGREE ASSAULT
- ○ GUILTY OF SECOND-DEGREE ASSAULT
- ○ GUILTY OF THIRD-DEGREE ASSAULT
- ○ NOT GUILTY

Before giving some specific punishment recommendations, is your general opinion that this defendant should be punished as little as legally possible (to the minimum extent) or as much as possible (to the maximum extent)?

Punish to the **Minimum** Extent Possible	○ ○ ○ ○ ○ ○ ○	Punish to the **Maximum** Extent Possible

Between the following two options, what was your primary purpose of imposing this sentence?

Both Equally

Punishment	○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○	Isolation from the Public

On a scale of 1–10, please indicate to what extent you feel that the defendant should be held **criminally** responsible.

	Not at all Responsible									Fully Responsible
	1	2	3	4	5	6	7	8	9	10
How Criminally Responsible?	○	○	○	○	○	○	○	○	○	○

On a scale of 1–10, please indicate to what extent you feel that the defendant should be held **morally** responsible.

	Not at all Responsible									Fully Responsible
	1	2	3	4	5	6	7	8	9	10
How Morally Responsible?	○	○	○	○	○	○	○	○	○	○

On a scale of 1–10, please indicate to what extent you feel that the defendant was in **control** of his actions.

	Not at all in control									Fully in control
	1	2	3	4	5	6	7	8	9	10
How In Control?	○	○	○	○	○	○	○	○	○	○

APPENDIX B

STUDY 2 MATERIALS AND MEASURES

Case Summary (Plaintiff Image/Defense No Expert)

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR THE COUNTY OF CLARK

JAMES ALLEN SNYDER, Plaintiff
vs.
KEVIN LEE WHITFIELD, Defendant
CV2015-5022-434

BACKGROUND

In this case the Plaintiff, JAMES ALLEN SNYDER, has made a personal injury claim against the defendant, KEVIN LEE WHITFIELD, regarding persistent injuries to his leg as the result of an automobile accident.

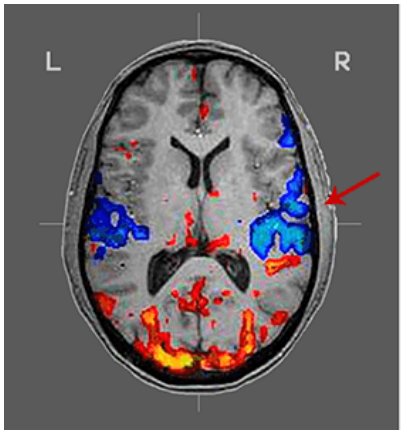
On June 30, 2014, Mr. Snyder was driving his vehicle through a green light, when the driver of another vehicle, Mr. Whitfield, failed to stop at a red light, striking the plaintiff's vehicle. Accident records show that the force of the impact caused the plaintiff's driver-side door to be pushed inward causing his left leg to become pinned by a metal door support. After being removed from the vehicle, the plaintiff was taken to the hospital and was treated for soft tissue injuries of his leg. Mr. Snyder remained in the hospital overnight for observation and was released the following day.

Mr. Snyder contends that he suffers from ongoing and persistent pain caused by the accident and that the defendant, Kevin Whitfield, should be held liable for this ongoing impairment. Specifically, Mr. Snyder claims that, over the months following the accident, the pain in his leg never went away even after the cuts and bruising subsided and his leg appeared to be physically healed. Mr. Snyder claims that he is now in constant pain and that this pain is negatively impacting his work and personal life. As such, Mr. Snyder believes that he is entitled to compensation.

Mr. Whitfield, the defendant, has already paid for the damage to Mr. Snyder's car and the hospital expenses incurred at the time of the accident. Mr. Whitfield asserts that the plaintiff does not actually suffer from any lingering injuries and that Mr. Snyder is simply attempting to get additional money out of him.

THE PLAINTIFF'S EVIDENCE

In support of his claim, Mr. Snyder called Dr. Marcus Robinson to testify. Dr. Robinson is a neurologist who recently examined the plaintiff. He testifies that he met with James Snyder roughly six months after the car accident due to his concern over his lingering pain. Dr. Robinson states that he conducted a functional magnetic resonance imaging (fMRI) scan of Mr. Snyder's brain and concluded from this that the plaintiff is in fact experiencing pain that is focused in his leg.



Plaintiff's Exhibit
fMRI Image of Mr. Snyder's Brain

Dr. Robinson stated that this test can be used to identify brain activation associated with the sensation of pain, and that this can be seen in the above image of the test results. He explained that the image shows the levels of a certain type of brain activity that is associated with the sensation of pain, and that the region of the brain that controls the left leg (indicated by the red arrow) shows a spike in this activity indicating a strong sensation of pain stemming from the plaintiff's leg (noting that the left side of the body is controlled by the right half of the brain). Dr. Robinson concludes that this test has clearly demonstrated that Mr. Snyder is indeed suffering from the exact sort of pain that he is claiming.

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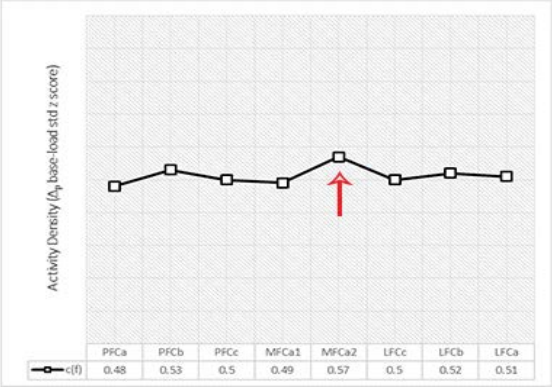

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Brain Function Graph

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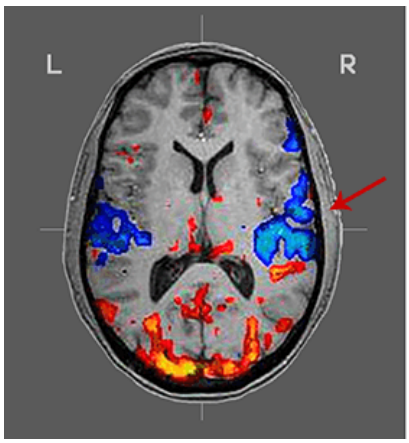

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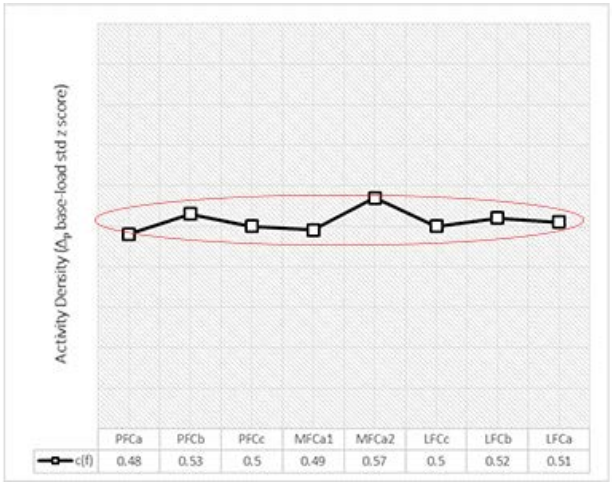
THE DEFENDANT'S EVIDENCE

In response to the plaintiff's expert, Mr. Whitfield consulted an independent neurologist, Dr. Henry Kurtz who examined the plaintiff's medical records and the results of the fMRI scan.



Defendant's Exhibit
Brain Function Graph

Dr. Kurtz testified that the actual data from the scan, depicted in the image above, show that the different active regions of the brain all seem to have their signals at about the

same level. While some areas have slightly higher or lower signals than others, he explained that this is normal, and that there is no evidence from this that Mr. Snyder is suffering from any sort of pain at all. As such, he concludes that the Plaintiff's claim is unfounded.

Case Summary (Plaintiff Graph/Defense Image)

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR THE COUNTY OF CLARK

JAMES ALLEN SNYDER, Plaintiff
vs.
KEVIN LEE WHITFIELD, Defendant
CV2015-5022-434

BACKGROUND

In this case the Plaintiff, JAMES ALLEN SNYDER, has made a personal injury claim against the defendant, KEVIN LEE WHITFIELD, regarding persistent injuries as the result of an automobile accident.

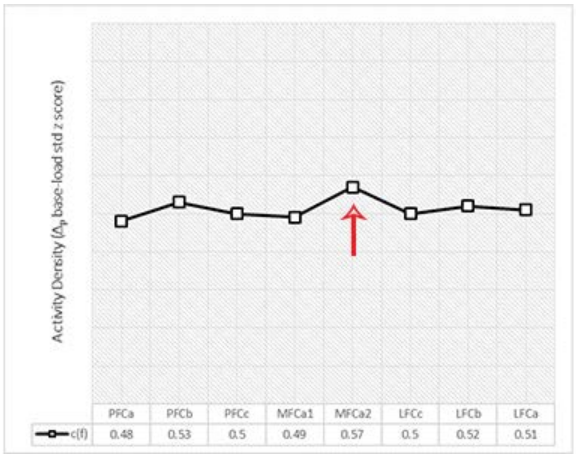
On June 30, 2014, Mr. Snyder was driving his vehicle through a green light, when the driver of another vehicle, Mr. Whitfield, failed to stop at a red light, striking the plaintiff's vehicle. Accident records show that the plaintiff hit his head on his vehicle's driver side window and his left leg was temporarily pinned between the driver's side door and the dashboard of his vehicle. He was taken to the hospital immediately after the accident and was treated for soft tissue injuries on both his head and his leg. Mr. Snyder remained in the hospital overnight for observation and was released the following day.

Mr. Snyder contends that he suffers from brain damage caused by the accident and that the defendant, Kevin Whitfield, should be held liable for this ongoing impairment. Specifically, Mr. Snyder claims that over the months following the accident he has had headaches, difficulty concentrating, and a declining memory. Mr. Snyder indicated that he had been evaluated by a neurologist and was diagnosed with brain damage as a result of hitting his head in the car accident. This brain damage is causing his cognitive impairments and is likely going to persist over time. As a result, Mr. Snyder claims that this injury will negatively impact his personal life and his work and that he is entitled to damages.

Mr. Whitfield, the defendant, has already paid for the damage to Mr. Snyder's car and the hospital expenses incurred at the time of the accident. However, Mr. Whitfield asserts that the plaintiff does not actually suffer from any lingering injuries and that Mr. Snyder is simply attempting to get additional money out of him.

THE PLAINTIFF'S EVIDENCE

In support of his claim, Mr. Snyder called Dr. Marcus Robinson to testify. Dr. Robinson is the neurologist who recently examined the plaintiff. He testifies that he met with James Snyder roughly six months after the car accident due to his concern over his lingering headaches and memory problems. Dr. Robinson states that he conducted a functional magnetic resonance imaging (fMRI) scan of Mr. Snyder's brain and concluded from this that the plaintiff does suffer from persistent pain.

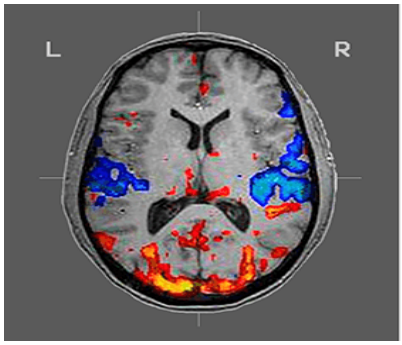


Plaintiff's Exhibit
Brain Function Graph

Dr. Robinson stated that this test can be used to identify brain activation associated with the sensation of pain, and that this can be seen in the above graph of the test results. He explained that the graph shows the levels of a certain type of brain activity that is associated with the sensation of pain, and that the region of the brain that controls the left leg (indicated by the red arrow) shows a spike in this activity indicating a strong sensation of pain stemming from the plaintiff's leg. Dr. Robinson concludes that this test has clearly demonstrated that Mr. Snyder is indeed suffering from the exact sort of pain that he is claiming.

THE DEFENDANT'S EVIDENCE

In response to the plaintiff's expert, Mr. Whitfield consulted an independent neurologist, Dr. Henry Kurtz who examined the plaintiff's medical records and the results of the fMRI scan.



Defendant's Exhibit
fMRI Image of Mr. Snyder's Brain

Dr. Kurtz testified that the actual data from the scan, depicted in the image above, show that the different active regions of the brain all seem to have their signals at about the same level. While some areas have slightly higher or lower signals than others, he explained that this is normal, and that there is no evidence from this that Mr. Snyder is suffering from any sort of pain at all. As such, he concludes that the Plaintiff's claim is unfounded.

Case Summary (Plaintiff Graph/Defense Graph)

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR THE COUNTY OF CLARK

JAMES ALLEN SNYDER, Plaintiff
vs.
KEVIN LEE WHITFIELD, Defendant

CV2015-5022-434

BACKGROUND

In this case the Plaintiff, JAMES ALLEN SNYDER, has made a personal injury claim against the defendant, KEVIN LEE WHITFIELD, regarding persistent injuries to his leg as the result of an automobile accident.

On June 30, 2014, Mr. Snyder was driving his vehicle through a green light, when the driver of another vehicle, Mr. Whitfield, failed to stop at a red light, striking the plaintiff’s vehicle. Accident records show that the force of the impact caused the plaintiff's driver-side door to be pushed inward causing his left leg to become pinned by a metal door support. After being removed from the vehicle, the plaintiff was taken to the hospital and was treated for soft tissue injuries of his leg. Mr. Snyder remained in the hospital overnight for observation and was released the following day.

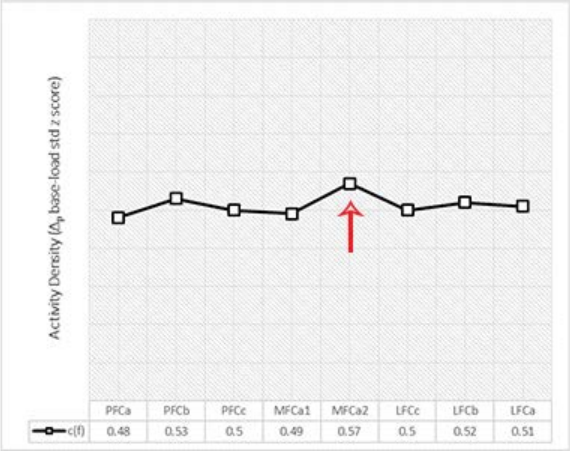
Mr. Snyder contends that he suffers from ongoing and persistent pain caused by the accident and that the defendant, Kevin Whitfield, should be held liable for this ongoing impairment. Specifically, Mr. Snyder claims that, over the months following the accident, the pain in his leg never went away even after the cuts and bruising subsided and his leg appeared to be physically healed. Mr. Snyder claims that he is now in constant pain and that this pain is negatively impacting his work and personal life. As such, Mr. Snyder believes that he is entitled to compensation.

Mr. Whitfield, the defendant, has already paid for the damage to Mr. Snyder's car and the hospital expenses incurred at the time of the accident. Mr. Whitfield asserts that the

plaintiff does not actually suffer from any lingering injuries and that Mr. Snyder is simply attempting to get additional money out of him.

THE PLAINTIFF'S EVIDENCE

In support of his claim, Mr. Snyder called Dr. Marcus Robinson to testify. Dr. Robinson is a neurologist who recently examined the plaintiff. He testifies that he met with James Snyder roughly six months after the car accident due to his concern over his lingering pain. Dr. Robinson states that he conducted a functional magnetic resonance imaging (fMRI) scan of Mr. Snyder's brain and concluded from this that the plaintiff is in fact experiencing pain that is focused in his leg.



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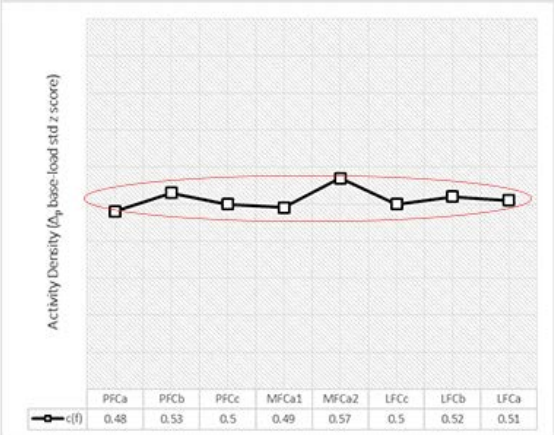


Defendant's Exhibit
Brain Function Graph

Dr. Kurtz testified that the actual data from the scan, depicted in the image above, show that the different active regions of the brain all seem to have their signals at about the same level. While some areas have slightly higher or lower signals than others, he explained that this is normal, and that there is no evidence from this that Mr. Snyder is suffering from any sort of pain at all. As such, he concludes that the Plaintiff's claim is unfounded.

Jury Instructions

It is time for you, the juror, to make some decisions about the case. The first decision is about **liability**.

In this type of case, we ask you to base your decision on something called the "preponderance of evidence." This means that you must believe that it is **more likely than not** (or, in other words, more than 50% likely) that:

The Plaintiff, Mr. Snyder, suffers from an injury, AND that
The Plaintiff's injury was caused by his automobile accident with the Defendant, Mr. Whitfield

If you believe, based on the information that we provided to you about the case, that it is more likely than not that the Plaintiff is injured and that the car accident caused that injury, then you must find for the **Plaintiff.**

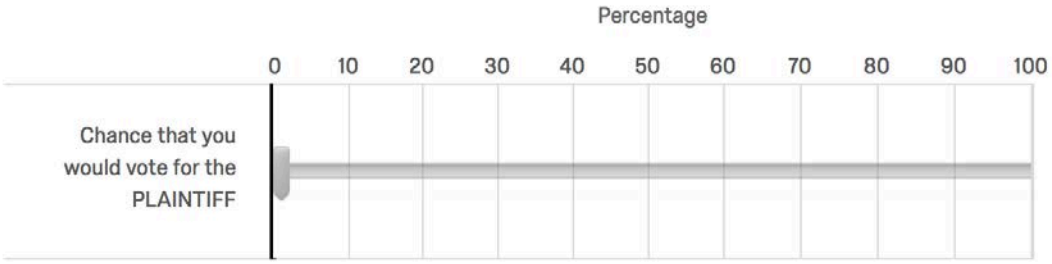
If, on the other hand, you believe that it is more likely than not that the plaintiff does not suffer from an injury and/or that the injury was not caused by the defendant's car accident, then you must find for the **Defendant.**

Given these instructions, what verdict do you choose?

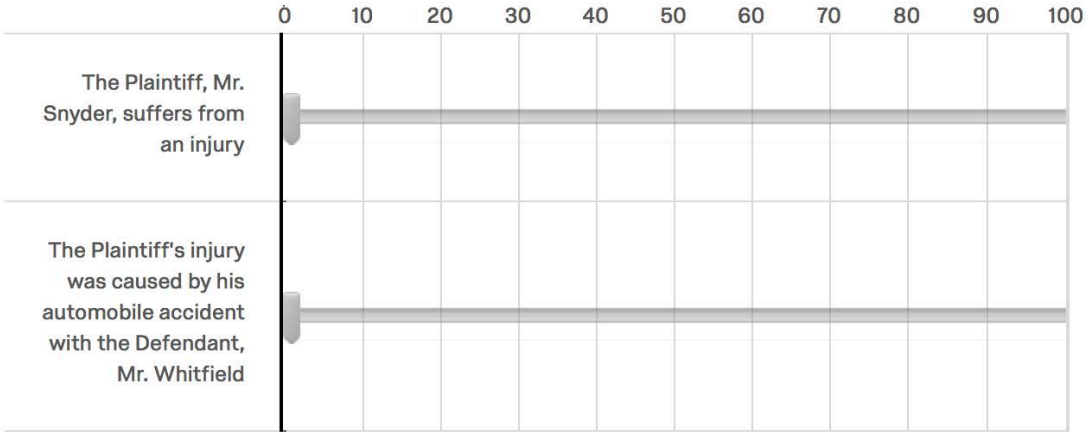
- ○ I Find For The **Plaintiff**
- ○ I Find For The **Defendant**

In a real trial, you would of course have to choose between one side or the other. However, we would like to give you more flexibility. Using the scale below, please indicate how certain you are about the outcome of this case.

If this was a real trial and you were a real juror, based on the information that you received, what is the probability (from 0% to 100%) that you would decide for the **plaintiff**?



Using the sliders below, please let us know your opinion as to how likely it is (from 0% to 100%) that each of those two statements are true.



Because you have found for the plaintiff, the next question you must address is that of **damages**.

Damage awards are money that the plaintiff must pay to the defendant to compensate him for his injuries. In this case, the plaintiff is asking for money for **medical expenses**, and **pain and suffering**. In addition, you will have the ability to award extra money as a punishment (**punitive damages**) to the defendant if you desire.

First you will need to make a decision about medical expenses. This portion of the award is specifically designed to reimburse the plaintiff for his actual out of pocket expenses.

Based on verified documents, the plaintiff's out of pocket medical costs associated specifically with this leg pain (including future testing and treatment) are calculated to be $24,500. You are free to award exactly that amount, or you may adjust it as you see fit.

Given these instructions, how much money would you recommend be awarded to the Plaintiff for the **medical expenses** related to his injury? (Please enter only numbers -- no commas or dollar signs.)

Next, you must consider whether to award damages for the plaintiff's **pain and suffering**.

According to the law, these types of awards are designed to compensate for "The pain, discomfort, suffering, disability, disfigurement, and anxiety already experienced, and reasonably probable to be experienced in the future as a result of the injury." In other words, you must put a one-time dollar figure on the amount of pain and suffering experienced by the defendant in the past, present, and future.

As part of the court filings, the Plaintiff has asked for $2,000,000 (two million dollars) as compensation for his pain and suffering. However, in your role as a juror, you are free to award any amount you see fit -- from $0 to however large an award you believe is appropriate. It is also worth mentioning that this award should not be made with regard to the defendant's income, assets, or insurance status -- that will all be taken into account by a judge.

Given these instructions, how much money would you recommend be awarded to the Plaintiff for the **pain and suffering** related to his injury? (Please enter only numbers -- no commas or dollar signs.)

We would also like to ask you about pain and suffering in a different way: Without using actual dollar amounts, please indicate on the scale below how much money the plaintiff should be awarded for his pain and suffering.

Finally, you as a juror are allowed to decide whether to award **punitive damages**.

You may consider assessing additional damages to punish defendant or to deter the defendant and others from similar misconduct in the future. The law provides no fixed standard for the amount of punitive damages you may assess, if any, but leaves the amount to your discretion.

Given these instructions, how much money, if any, would you recommend be awarded as **punitive** damages? If you choose not to award any punitive damages, please enter 0. (Please enter only numbers -- no commas or dollar signs.)

Table 1. *Study 1 Means and Standard Deviations of Punitiveness.*

	One Expert—Graph		One Expert—Image		Two Experts—Defense Graph		Two Experts—Defense Image	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Punishment Severity	3.76	1.58	3.66	1.61	4.47*	1.49	3.70*	1.55
Punishment Purpose	5.87	2.36	5.78	2.26	5.05	2.56	5.08	2.30

Note. For punishment severity higher values indicate more severe punishment. For punishment purpose, lower values indicate punishment and higher values indicate isolation from the public. *p = .007.

Table 2. *Study 1 Means and Standard Deviations of Responsibility.*

	One Expert—Graph		One Expert—Image		Two Experts—Defense Graph		Two Experts—Defense Image	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Criminal Responsibility	7.44	2.71	7.56	2.14	8.53*	1.72	7.67*	2.49
Moral Responsibility	7.60	2.42	7.95	2.10	8.41	2.02	8.13	2.26
Controllability	6.47	2.65	6.42	2.31	7.52	2.20	7.05	2.51

Note. Higher values indicate more responsibility and control on the part of the defendant.
*p = .029.

Table 3. *Study 2 Means and Standard Deviations of Damages.*

	One Expert—Graph	One Expert—Image	Two Experts—Defense Graph	Two Experts—Defense Image	Two Experts Control—Both Graph
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Medical Expenses	25,451.32 (8,127.59)	22,975.61 (7,183.27)	30,771.43 (38,949.50)	22,461.33 (5,199.39)	23,976.19 (3,919.43)
Punitive Damages	10,666.67 (27,619.91)	124,654.79 (490,320.83)	11,685.71 (26,375.98)	67,037.04 (287,382.95)	30,761.91 (109,761.97)
Pain & Suffering	286,342.11 (493,991.32)	467,287.50 (675,443.39)	395,205.88 (610,343.66)	281,938.70 (465,018.10)	26,2428.57 (471,641.13)
Pain & Suffering Continuous	5.36* (1.94)	6.26* (2.13)	5.74 (2.01)	5.07 (2.06)	4.91 (1.95)

Note. Medical expenses, punitive damages and pain and suffering are suggested award in dollars. Pain and suffering continuous was measured such that a higher value indicates the plaintiff should be awarded a higher amount. *p = .048.

Table 4. *Study 2 Means and Standard Deviations of Verdict Certainty.*

	Both Graphs		Plaintiff Image, Defense Graph		Plaintiff Graph, Defense Image	
	M	*SD*	*M*	*SD*	*M*	*SD*
Verdict Certainty	6.06*	2.72	4.87*	2.46	4.63*	2.36

Note. Verdict certainty was measured on a 1–10 scale, with lower values indicating more certainty that the plaintiff should win and higher values indicting more certainty that the defendant should win. *$p < .05$.

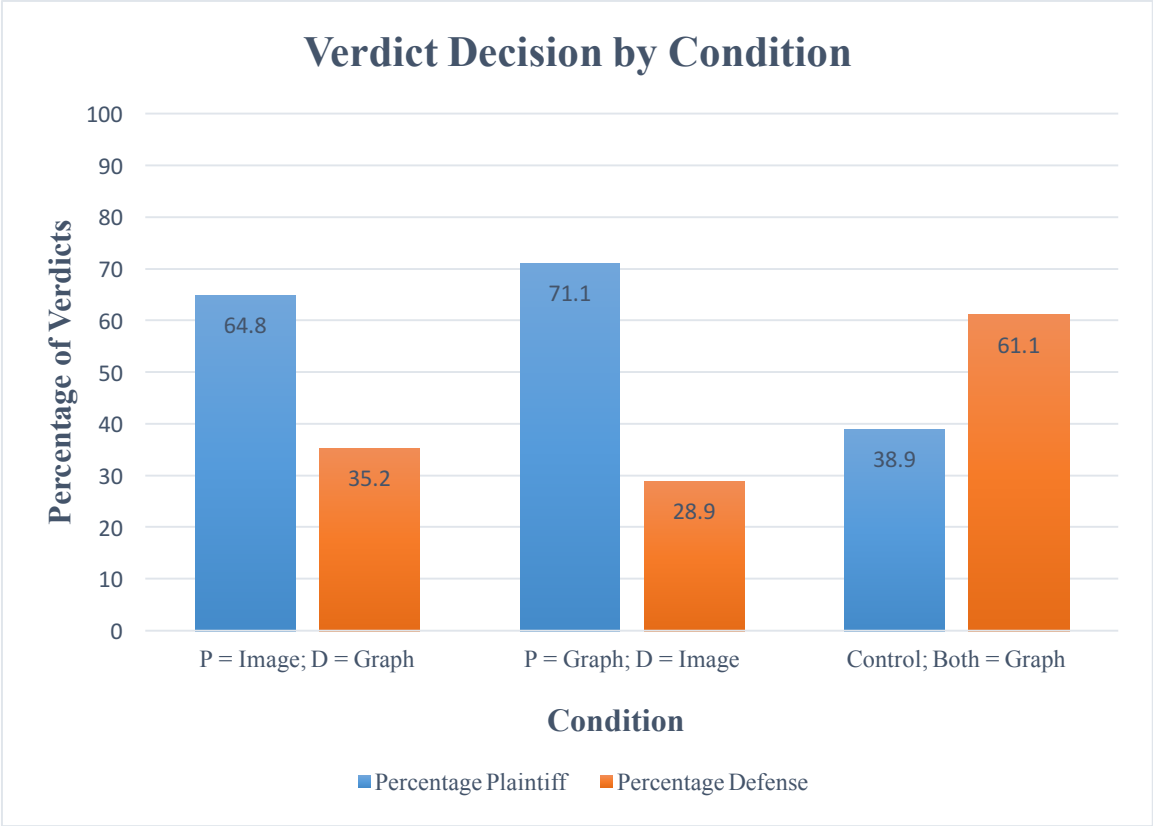


Figure 1. Verdict decision by condtion. Control group significantly different than both preceeding conditions at the $p < .01$ level.