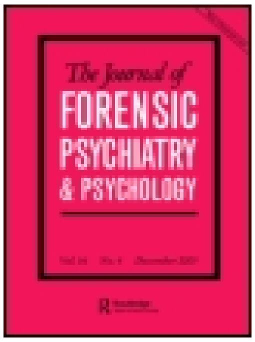

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The role of neurological and psychological explanations in legal judgments of psychopathic wrongdoers

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ABSTRACT

Although brain imaging has recently taken center stage in criminal legal proceedings, little is known about how neuroscience information differentially affects people's judgments about criminal behavior. In two studies of community participants (N = 1161), we examined how mock jurors sentence a fictional psychopathic defendant when presented with neurological or psychological research of equal or ambiguous scientific validity. Across two studies, we (a) found that including images of the brain did not alter mock jurors' sentencing judgments, (b) reported two striking non-replications of previous findings that mock jurors recommend less severe punishments to defendants when a neuroscientific explanations are proffered, and (c) found that participants rated a psychopathic individual as more likely to benefit from treatment and less dangerous when a neurological explanation for his deficits was provided. Overall, these results suggest that neuroscience information provided by psychiatrists in hypothetical criminal situations may not broadly transform mock jurors' intuitions about a psychopathic defendant's sentence, but they provide novel evidence that brain-based information may influence people's judgments about treatability and dangerousness.

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Introduction

Neuroscience has recently taken center stage in criminal legal proceedings (Denno, 2016; Farahany, 2016). Despite debates about the relevance of brain-related research in legal matters, information derived from functional magnetic

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resonance imaging (fMRI) of suspected criminals is likely to continue to play a growing role in legal disputes (Baskin, Edersheim, & Price, 2007; Buckholtz & Faigman, 2014; Morse, 2005). This increased inclusion of neuroscientific findings in the courtroom raises an important question about the prejudicial nature of such evidence: Do references to the brain influence jurors in a manner that alters convicted criminals' recommended sentences? Although this question has received ample attention, little clarity has emerged concerning whether neuroscientific expert testimony, including brain images and brain-based explanations, unduly persuade jurors to believe that offenders are deserving of shorter or longer sentences. The current study sought to examine this question with an emphasis on elucidating how equally valid brain-related or psychological-related information may influence attitudes of criminal behavior.

The seductive allure of neuroscientific information

Some authors have proposed that neuroscience carries a seductive allure. Specifically, they hypothesize that neuro-explanations are accorded undue prominence in the courtroom and the media because of their scientific appeal, especially in the eyes of laypersons (Weisberg, Keil, Goodstein, Rawson, & Gray, 2008). The experimental evidence for the seductive allure hypothesis has its origins in two seminal experiments. First, McCabe and Castel (2008) asked participants to read scientific articles with or without brain images and make judgments of scientific credibility. They found that participants who saw brain images alongside a neurological explanation tended to rate the article as *more* scientific than articles that featured only 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. These findings have been widely cited; for example, according to a *Google Scholar* search, McCabe and Castel's study has been cited 476 times as of this writing and continues to be cited in many recent publications. Nevertheless, their influential results were not replicated in a subsequent study (Michael, Newman, Vuorre, Cumming, & Garry, 2013). Other studies have also not supported the conclusion that brain images are especially impactful (Gruber & Dickerson, 2012; Hook & Farah, 2013; Schweitzer, Baker, & Risko, 2013), although Ikeda, Kitagami, Takahashi, Hattori, and Ito (2013) found that participants reported greater understanding of a scientific finding when a description was accompanied by a brain image as opposed to a bar graph.

Second, Weisberg and colleagues (2008) sought to ascertain how neuroscientific *information* bolstered flawed arguments. In their experiment, participants either read valid or invalid explanations of psychological findings, accompanied by either relevant or irrelevant neuroscience. For instance, the researchers provided all participants with a brief description of a developmental psychology finding regarding children's ability to understand the mind of another actor.

Sometimes the sentence began with 'researchers found,' whereas in other cases, it began with 'brain scans indicate.' The investigators found that participants were able to discern between valid and invalid explanations; nonetheless, participants with a limited science education background and those who had taken a cognitive neuroscience course were more satisfied with, and persuaded by, invalid explanations of behavior when neuroscience information was included. However, psychology graduate students were not. In contrast to the McCabe and Castel findings, the findings from the Weisberg et al. (2008) study have been replicated (Michael et al., 2013), and a more recent study similarly found support for the influence of bogus neuroscience explanations (Scurich & Shniderman, 2014). The researchers found that participants viewed neuroscience information as especially credible when the explanation coincided with participants' beliefs about divisive issues (e.g. abortion).

The results of these studies provide support for a differentiation between neuro-explanations as neuroimages, given that findings for the former appear to be more robust than those for the latter. Taken together, these studies provide support for the argument that neuro-information could unduly bias people toward believing neuroscientific findings. Also emerging from this body of literature are two explanations for these findings: (1) people's perception of neuroscience as a 'harder' science and (2) people's intuitive beliefs concerning the distinction between the mind and body.

With respect to the former, one reason for such a bias may be that people tend to view psychology as a less scientific enterprise, replete with subjective hypotheses regarding the causes of behavior (Lilienfeld, 2012). For instance, two methods often used in the psychiatric and psychological professions – clinical interviews and self-report measures – may not be thought of as truly 'scientific' methods of understanding human behavior. In line with this possibility, Munro and Munro (2014) asked people to evaluate magnetic resonance imaging (MRI; i.e. a neurological explanation) findings and cognitive testing results (i.e. a psychological explanation) to determine whether a political leader should be allowed to continue serving in his position. They found that the participants deemed MRI evidence as a higher quality explanation than comparable behavioral information. This effect was especially pronounced for people who identified with the political party of the person in question and, as a result, ostensibly had an ulterior motivation to believe the MRI evidence.

An additional explanation for why people find neuro-explanations more persuasive emerges from research on how people understand the mind–brain distinction. Because people tend to think of the brain as separate from the mind (Bloom, 2009; Bloom & Weisberg, 2007), dualists may find neurological descriptions of behavior to be counterintuitive (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. We will henceforth refer to the idea that mind–body dualists find brain images as unduly persuasive as the 'mind-body' hypothesis. Somewhat in line with this hypothesis, Hook and Farah (2013) asked participants to rate scientific explanations with or without images (e.g. fMRI image) on a variety of outcome measures and responded to questions assessing dualism beliefs. Although they did not find much evidence for the 'mind-body' hypothesis, they did find that physicalists – individuals who believe that the mind and brain are one in the same – were significantly more likely to rate scientific findings as worthy of funding and as truthful in comparison with those in the intermediate mind–body dualism belief group. Still, none of this research has examined how differential dualist beliefs relate to legal judgments in the context of varying types of evidence.

The brain on trial

Seductive allure research has also been applied to courtroom scenarios to understand how neuroscientific testimony affects legal judgments. Overall, the results from this body of research mostly align with those from the non-legal seductive allure research (e.g. Weisberg et al., 2008): explanations using neurological language appear to influence participants' sentencing determinations, whereas findings regarding the impact of brain images on judgments of the explanations of criminal behavior are more variable. For instance, Schweitzer et al., (2011) found that neuroimages played little role in verdicts or sentencing, but they also reported that participants tended to judge psychiatric testimony accompanied by neurological evidence as more persuasive than psychiatric testimony accompanied by clinical psychological evidence. A follow-up study revealed that participants rated a psychopathic offender as less responsible for his actions when the defense included a neuroimage, compared with when the defense did not. This study also revealed that participants rated the neuroscientific expert testimony in conjunction with a brain image as the most persuasive (Saks, Schweitzer, Aharoni, & Kiehl, 2014). This finding is worthy of attention considering that a number of previous studies (post-McCabe & Castel, 2008) reported that neuroimages did not afford additional persuasive power above and beyond the neuro-information (Hook & Farah, 2013). Three other noteworthy studies (Aspinwall, Brown, & Tabery, 2012; Gurley & Marcus, 2008; Schweitzer & Saks, 2011) found that participants reduced the sentence of a hypothetical offender when presented with scientific evidence referencing a brain ailment. In contrast, Greene and Cahill (2012) found no differences in sentencing preference as a function of the type of evidence.

One rival but untested explanation for these findings worthy of experimental exploration emerges from the possibility that neurological information plays a probative role in evaluating evidence. That is, brain-based explanations accompanied by fMRI images may provide mock jurors with relevant and valid information *above and beyond* descriptions without an image or with another type picture (e.g. bar graph, image of a courtroom). Farah and Hook (2013) reasonably argued that including an image of a brain that depicts differential activation in certain brain regions is more informative than an analogous neurological explanation accompanied by a bar graph that only corroborates the differential activation patterns. In other words, the neurological explanation encompasses both (a) differential neural activation and (b) activation in a specific area of the brain. The neurological condition with a brain image substantiates *both* the differential activation pattern and the localized nature of that difference; in contrast, the bar graph substantiates the differential activation without reference to its location. With this alternative view in mind, if neuroscientific evidence presented by psychiatric professionals provides relevant information above and beyond psychological information, the consensus finding that people punish less when given neurological information may not be a bias per se. Rather, these findings (Aspinwall et al., 2012; Gurley & Marcus, 2008; Schweitzer & Saks, 2011; Schweitzer et al., 2011) may reflect participants' accurate understanding of the relevance of neurological versus psychological explanations (Farah & Hook, 2013).

Hence, the studies presented here addressed the broad question of whether neuroscience explanations and images influence people's sentencing judgments and related beliefs about criminal behavior. To do so, when presenting participants with neuroscientific and psychological explanations of a psychopathic individual, such explanations referenced a neuroscientific or psychological diagnostic technique of equal validity and reliability in response to criticisms regarding condition equivalence (cf. Hook & Farah, 2013). We then examined whether explanation type affected judgments of a hypothetical offender's deserved sentence. Further, in exploratory analyses, we also examined how explanation type and image inclusion affected other judgments about the alleged offender, such as treatability, dangerousness, and self-control.

With these changes in mind, we primarily hypothesized that participants in the neurological explanation condition would recommend granting the defendant with a neurological ailment a less severe punishment, in line with previous findings (Aspinwall et al., 2012; Gurley & Marcus, 2008; Schweitzer & Saks, 2011; Schweitzer et al., 2011). We expected this 'bias' to persist even when the explanations were matched in their scientific quality because the tendency to attribute greater scientific quality to findings from 'hard' sciences (Lilienfeld, 2012; Munro & Munro, 2014) would persist even when the explanations explicitly described diagnostic techniques of equal quality.

Our predictions about how a brain image would influence sentencing judgments were more challenging to formulate given the mixed findings in this area of research (McCabe & Castel, 2008; Michael et al., 2013; Schweitzer et al., 2013). Nonetheless, we tentatively predicted that participants would recommend lighter sentences when presented with the combination of neurological explanation and an accompanying brain image in comparison to any of the other conditions. With regard to how neurological explanations or brain images would alter *other* relevant legal judgments (dangerousness, treatability, self-control), we remained agnostic about how such factors would affect such beliefs because little research, if any, has focused on how people differentially evaluate neurobiological explanations in legal matters.

Lastly, to test the 'mind-body' hypothesis, we predicted that mind–body dualists would find neurological explanations of criminal behavior more impactful because the brain-related information provides evidence that some behaviors are a consequence of brain activity – not just 'mind' processes. The way in which brain-related information would then translate into differential sentencing judgments amongst people with differing beliefs in mind–body dualism could take different forms. On one hand, a highly dualist individual may take brain information as evidence for a less severe sentence because the brain is an aspect of the mind–brain system that is supposedly 'broken.' Alternatively, a highly dualist individual may also take brain information as evidence for harsher sentence because the suspected criminal has a weak 'mind' to overcome his criminal brain-based impulses.

Study 1

In the first study, we tested the hypothesis that invoking the brain in otherwise matched explanations of psychopathic behavior could alter judgments of an offender's deserved sentence. Second, we intended to ascertain whether individuals' philosophical beliefs regarding mind–body dualism interacted with the effect of images and biological information. To our knowledge, no study to date has examined both research questions in tandem.

In contrast to previous experiments, we made four changes to better evaluate the effects of brain-based information on participant judgments. First, we exclusively assessed sentencing and *not* judgments of guilt because the latter is not a sensitive proxy for measuring differential intuitions about how brain-based information influences culpability (Roskies, Schweitzer, & Saks, 2013). 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 an offender with psychopathy. This change also mirrors the way in which evidence would be discussed in a criminal trial in real-world legal settings, as judges use error rate as one of the standards for determining whether scientific expert testimony is admissible under the *Daubert* rule (*Daubert v. Merrell Dow Pharmaceuticals*, 1993). Further, 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 their implicit beliefs about the relation between mind and brain (Munro & Munro, 2014; Scurich & Shniderman, 2014), we included a self-report mind–body dualism measure. Fourth and finally, participants responded to several questions regarding the offender's treatability, dangerousness, and level of control over his actions to provide a more comprehensive picture of the factors that may influence mock jurors' sentencing decisions.

Method

Participants

All participants were recruited through Amazon's Mechanical Turk (M-Turk). Each participant was paid $1.50 for completing the survey that took approximately 30 min. The protocol was limited to M-Turk workers who had performed at least 1000 human interest tasks (HITs) and lived in the United States.

Because the study required participants to read through a set of detailed court transcripts and to render verdicts on relatively complex matters, we included a set of 8 comprehension questions. To maximize the likelihood that participants included in the analyses were attending to the material, we set a stringent cut-off for inclusion in analyses. Doing so resulted in eliminating 8.5% of the original sample ($n = 828$). The final sample ($N = 758$) included only participants who obtained a perfect score on the comprehension test ($n = 575$) or missed only one question ($n = 183$).

Consistent with other data from M-Turk samples (Dai, Lin, & Mausam, 2013), the final sample included more females ($n = 412$) than males ($n = 340$), ranging in age from 18 to 73 ($M = 33.55$, SD = 11.91). .3% reported having some high school education, 9.0% reported having finished high school, 32.1% reported having finished some of a college degree, 41.8% reported having completed college, and 16.9% reported a graduate degree. Participants also rated their political orientation on a Likert-type scale with 1 indicating very liberal and 5 indicating very conservative. Additionally, participants noted their social and economic political leanings on an analogous Likert-type scale as was used in the overall political affiliation question. A sizeable plurality ($n = 236$) did not self-identify as either very liberal or very conservative ($M = 2.56$, 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).[1]

Procedure

A link to a study was published on M-Turk. Participants were directed to a description of a hypothetical criminal case (See Supplemental Material). After reading, participants were quasi-randomized into four conditions (neurological or psychological explanation with or without an image). Each participant then read an expert testimony transcript and responded to comprehension, sentencing, and reasoning questions. Finally, each participant answered a mind–body dualism questionnaire concluding with demographic information.

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) eight comprehension questions, (4) a set of questions regarding the crime, and (5) a mind–body dualism self-report measure.

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 following a minor car accident. In the story, the defendant became angry and impulsively strangled the other driver. Participants then learned that the defendant was brought to trial for murder.

Transcript. Participants were asked to carefully read one of four expert testimony transcripts (see Supplemental Material for the full transcript). These transcripts depicted the direct examination of an expert witness scientist by an attorney regarding the causes of the defendant's actions. The neurological and psychological explanations differed in their content, with the neurological explanation referencing neuroscientific diagnostic techniques and the psychological explanation referencing psychological ones. Within the two explanation types, one transcript was accompanied by an image, either a bar graph or an fMRI picture. Both neurological and psychological explanations included an explicit reference to the diagnostic measures' validity and reliability.

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 image depicted activation in two brain areas: the amygdala and the orbitofrontal cortex. The expert noted that the offender exhibited underactivation in these two areas of the brain. These two regions were chosen because recent reviews of psychopathic personality have reported structural and functional abnormalities in these regions (e.g. Anderson & Kiehl, 2012). 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 widely used and well validated Hare Psychopathy Checklist-Revised, whose scores also range from 0 to 40 (Hare, 1991/2003). The neuroscientist explained the nature of psychopathy by describing psychopaths as people who exhibit distinctive behavioral, emotional, and interpersonal characteristics. The remaining two expert testimony transcripts described the direct examination of a psychiatrist.

As was the case with the neurological conditions, the psychological transcripts also differed only in their inclusion of an image.

Comprehension questions. After reading the trial materials, participants responded to 8 recall questions (see Supplemental Material). 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 difficulty comprehending these materials.

Sentencing and reasoning questions. The participants were instructed to answer two questions about the defendant's sentence. The first sentencing question inquired about how long the defendant should serve if found guilty. The second sentencing question asked about where the fictional offender should serve his sentence if found guilty; the answers to this question were 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 sentencing question were ranked on a scale from 1 to 6, with 1 representing a treatment facility and 6 representing a supermax prison. See Supplementary Material for exact wording of these questions.

After completing these questions, participants were instructed to answer 10 questions about their reasoning for their sentencing decisions and thoughts about the offender.[2] The questions assessed different considerations that could be relevant to the participant's understanding of the psychopath's behavior. 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 Table 1. The participant responded to these questions on a four-point Likert-type scale with 1 representing 'not at all' and 4 representing 'very much.'

Mind–body dualism. Participants completed a 27-item mind–body dualism measure (Stanovich, 1989; Cronbach's α = .90 in the current sample). This questionnaire assessed 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.' Respondents answered the questions on a five-point Likert-type scale. A composite dualism score was calculated by

Table 1. Factor loadings based on a principal axis factor analysis with Promax rotation for 10 reasoning questions from Study 1 and 2.

Item	1	2	3
To what extent did you find Dr. Morgan's argument persuasive?	−.003 (−.042)	.704 (.847)	−.032 (.048)
To what extent did Dr. Morgan's argument regarding Brock's ability to withhold his impulses play into your decision about sentencing?	−.059 (.042)	.771 (.677)	.020 (−.022)
Do you think that [the offender] was fully in control of his actions when he committed the murder?	.024 (−.220)	−.407 (−.379)	−.229 (.042)
Do you think that [the offender] could be helped by treatment?	−.120 (.926)	−.053 (−.078)	.761 (−.022)
Do you think [the offender] could be cured by treatment?	−.186 (.578)	−.029 (.048)	.693 (−.136)
Do you think [the offender] should be prescribed medicine to help with his condition?	.215 (.435)	.130 (.128)	.495 (.205)
Do you think [the offender] should receive brain surgery to help with his condition?	.135 (.260)	.132 (.039)	.319 (.006)
Do you think [the offender] poses a threat to the general public?	.742 (−.006)	−.035 (−.069)	.016 (.709)
Do you think [the offender] could be a risk to others in prison?	.821 (.067)	−.017 (.031)	.151 (.646)
Do you think your punishment of choice is an effective way to deter other people from committing similar crimes in the future?	.024 (−.063)	−.009 (.055)	.037 (.080)

Note: Loadings from Study 2 are in parenthesis.

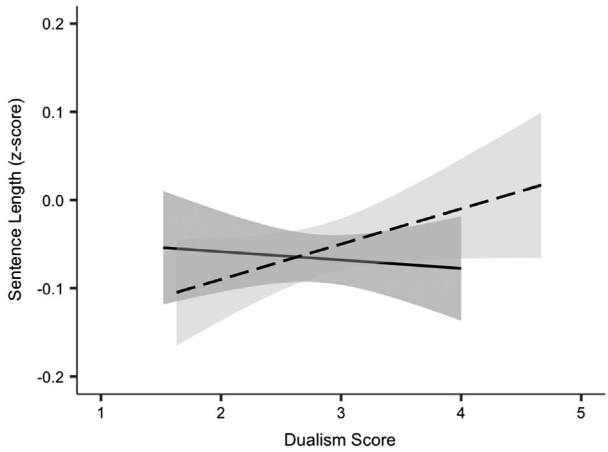

Figure 1. Sentencing length judgments as a function of participants' self-reported dualism scores. Striped line represents those in the neurological explanation condition, and the solid line represents those in the psychological explanation condition.

averaging the responses to each item on the scale. Higher scores on the measure reflected dualist beliefs and lower scores stronger physicalist beliefs.

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

Results

Factor analysis

To better understand the differential features of people's beliefs about criminal behavior and justice, we conducted a Principal Axis Factor Analysis with an oblique (Promax) rotation utilizing the responses from the 10 reasoning questions of those who passed comprehension checks.[3] An oblique rotation was used given that we anticipated that many of the dependent measures would be at least moderately correlated. The scree plot revealed a three factor solution, and we used the composite factor scores estimated by means of multiple regression. The eigenvalues for the first five factors were 2.57, 1.88, 1.15, 1.04, .83, and .68. The first factor explained 25.70% of the variance. The remaining two factors explained 18.76% and 11.52% of the variance, respectively. See Table 1 for factor loadings.

The first factor was deemed a 'Dangerousness' factor because the two items that loaded highly on this factor referred to how much of a threat the defendant posed to the general public or to people in prison. The second factor was deemed a 'Defendant Self-Control' factor because the two high-loading items on the factor referenced the offender's control or impulsivity. The final factor was deemed a 'Treatability' factor, as the high-loading items referred to the extent to which the participant believed the defendant could be helped or cured by treatment or should be prescribed medicine.

Because the reasoning questions were intended to examine people's justifications for their sentencing choice, sentence length (M = 33.19, SD = 25.38), and sentence location (M = 4.05, SD = 1.58) were not included in the factor analysis. However, we standardized the scores for both of these measures, as the responses for each question were not on the same Likert scale.

Sentencing judgments

We first conducted a 2 (Explanation Type: Neurological, Psychological) × 2 (Image Inclusion: Yes, No) multivariate analysis of variance (MANOVA) using the two sentencing measures as dependent variables: sentence length and sentence location. Contrary to the 'seductive allure' hypothesis, the results indicated a statistically non-significant main effect of both explanation type, $F(2, 743) = .472$, $p = .624$, and image inclusion, $F(2, 743) = .942$, $p = .390$. The interaction was also not statistically significant, $F(2, 743) = .249$, $p = .779$. Because sentence length judgments may mean something different for defendants sentenced to a treatment facility versus prison, we conducted two separate analyses of variances (ANOVAs) for those who indicated that the defendant should go a treatment facility and for those who indicated that the defendant should go to prison. There was no significant effect of explanation type, image inclusion, or an explanation type x image inclusion interaction for either set of participants.

To test the 'mind-body' hypothesis, we conducted a multivariate analysis of covariance (MANCOVA) using dualism scores as an interaction term. Although we 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 among the outcome variables of interest. Thus, the following analyses were strictly exploratory. The Dualism x Image Inclusion interaction, $F(2, 739) = .1.213$, $p = .298$, and the Dualism x Explanation Type x Image Inclusion interaction were not significant, $F(2, 739) = .038$, $p = .962$. However, the MANCOVA revealed a significant Dualism x Explanation-Type interaction, $F(2, 739) = 3.16$, $p = .043$; Wilk's $\lambda = .99$, partial $\eta^2 = .008$. Follow-up tests of between-subjects effects demonstrated a significant difference in responses on the sentence length question, $F(1, 748) = 5.159$, $p = .023$, partial $\eta^2 = .007$, but not in responses to the sentence location question, $F(1, 748) = .074$, $p = .069$, partial $\eta^2 = .004$.

These findings suggest that dualist beliefs are differentially related to sentencing length judgments across the psychological and neurological explanation conditions. To determine in which direction dualist beliefs were associated with sentencing length judgments in each condition, we conducted a linear regression to assess if dualism scores statistically predicted such judgments in both the psychological and neurological explanation conditions. These analyses

Table 2. Correlations between sentencing and reasoning variables.

		1	2	3	4	5
(1)	Sentence length	1	.36 (.35)**	.33 (.30)**	−.12 (−.15)**	−.42 (−.30)**
(2)	Sentence location	.36 (.35)**	1	.39 (.39)**	−.18 (−.20)**	−.49 (−.54)**
(3)	Dangerousness	.33 (.30)**	.39 (.39)**	1	.12 (.12)*	−.50 (−.48)**
(4)	Defendant self-control	−.12 (−.15)**	−.18 (−.20)**	.12 (.12)*	1	.31 (.25)**
(5)	Treatability	−.42 (−.30)**	−.49 (−.54)**	−.50 (−.48)**	.31**(.25)	1

Notes:Numbers in parentheses indicate correlations in Study 2. The asterisks apply to both correlations from Study 1 and Study 2.
*$p < .05$; **$p < .01$.

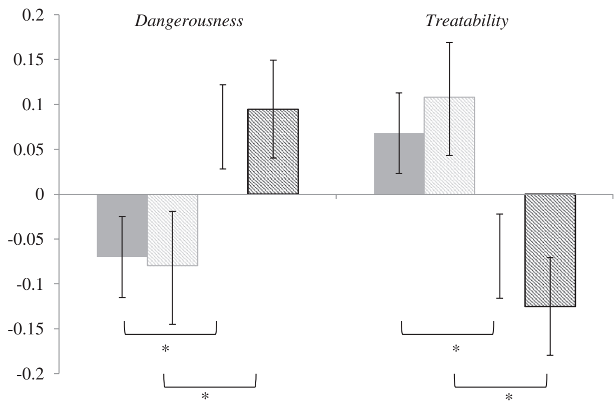

Figure 2. Means and standard errors of participant responses to Dangerousness and Treatability questions (*z*-scored) from Study 1 and 2. Solid bars represent results from Study 1; striped bars represent results from Study 2. Gray bars represent responses from the neuroscience explanation condition; Black bars represent responses from the psychological explanation condition. $^*p < .05$.

revealed that dualism scores negatively predicted sentencing in the psychological explanation condition ($b = -.155$, $t(379) = -1.767$, $p = .078$) but positively predicted sentencing in the neurological explanation condition ($b = .075$, $t(434) = .951$, $p = .342$; See Figure 1). In neither the psychological nor the neurological condition did dualism scores predict a statistically significant portion of the variance in sentencing, $R^2 = .09$, $F(1, 379) = 3.123$, $p = .08$; $R^2 = .05$, $F(1, 434) = .905$, $p = .34$, respectively.

Reasoning questions

We then conducted three 2 (Explanation Type: Neurological, Psychological) × 2 (Image Inclusion: Yes, No) ANOVAs to ascertain differences in beliefs about criminality based on the aforementioned factor analysis.[4] See Table 2 for correlations between sentencing and reasoning variables.

For Dangerousness, there was a significant main effect of explanation type, $F(1, 724) = 4.857$, $p = .028$, partial $\eta^2 = .007$, with those in the neurological explanation group ($n = 378$) rating the defendant as less dangerous ($M = -.07$, SD = .90) than those in the psychological explanation group ($n = 350$, $M = .073$, SD = .84; See Figure 2). The main effect of image inclusion, $F(1, 724) = .016$, $p = .900$, and the Explanation-Type x Image Inclusion interaction, $F(1, 724) = 2.836$, $p = .093$, were both not statistically significant.

For Defendant Self-Control, there was a marginally significant main effect of explanation type, $F(1, 724) = 3.651$, $p = .056$, and a clearly nonsignificant effect of image inclusion, $F(1, 724) = .020$, $p = .889$. The Explanation-Type x Image Inclusion interaction was also not significant, $F(1, 724) = .820$, $p = .365$.

For Treatability, there was a significant main effect of explanation type, $F(1, 724) = 4.424$, $p = .036$, partial $\eta^2 = .006$, with those in the neurological explanation group ($n = 378$) rating the defendant as more treatable ($M = .068$, SD = .87) than those in the psychological explanation group ($n = 350$, $M = -.069$, SD = .90). The main effect of image inclusion, $F(1, 724) = .087$, $p = .768$, and the Explanation Type × Image Inclusion interaction, $F(1, 724) = .919$, $p = .338$, were both not significant.

Summary and discussion

Contrary to the 'seductive allure' hypothesis, neither explanation type nor image inclusion exerted a statistically significant effect on sentencing judgments. Additionally, when dualism beliefs were included as an interaction term when assessing the effect of explanation type, differences in sentencing tendencies emerged. For sentence length judgments, participants who exhibited more dualist beliefs sentenced more severely in the neurological explanation condition than did less dualist participants, whereas participants who exhibited more dualist beliefs in the psychological condition tended to punish less severely in the psychological condition. Further, exploratory analyses revealed that explanation-type affected participants' beliefs about dangerousness and treatability.

The current findings suggest that highly dualist participants tend to sentence *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 defendant's brain, people may think he cannot overcome his psychopathic predilections and therefore should be sanctioned more severely than someone suffering from a 'mere' personality disorder. However, this explanation is speculative and needs to be replicated before positing any strong conclusions regarding how dualist beliefs differentially influence punishment proclivities; we undertake this task in Study 2.

Perhaps most interestingly, the current results also provide preliminary evidence that neurological information may generally alter beliefs about a psychopathic person's dangerousness and treatability in unexpected ways. Brain-based information led participants to rate the offender as *more* treatable. Such a finding may be due to the fact that neurological information provides people with a target for treatment – the brain itself, whereas psychological information may not aid in understanding how an offender may improve from his condition. Together, the dualism, treatability, and dangerousness findings suggest that people's beliefs concerning the mutability of an offender's behavior may relate to their legal judgments. Because these findings stand in contrast to previous research (Haslam & Kvaale, 2015), replication of such an effect is needed; again, we sought to do so in Study 2.

Study 2

Study 2 sought to replicate the effect of explanation type and self-reported dualism beliefs on sentencing recommendations in addition to the effect of neurobiological descriptions on judgments of treatability and dangerousness. In addition, we suspected that the effect of explanation type on sentencing judgments did not emerge because we designed the hypothetical court transcripts to explicitly note that the psychological and neurological diagnostic techniques were equally valid and reliable. The primary aim of Study 2 was to see if explanation type would mitigate sentencing judgments when the neurological and psychological explanations no longer reference the scientific quality of the diagnostic technique used to determine that the defendant was psychopathic.

Method

In light of the findings of Study 1, we made two changes to the experimental protocol in Study 2. First, rather than explicitly mentioning the reliability and validity of both the neuroscientific and psychological explanations, we excluded the lines referencing the error rate of the measures in the court transcript. In doing so, we tested whether participants thought neurological explanations were *inherently* representative of a more reliable and valid diagnostic technique. Second, given the clear lack of effect of image inclusion across conditions, we no longer examined how participants differentially evaluated criminality in light of viewing a brain image. In other words, we manipulated only the explanation type, but not image inclusion.

Given these changes and the results of Study 1, we expected to find an effect of explanation type on sentencing judgments because we suspected that the null effect of explanation type in Study 1 was due to our equating the two explanations in validity. In removing the discussion of the validity and reliability of the described diagnostic tool, we sought to conceptually replicate previous findings (Aspinwall et al., 2012; Gurley & Marcus, 2008; Schweitzer & Saks, 2011; Schweitzer et al., 2011) that participants diminish the sentence of a neurologically compromised individual compared with a psychologically compromised one. Additionally, we hypothesized that neurological information would influence people's judgments of an offender's dangerousness and treatability. We also conducted another independent test of the Dualism × Neurological Explanation interaction found in Study 1.

Participants

As was the case in Study 1, all participants (n = 530) were recruited through Amazon's Mechanical Turk. The same participant inclusion criteria were in place in Study 2 as in Study 1.

A similar comprehension question technique was employed. To maximize the likelihood that the final sample attended to and understood the material, we established a cut-off of either a perfect score (7/7; 67.9% of participants) or a near perfect score (6/7; 20.8% of participants) for inclusion in analyses. Further, we also monitored whether the participant had taken the survey previously published on M-Turk for Study 1. We excluded these participants (n = 90) to constitute the final sample (N = 400).

The final sample comprised 198 females and 195 males, ranging in age from 18 to 68 (M = 35.14; SD = 11.45). Most participants identified as white (n = 319) with the remainder identifying as African American (n = 30), Asian (n = 24), or Hispanic (n = 18). The participants also responded to the same political affiliation questions. The sample was politically moderate (M = 2.60, SD = 1.14) with participants tending to indicate a liberal affiliation on social issues (M = 2.35, SD = 1.15) and a conservative affiliation on economic issues (M = 2.85, SD = 1.18). 15.8% of participants (n = 63) reported ever having served on a jury.[5]

Procedures

A link to a study 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. Participants who agreed to participate were directed to the same set of materials presented in Study 1 save for the changes described in 'Materials.' In contrast to Study 1, participants were quasi-randomized into two conditions (instead of 4): neurological or psychological explanation.

Materials

Study 2 consisted of the same five parts in Study 1. Two minor changes were made to the protocol in part 2 and 5 of the experimental protocol.

Transcript. First, in contrast to Study 1, the transcript did not reference the error rate of either the neurological or psychological diagnostic technique. More specifically, the line that discussed how the psychopathy scale had an error rate of 30–35% was removed. Further, the part of the transcript that described how the neuroscientist or psychiatrist placed the defendant at the 95% percentile was removed and replaced with a line that simply noted that the defendant placed highly on the scale. Both of these items were replaced to remove any reference to the quality of the diagnostic tool that could provide equivalent legitimacy to both the psychological and neurological explanation.

Results

Factor analysis

We first conducted an identical factor analysis of the reasoning questions. The results rendered a similar three-factor structure of the 10 questions. The

Eigenvalues for the first five factors were 2.46, 1.76, 1.15, 1.12, and .87. The first factor included the Treatability items. The second and third factors represented the Defendant Self-Control items and the Dangerousness items, respectively. The Treatability factor explained 24.62% of the variance; the Defendant Self-Control factor explained 17.60% of the variance; and the Dangerousness factor explained 11.50% of the variance. See Table 1 for factor loadings. Again, each factor score was computed using multiple regression. Because we advanced specific predictions about how explanation type may influence sentencing judgments, we again did not include sentence length or sentence location in the factor analysis.

Sentencing judgments

We conducted a 1-way (Explanation Type: Neurological, Psychological) MANOVA using sentence length and sentence location as dependent variables. Replicating the results from Study 1, there was no statistically significant main effect of explanation type, $F(2, 395) = .915$, $p = .401$.[6] Because participants who recommended that the defendant go to a treatment facility may differ in their sentencing judgments from those who recommended prison, we conducted two subsidiary one-way ANOVAs to assess if sentencing judgments differed as a function of explanation type within the treatment facility and prison groups. Within either group, no significant sentencing judgment differences emerged.

We also conducted the same MANCOVA as in Study 1 to ascertain whether Dualism beliefs interact with punishment judgments. Using the Stanovich composite scores as an interaction term in the MANCOVA, there was no Dualism x Explanation-Type interaction, $F(2, 393) = .799$, $p = .450$, failing to replicate the findings of Study 1.[7]

Reasoning questions

We then conducted three one-way (Explanation Type: Neurological, Psychological) ANOVAs to ascertain differences in beliefs about criminality based on the aforementioned factor analysis. Overall, the effects replicated the results from Study 1. See Table 2 for correlations between sentencing and reasoning variables.

For dangerousness, there was a significant main effect of explanation type, $F(1, 383) = 4.544$, $p = .034$, partial $\eta^2 = .012$, with those in the neurological explanation group ($n = 206$) rating the defendant as less dangerous ($M = -.06$, SD = .88) than those in the psychological explanation group ($n = 179$, $M = .095$, SD = .73). For defendant self-control, there was no significant main effect of explanation type, $F(1, 383) = 1.521$, $p = .165$. For treatability, there was a significant main effect of explanation type, $F(1, 383) = 6.060$, $p = .014$, partial $\eta^2 = .016$, with those in the neurological explanation group ($n = 206$) rating the defendant as more treatable ($M = .108$, SD = .93) than those in the psychological explanation group ($n = 179$, $M = -.124$, SD = .93).

Discussion and concluding remarks

The current results pose a challenge to the idea that mock jurors view neuroscience information as reflecting the need for a less severe sentence. Our findings provide virtually no evidence for the 'seductive allure' hypothesis of such information given that the inclusion of a brain image or a neurological explanation did not influence sentencing judgments in either study. Mock jurors did not find the 'my brain made me do it' defense any more blame-reducing than the 'my personality disorder made me do it' when the explanations were matched for ostensible scientific quality (Study 1) or left ambiguous with respect to scientific quality (Study 2). Nevertheless, across both studies, participants rated the neurologically described psychopathic defendant as more treatable and less dangerous than his psychologically described counterpart, suggesting that neurological information does influence mock jurors' legal reasoning in a way not previously documented.

One potential explanation for the surprising sentencing findings stem from the possibility that, by matching the explanations for scientific validity and reliability, the differential diagnostic measures were no longer scientifically differentiable in a way that translated into punishment mitigation. Nevertheless, Study 2 ruled out this possibility by demonstrating that even after key features of the neurological and psychological explanations that described the diagnostic measure's scientific reliability and validity were removed, no effect of explanation type emerged. An additional explanation for the largely null findings may arise from individual differences in participants' past experience with and exposure to the legal system. Study 2 provided preliminary evidence against this explanation, however, because participants who had served on a jury did not differ significantly from other participants in how they viewed neuroscientific information in sentencing (see Endnote 1 and 5). Nevertheless, further research examining the generalizability of our findings to actual jurors is warranted.

A more promising account of our results is that neurological explanations typically play a role in extenuating mock jurors' sentences for most defendants, but this tendency does not extend to psychopaths. People may not hold the intuition that neurological evidence is a marker of mitigated sentencing because they harbor strong prior beliefs that psychopaths engage in criminal behavior. Such an explanation is consistent with research on people's perceptions of psychopathy. Survey data suggest that most people believe that the majority of psychopaths engage in criminal, even violent, behavior (Furnham, Daoud, & Swami, 2009). Future research, however, is required to corroborate this explanation.

It is unclear and surprising why participants express this set of beliefs when the defendant is described as suffering from psychopathy as opposed to other disorders, such as depression or schizophrenia. Previous work has demonstrated the opposite pattern of results for dangerousness and treatability for other psychological conditions. For instance, the 'Mixed Blessings Model' (Haslam & Kvaale, 2015) maintains that biological explanations tend to decrease blame for people suffering from brain-based psychopathologies and increase prognostic pessimism for patients themselves and clinicians (Lebowitz & Ahn, 2014). Furthermore, individuals described as suffering from a neurological ailment are typically socially stigmatized to a greater extent than those who suffer from a psychological problem (O'Connor & Joffe, 2013). Such research notwithstanding, our findings raise the possibility that neuroscience information may have differing effects on sentencing recommendations on conditions traditionally deemed 'bad' as opposed to 'mad' or 'sad.'

In the present studies, the sentencing judgments, in conjunction with the treatability and dangerousness findings, paint a nuanced and previously undocumented depiction of how people reason about legal punishment. Even though mock jurors regard a brain-based condition as qualitatively different than a psychological-based one, such beliefs apparently do not translate into differential punishment decisions. Perhaps the treatability and dangerousness pattern of results emerges because participants, while rating the psychopathic defendant as less of a threat to the public, still believe the defendant to be sufficiently dangerous to require imprisonment. In addition, participants may have been unsure how beliefs about dangerousness ought to influence a sentencing judgment given the severity of the crime. This explanation is in line with research indicating that people tend to focus on the severity and perceived heinousness of a crime rather than other relevant factors (e.g. the future dangerousness of the offender, the deterrence value of punishing) when punishing a wrongdoer (Darley, Carlsmith, & Robinson, 2000). Future research should examine whether alternative variables, such as the type of crime or the offender's personality disorder, influences how mock jurors interpret neuroscientific information in the courtroom.

Alternatively, laypersons may tend to view psychopathy as a product of an inborn and largely unmalleable personality disposition toward 'evil,' or at least toward aggressive and even violent behavior (see Berg et al., 2013, for a discussion and review of survey data). They may assume that psychopaths are 'bad,' and that their malevolent behavior reflects their life choices. Nevertheless, when provided with information that individuals with psychopathy display identifiable brain deficits, laypersons may become more willing to cut them a 'break': Perhaps it is not entirely psychopaths' fault, they may assume. Moreover, laypersons may now be more willing to entertain at least some hope for treatment, especially given that such an intervention does not hinge on psychopaths' motivation to improve.

Beyond the discussion of how explanations influence criminal judgments, the current set of studies makes a strong argument against the prejudicial nature of neuroimages in the courtroom. The predictions regarding the inclusion of the image were initially uncertain due to the results of several studies, which found no significant effect of brain images on ratings of legal judgment outcomes (Farah & Hook, 2013; Gruber & Dickerson, 2012; Michael et al., 2013). The present results, however, consistently found no evidence for the contention that images unduly bias mock jurors, regardless of the explicit mention of the validity and reliability of a diagnostic technique presented by a hypothetical psychiatrist. The effect of brain images on people's legal judgments may not emerge because brain images are featured more frequently in the media. In turn, 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. Indeed, the timing of the McCabe and Castel (2008) study may have captured a cultural moment in United States history in which neuroscience ventured beyond basic research and into the realm of application to law, treatment, and everyday life.

This study's findings have potential practical implications. The current results 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 provides no additional weight or influence when it comes to explaining the causes of behavior for legal purposes because people made similar sentencing recommendations based on neurological evidence versus psychological evidence. Furthermore, this explanation aligns with work suggesting that individuals do not find neuroscientific evidence as either aggravating or mitigating in the sentencing phase of legal trials; instead, jurors think of the inclusion of neuroscientific information as a means of presenting valid, comprehensive, and precise information about the defendant (Denno, 2015). 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 (Faigman, Monahan, & Slobogin, 2014; for a more in-depth discussion, see Buckholtz & Faigman, 2014; Satel & Lilienfeld, 2013).

The present results must be interpreted in the context of several methodological limitations. One 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. 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. 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 have the opportunity to cross-examine the expert. To remedy this concern, researchers could develop a more sophisticated experimental protocol that includes a video of a defense attorney cross-examining an expert on issues pertaining to an offender's mental state.

To conclude, the body of literature on how biological explanations influence legal judgments is murky and challenging to navigate. However, the current study underscores the importance of evaluating individual differences in implicit beliefs among laypersons when attempting to assess how people differentially evaluate neuroscience in legal contexts. Because mock jurors tend to hold intuitions about the immoral nature of psychopathy and the purpose of criminal sentencing, the null results with regards to punishment choices may reflect a general proclivity to penalize those who engage in especially bad criminal behavior. The treatability and dangerousness findings, however, demonstrate that neuro-explanations do influence how people conceptualize personality disorders; yet those beliefs do not seem to affect sentencing judgments. Ultimately, it seems, 'the brain made me do it' defense may not weaken mock jurors' intuitions to punish any more than an explanation of a personality disorder in psychological terms.

Notes

1. In subsidiary exploratory analyses, we examined whether the effects differed as a function of age, education level, and political orientation, and no significant effects emerged (analyses are available from first author upon request).
2. One additional question was administered in Study 1 asking participants if they believed their punishment decision was fair. However, we ultimately ended up excluding the question from analyses because the question was not administered in Study 2 due to experimenter error. When including this factor in the present analyses, this question loaded on a factor along with the question relating to whether the punishment decisions served as an effective deterrent (See Supplementary Material). Still, we found no significant main effect of neurological explanations or image inclusion (or an interaction) when examining judgments on the two questions that loaded onto this factor.
3. Factor and subsequent analyses were conducted including only the people who scored highly on the comprehension test. Each test was also re-conducted with the entire data-set, and no meaningful differences were found.
4. In exploratory analyses, we examined the Explanation-Type x Image Inclusion x Dualism interaction and each two-way interaction via MANCOVA while including Dualism scores as an interaction term. None of the results were significant and analyses are available from the first author upon request.
5. For all analyses presented here, we examined whether the effect of explanation type differed as a function of age, education level, political orientation, ethnicity, and whether participants had served on a jury. No significant effects emerged (analyses are available from first author upon request).
6. We administered an additional punishment questionnaire (Tyler & Weber, 1982) to assess attitudes toward the death penalty because we predicted that attitudes

towards punishment more generally may influence sentencing judgments (Webster & Saucier, 2015). The death penalty beliefs measures asked participants three questions probing under what circumstances (e.g. murder, kidnapping, kill) the death penalty is justified. The responses to these three questions were averaged to create a composite death penalty belief score, with higher scores representing someone who strongly believes that the death penalty is justified in many circumstances ($\alpha = .87$).

When we examined the effect of neurological explanations on sentencing judgments while controlling for beliefs in the death penalty, no significant differences emerged, $F(2, 393) = 1.302$, $p = .273$.

7. Given that we hoped to replicate the Dualism x Explanation-Type interaction from Study 1, we administered the additional dualism measure in Study 2 (Forstmann, Burgmer, & Mussweiler, 2012; Schubert & Otten, 2002). The dualism measure presented participants with two circles that become progressively closer across four depictions. One circle is labeled mind and the other is labeled brain. Participants were asked to pick which picture best represented their understanding of the relation between mind and brain. When using the pictoral measure as an interaction term, there was also no significant Dualism x Explanation-type interaction, $F(2, 393) = 2.282$, $p = .103$.

Disclosure statement

No potential conflict of interest was reported by the authors.

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