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Fooled by the brain: Re-examining the influence of neuroimages

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ABSTRACT

A series of highly-cited experiments published in 2008 demonstrated a biasing effect of neuroimages on lay perceptions of scientific research. More recent work, however, has questioned this bias, particularly within legal contexts in which neuroscientific evidence is proffered by one of the parties. The present research moves away from the legal framework and describes five experiments that re-examine this effect. Experiments 1 through 4 present conceptual and direct replications of some of the original 2008 experiments, and find no evidence of a neuroimage bias. A fifth experiment is reported that confirms that, when laypeople are allowed multiple points of reference (e.g., when directly comparing neuroimagery to other graphical depictions of neurological data), a neuroimage bias can be observed. Together these results suggest that, under the right conditions, a neuroimage might be able to bias judgments of scientific information, but the scope of this effect may be limited to certain contexts.

1. Introduction

The judgments individuals' make can be influenced by a number of factors ostensibly unrelated to that judgment (Tversky & Kahneman, 1974). Understanding these factors provide clues regarding how individuals make judgments and decisions and can have wide-reaching societal implications, for example, by allowing policy makers to institute policies that minimize the negative impact of these biases (e.g., in legal, medical, and economic contexts). A salient example of such research, published in Cognition, emerged recently with the demonstration that the presence of neuroimages altered individuals' judgments of scientific credibility (McCabe & Castel, 2008). This finding has had a striking impact in cognitive science and beyond as evidenced, for example, by research in the legal domain where "neuroevidence" has the potential to bias legal decision makers (Appelbaum, 2009; Compton, 2010; Roskies, Schweitzer, and Saks, 2013; Vincent, 2011). This subsequent research, however, has largely failed to corroborate the original findings. In the present investigation, we return to the original context (rather than a legal context) in order to explore this discrepancy further.

1.1. The impact of neuroimages

McCabe and Castel (2008) presented three experiments demonstrating that neuroscientific information has the potential to unduly influence decision-making. Their participants were given brief articles that summarized a fictitious neuroscience study. The articles were manipulated to contain a neuroimage, a non-neuroimage graphical representation of the experimental data (e.g., a bar graph or a topographical map of the brain), or no image at all. In each experiment the authors reported findings that suggested the articles accompanied by the brain image were judged more favorably than the control articles. The authors concluded, "...there is, indeed, something special about the

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brain images with respect to influencing judgments of scientific credibility" (p. 350). This result was corroborated by Weisberg, Keil, Goodstein, Rawson, and Gray (2008) who presented neuroscience students and laypeople with descriptions of psychological phenomena. When these descriptions included neuroscientific language both groups were more satisfied with the description of the phenomena, even though the neuroscientific language was designed to be irrelevant. Further corroboration comes from a recent study by Keehner, Mayberry, and Fischer (2011) who presented their participants with neurological information in several graphical formats (e.g., a topographical map of the brain, a 3-D color representation of the brain) and found that certain highly-realistic depictions of the brain made the accompanying passages more convincing relative to the less-realistic images. Most recently, Ikeda, Kitagami, Takahashi, Hattori, and Ito (in press) demonstrated both an effect of neuroimages on credibility judgments and on metacomprehension judgments. That is, individuals felt like they understood a text passage better when an image of the brain was included compared to no image or a bar graph.

If neuroimages hold the sort of persuasive power suggested by McCabe and Castel (2008), Keehner et al. (2011) and Ikeda et al. (in press), then this would raise a number of potential concerns about the use of such information in decision-making contexts. This concern is particularly salient in legal contexts where presenting such neuroimages may very well be considered prejudicial if admitted into a trial. Indeed, in response to such findings, legal scholars' existing concerns over neuroimaging (Baskin, Edersheim, & Price, 2007; Dumit, 1999; Pratt, 2005; Rose, 2000) began to intensify (Appelbaum, 2009; Brown & Murphy, 2010; Compton, 2010; Erickson, 2010; Vincent, 2011). These concerns appeared to be well supported. For example, Gurley and Marcus (2008) examined the impact of neuroimaging on mock jurors' willingness to find a criminal defendant Not Guilty by Reason of Insanity (NGRI). When their participants were given a written piece of expert testimony that included a structural neuroimage, a greater number of participants rendered NGRI verdicts—based on their belief in the findings of the neurological evidence—compared to the same expert testimony that lacked neuroimage evidence.

1.2. Reexamining the impact of neuroimages

Provided both the theoretical and practical significance of these findings, a number of subsequent experiments assessed the impact of neuroimages on judgment in legal contexts and elsewhere. Interestingly, almost no evidence emerged that supported the notion that brain images have any impact on judgment in these contexts. For example, Schweitzer et al. (2011) used a large nationally-representative sample to assess the impact of neuroimage evidence when offered in support of a *mens rea* defense in a criminal trial. Across four different experiments varying the severity of the charged crime, the type of neuroimage used, and the visual impact ("glitziness") of the image, evidence that contained neuroimages was in no way more persuasive than similar evidence that did not contain neuroimages (see also Greene & Cahill, 2011; Schweitzer & Saks, 2011 for similar results in a legal context). It is important to note that, while these experiments focused on legal decisions, mediating variables that measured the credibility of the specific scientific evidence associated with the neuroimage (more akin to measures used in the original studies) were also collected, and were also unaffected by the presence of neuroimagery. In addition, these failures to replicate do not seem limited to the legal context. For example, Gruber and Dickerson (2012) paired popular media science articles with neuroimages, sci-fi images, and fantasy-like artistic renderings. In line with the legal work on neuroimages, no persuasive impact of neuroimages were found. Similarly, Michael, Newman, Vuorre, Cumming, and Garry (2013) sought to replicate the McCabe and Castel (2008) findings. Across multiple attempts with various samples and presentation modalities, Michael et al. were unable to replicate the findings reported in McCabe and Castel's third experiment, finding that perceptions of a newspaper-type article describing a scientific finding were not influenced by the inclusion of an accompanying neuroimage. Finally, Hook and Farah (2013), examined neuroimagery's influence on judgments of research summaries, again finding no persuasive impact, and no relation between neuroimage effects and a person's belief in mind–brain dualism.

2. The present experiments

The conflicting findings within this body of literature are puzzling. Looking specifically at the methodology of the earlier studies that purportedly support a neuroimage bias explains only part of the discrepancy. For example, Weisberg et al. (2008) focused on neuroscience language generally without specifically testing the impact of neuroimagery. Gurley and Marcus (2008) confounded the presentation of neuroimages with additional expert evidence, making it impossible to parse the contribution of the neuroimage. Lastly, Keehner et al. (2011) presented neuroimages in a repeated-measures design, opening the door to contrast effects in which neuroimages may be persuasive only when other points of reference are given. Making a similar claim with respect to McCabe and Castel (2008), however, is more difficult and thus the potential reason for the incongruity is not as clear. It could be the specific task used in the studies, that the dependent construct was not properly operationalized, or that the effects found were simply idiosyncratic or spurious. In five experiments, we endeavored to understand this remaining discrepancy by attempting to re-examine the neuroimage bias by conceptually and directly replicating McCabe and Castel's (2008) findings and then attempting to identify the conditions most likely to elicit a neuroimage effect.

2.1. Experiment 1

In Experiment 1 we conducted a conceptual replication of McCabe and Castel (2008) – hereafter noted as "M&C" – using a web-based experiment that presented participants with one of three different scenarios describing a purported link between a particular mental condition and a