

## ABSTRACT

In this study we examined the effectiveness of brain imaging technologies when used to establish scientific credibility and influence opinion. Fictional reports on religious and non-religious topics with fMRI images, bar graphs, or absent visual aids impact on perceptions of credibility and persuasiveness were evaluated.

## INTRODUCTION

With advances in medical imaging technology and the increased availability and affordability of neurological imaging systems over the last twenty years, there has been an explosion of research on the brain. Researchers have found themselves in the awkward position of translating incredibly technical research and detailed findings about the brain to the lay public. Unfortunately, much of the public does not have the scientific education or sufficient technical expertise to evaluate the claims often presented in reports presented in the popular media. Because of this, a cognitive bias to ascribe greater scientific credibility to the claims made in media claims has been discovered.

In a 2008 study McCabe and Castel asked undergraduate students to read a popular press article and to evaluate its scientific credibility. The articles used were, in fact, actually fictional and flawed in their methodology and interpretations provided. They contained headlines such as 'Playing Video Games Benefits Attention' and 'Watching TV Is Related to Math Ability.' The authors discovered that when these fictional articles were accompanied by brain images (such as those taken during functional magnetic resonance imaging - fMRI), readers were more likely to assign greater scores to the scientific credibility and claims of the research described in the text when compared to readers who read the text without any brain images. What made this even more interesting was that a more complex presentation of the data as a brain map (which did not have the obvious appearance of a brain, but was instead a brain map depicted as a patchwork of colours with diffuse borders), was not judged to be equally as credible as an fMRI image which was more easily recognizable (a familiar image with clear borders and multicoloured active regions often used in scientific articles, medical settings, and media reports). Since this study, a number of authors have examined the impact that presentation of brain research has on public perception of research findings in a variety of contexts, and offered alternate explanations for the findings (Dekker et al, 2012; Fisher et al, 2010; Illes et al, 2010, McCabe et al, 2010; Miller, 2010; Satel and Lilienfeld, 2013; Weisberg et al, 2008).

The purpose of this study was to replicate this study and to examine the nature of the article content within a religious domain. In addition, we were interested in population factors (i.e. religiosity) and its' impact on this effect by article topic. Three articles were selected - two with a nonreligious topic (i.e Video gaming's effects on the brain, and a novel addictive street drug) and one with a religious topic (i.e. Temporal Lobe Epilepsy and Mystical Experiences of religious figures). Articles would be paired with either no images, a bar graph, or a color fMRI image with the article text (similar to McCabe and Castel, 2008) and measures of religious attitudes, involvement, and provision would be examined.

## METHODS

### Participants

Students were recruited from an Introductory Psychology/General Education course at a religiously affiliated university. Students were given the opportunity to participate in the study and receive extra credit towards their grade in the course in exchange for their participation.

### Materials

Materials consisted of a study packet which included: 1) an informed consent form, 2) a set of demographic questions, 3) a 5 point Likert scale self-report of spirituality and the Religious Support Scale (RSS; a measure of religious provision with three subscales: Congregational, Social, and God-Support), 4) three sets of articles with rating packets for credibility, persuasiveness, and change of opinion, 5) a debriefing form, and 6) extra credit participant information. With respect to the articles, the first article was on a nonreligious topic (the impact of Video Gaming on the brain) which was either unaccompanied by any illustrations, accompanied by a bar graph illustrating the neurological findings, or a color fMRI image. The second article was on a religious topic (Temporal Lobe Epilepsy and mystical experiences) and was either unaccompanied by any illustrations, accompanied by a bar graph illustrating the neurological findings, or a color fMRI image. The third article was on another nonreligious topic (a novel addictive drug - Drug Addiction) and was either unaccompanied by any illustrations, accompanied by a bar graph illustrating the neurological findings, or a color fMRI image. Each packet contained one article with no accompanying text, one article with a bar graph, and one article with a color fMRI. Ratings for the perceived credibility of the article (1- Not credible at all; 5- Extremely credible), the Persuasiveness of the article (1 - Not persuasive at all; 5 - Extremely persuasive), and Change in Opinion about the topic (1 - No change; 5 - Completely changed my opinion) were provided after each article. Additional, open-ended questions were provided after each of the three ratings for participants to explain their ratings. The order of the articles was block randomized for the sample.

### Procedures

Students were informed of the extra credit opportunity at the end of a lecture hour and given a brief description of their involvement. Those students who elected to remain in participate were randomly given a copy of the vignette packet. Each packet contained an informed consent document which they were allowed to read and sign. Those students who sign the informed consent document were then instructed to go to the second page for a set of demographic questions (i.e. age, gender, ethnicity, year in school). The next section consisted of the RSS, followed by the instructions about the articles and ratings. Students were allowed 5 minutes to read and rate the three articles. An article taken from a popular press report was slightly modified with graphics (i.e. none, bar graph, or fMRI) along with rating scales for Credibility, Persuasiveness, and Change in Opinion were provided. Participants were instructed to wait until the 5 minutes had elapsed before progressing on to the next article. After all three articles had been completed, participants turned in their packet with their scores and the original articles, and were then debriefed.

## RESULTS

### Demographics and Religiosity

A total of 30 female and 29 male students participated in this study (N=59), the majority of which were Freshmen (n=26), followed by Sophomores (n=18), Juniors (n=13) and Seniors (n=2)(see Figures 1 and 2). The mean age for all students was 19.25 (sd ±0.96) with the mean age of Females=19.27 and Males=19.24). As shown in Figure 3, Ethnicity was predominately White/Caucasian (72.9%), followed by Asian (10.2%), Hispanic/Latin American (6.8%), African-American (5.1%), and Other (5.1%). Participants reported a high degree of interest in spirituality indicated by a mean of 4.63 (±.61) on a self-reported 5 point Likert scale. They also had high scores on all three subscales of the Religious Support Scale, with no difference observed between Males and Females (See Table 1).

### Nonreligious Articles

For the two non-Religious topic articles (Video Game and Drug Addiction), ratings for Credibility, Persuasiveness and Change of Opinion are shown in Figure 4 and Figure 5, and in Table 2. Overall, Credibility, Persuasiveness and Change in Opinion ratings were flat across the two nonreligious articles. There were no significant differences between the groups for the videogame or novels drug articles.

### Religious Article

For the article that was related to a religious topic (i.e. Temporal Lobe Epilepsy and Mystical Experiences), ratings for Credibility, Persuasiveness and Change of Opinion are shown in Figures 3-8. There was a significant reduction in the credibility, persuasiveness, and change in opinion scores with use of the fMRI image resulting in significantly lower scores when compared to the bar graph or no accompanying graphic scores.

FIGURE 1. GENDER

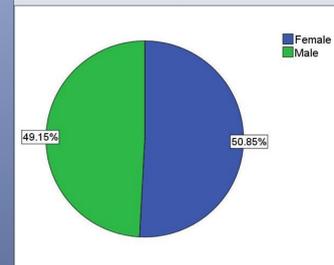


FIGURE 2. - YEAR IN SCHOOL

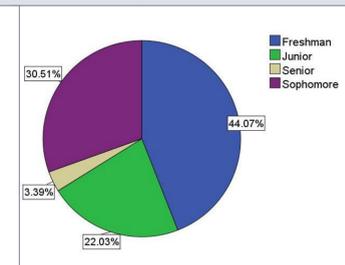
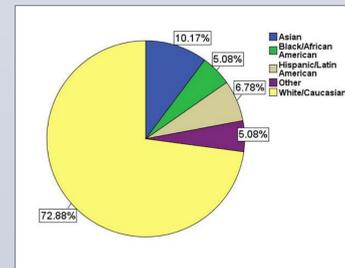


FIGURE 3. ETHNICITY



## RESULTS (CONT'D)

TABLE 1. AGE AND RSS SCORES

	Mean (Tot)	Males	Females	t	p
AGE	19.25 ±.96	19.24 ±.87	19.27 ±1.05	.101	.92
Congregation Support (RSS)	25.51 ±5.11	28.56 ±4.99	28.47 ±5.31	.065	.95
God Support (RSS)	30.58 ±4.51	30.07±3.57	31.07 ±5.29	.85	.40
Social Support (RSS)	27.9 ±4.71	28.97 ±4.08	26.86 ±5.11	1.74	.09

TABLE 2. RATINGS FOR ARTICLES

	Credibility	Persuasiveness	Change in Opinion	F	p
Video Game					
Text Only	3.60 ±.8	3.45 ±1.0	2.4 ±1.2	.915	.41
Bar Graph	3.24 ±1.1	3.0 ±1.1	2.1 ±1.0	1.15	.32
fMRI	3.64 ±1.0	3.0 ±1.1	2.45 ±1.1	.70	.5
Drug Addiction					
Text Only	3.13 ±1.0	3.42 ±1.0	2.19 ±1.3	.44	.65
Bar Graph	2.9 ±1.2	3.15 ±1.46	2.2 ±1.2	.52	.6
fMRI	3.3 ±.5	3.63 ±1.3	2.75 ±1.6	.66	.52
TLE and Mystical Experience					
Text Only	3.13 ±1.0	2.63±1.3	2.75 ±1.0	2.4	.1
Bar Graph	2.77 ±.97	2.64 ±1.0	1.86 ±1.0	3.71	.03*
fMRI	2.34 ±.97	1.93 ±.84	1.41 ±.6	7.87	.001*

FIGURE 4. VIDEO GAME ARTICLE

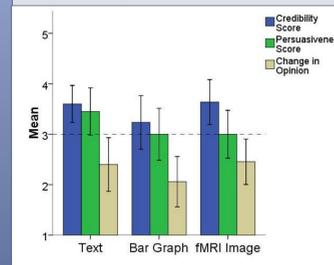


FIGURE 5. DRUG ARTICLE

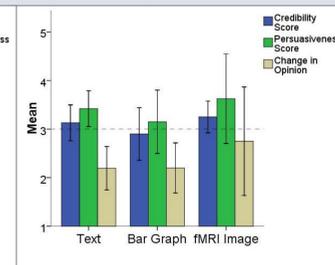
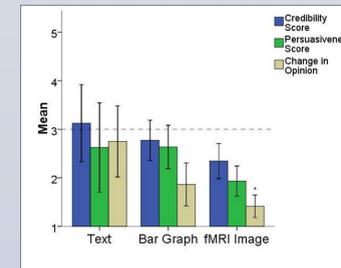


FIGURE 6. TLE & MYSTICAL EXPERIENCES



## DISCUSSION

The goal of this study was to replicate the findings of McCabe and Castel (2008), and to examine whether or not these findings extended into topics that had religious significance. To our knowledge, no previous studies have examined the impact religious topics or within a religious population. In summary:

- We did not replicate the findings of McCabe and Castel (2008) showing an increase in credibility ratings of popular press articles when brain images were used as support graphics when compared to alternate data presentations or no visual presentation.

- There was a trend towards a decrease in Credibility, and a significant reduction in Persuasiveness and openness to Changing an Opinion when brain scans are used in an article on a religious topic to a religious population when compared to nonreligious topics.

- There was no clear connection between RSS scores and any measures of Credibility, Persuasiveness, or Change in Opinion.

One issue with this study is the relatively small sample size (N=59) and the level of variability within the data. In addition, the sample demographics and RSS reveal that it is ethnically and religiously homogenous. The majority of students involved in this study were recruited from and attend a religiously affiliated school which biases the study towards a high degree of interest in religious matters. This potential bias may be the cause for the reduced scores on the TLE article resulting in a sensitivity towards any scientific evidence which may not fit neatly within neatly within or potentially threaten religious frameworks and belief systems. Currently, we are in the process of expanding the sample and also extending it to populations outside the current research setting. We are currently involved in recruiting participants from non-religiously affiliated schools and to include students from other ethnic and religious backgrounds to better examine the impact of religiosity on this topic.

## REFERENCES

Dekker S, Lee NC, Howard-Jones P, Jolles J. (2012) Neuromyths in Education: Prevalence and Predictors of Misconceptions among Teachers. *Front Psychol.*;3:429

Fisher CE, Chin L, Klitzman R. (2010) Defining Neuromarketing: Practices and Professional Challenges. *Harv Rev Psychiatry.* Jul-Aug;18(4):230-7.

Illes J, Moser MA, McCormick JB, Racine E, Blakeslee S, Caplan A, Hayden EC, Ingram J, Lohwater T, McKnight P, Nicholson C, Phillips A, Sauvé KD, Snell E, Weiss S. (2010) Neurotalk: Improving the Communication of Neuroscience Research. *Nat Rev Neurosci.* Jan;11(1):61-9.

McCabe DP, and Castel AD. (2008) Seeing is Believing. *Cognition*, Vol 107; p343-352.

McCabe DP, Castel AD, Rhodes MG, (2011) The Influence of fMRI Lie Detection Evidence on Juror Decision-Making. *Behavioral Science and Law*, Vol 29; p566-577.

Miller GA. (2010) Mistreating Psychology in the Decades of the Brain. *Perspect Psychol Sci.* Nov;5(6):716-743.

Satel S, Lilienfeld SO. (2013) Brainwashed: The Seductive Appeal of Mindless Neuroscience. *Basic Books*: New York, NY.

Weisberg DS, Keil FC, Goodstein J, Rawson E, Gray JR. (2008) The Seductive Allure of Neuroscience Explanations. *J Cogn Neurosci.* Mar;20(3):470-7.

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