

Media Portrayal of a Landmark Neuroscience Experiment on Free Will

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Abstract The concept of free will has been heavily debated in philosophy and the social sciences. Its alleged importance lies in its association with phenomena fundamental to our understandings of self, such as autonomy, freedom, self-control, agency, and moral responsibility. Consequently, when neuroscience research is interpreted as challenging or even invalidating this concept, a number of heated social and ethical debates surface. We undertook a content analysis of media coverage of Libet’s et al.’s (Brain 106(Pt 3):623–642, 1983) landmark study, which is frequently interpreted as posing a serious challenge to the existence of free will. Media descriptions of Libet et al.’s experiment provided limited details about the original study. Overall, many media articles reported that Libet et al.’s experiments undermined the existence of free will, despite acknowledging that several

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methodological limitations had been identified in the literature. A propensity to attribute greater credibility than warranted to neurobiological explanations could be at stake.

Keywords Media · Free will · Libet · Neuroscience · Ethics

Introduction

Free will has been heavily debated in philosophy and in the social sciences (Bourke 1964; Dilman 1999; Fischer 1994; Kane 1996; Mess 1943; Pereboom 2001; Strawson 2011; Van Inwagen 1983). The concept of free will is often associated with phenomena and processes that are fundamental to our understandings of self. These concepts include those like autonomy, freedom, self-control, agency, and moral responsibility (Monroe et al. 2014). Theories that claim to threaten or invalidate the existence of free will (Wegner 2002) are often thought to impact or bring these other concepts into question as well. Consequently, free will has been at the core of many discussions in moral philosophy that attempt to answer whether free will exists (Fischer 1994; Kane 1996, 2002; Pereboom 2001; Strawson 2011; Van Inwagen 1983). Philosophical solutions to this problem range along a spectrum from compatibilist to incompatibilist solutions (Dilman 1999; Kane 1996). Compatibilism describes theories that grant the possibility of the existence of free will while still being committed to the law of cause and effect (i.e., determinism) (Dennett 1984; Frankfurt 1971; Strawson 1962). Incompatibilism (i.e., “hard determinism”) typically describes theories that adhere to the overriding domination of causal determinism in a way that does not leave any room for the existence of free will (Wegner 2002). However, some incompatibilists are libertarians who believe that free will is incompatible with causal determinism but, unlike hard determinists, believe that we have free will and, therefore, that causal determinism is false (Van Inwagen 1983).

Academic exploration into the existence of free will has not stopped at philosophical debates. Researchers from other disciplines, such as psychology and neuroscience, have also begun to test if free will can be confirmed or altered experimentally. One of the most well-known scientific studies about free will was conducted by Benjamin Libet and his colleagues in 1983. During this experiment, they used electroencephalography (EEG) to track the presence of brain activity before and after participants were asked to make a spontaneous and voluntary finger movement. The researchers compared the timing of the observed neural activity (readiness potentials or RP) to the time when participants reported their first awareness of an urge to initiate action (W) or their first awareness that they had moved (M), depending on the trial. Participants self-reported the timing of W and M using a clock. Libet et al. observed RP several hundred milliseconds before W. This finding has been interpreted as placing limitations on the existence of free will (Libet et al. 1982, 1983). Since this study was published, scholars have debated its relevance extensively (Klemm 2010; Mele 2009; Roskies 2006) and significant research has been done in this area (Saigle et al. 2015). For example, Libet et al.’s

original paper has been cited over 1700 times (Google Scholar, January 29, 2016; over 750 citations in the Web of Science, 2016) and has inspired dozens of studies with similar methodologies (Saigle et al. 2015). One of the driving forces behind this area of scholarship is its alleged relevance to ontological questions about free will (e.g., whether humans have free will, whether free will is compatible with a deterministic understanding of the universe).

Research from psychology and the social sciences indicates that attitudes and behaviors are impacted by opinions about free will. For example, one study showed that participants were more likely to cheat on a self-reward task after reading a passage that supported a deterministic worldview (i.e., no free will) than those who read a passage encouraging belief in free will (Vohs and Schooler 2008). A similar study showed that participants were less helpful and were more aggressive toward others after they were presented with text that discouraged a belief in free will (Baumeister et al. 2009). Other studies suggest that a weaker belief in free will is associated with individuals feeling less grateful for others' actions because the benefactor is no longer seen as acting as selflessly if he/she could not choose to do otherwise (MacKenzie et al. 2014). Interestingly, individuals' intuitions that they themselves have free will seem to be impacted by their own circumstances. For example, individuals' belief in free will decreases when they are experiencing strong basic physiological signals (e.g., urge to urinate, sexual desire) (Ent and Baumeister 2014).

Given that studies demonstrate the impact that beliefs about free will have on behavior, it is important to assess how these issues are discussed by the public. The fact that Libet et al.'s work was widely disseminated and was one of the first studies to study free will scientifically makes it an excellent case to better understand the public's understanding of free will in light of neuroscience research. Accordingly, we analyzed print media articles that discussed Libet's research and its implications about free will to examine how this study was reported and what statements were made about its alleged implications for free will.

Methods

Sample

To generate an initial sample of media articles about Libet et al.'s (1983) experiment, we searched the keyword "Libet" in Factiva, which is a database with international media content. The first search was completed in June 2013, and we conducted subsequent searches to catch all articles published between then and June 2015. In total, the initial searches yielded 903 articles. We excluded articles based on the content of their headlines. Our exclusion criteria were: duplicates of articles, articles not written in English, articles from academic journals (e.g., *American Philosophical Quarterly*), articles from sources aimed at professionals (e.g., NewsRX), articles from sources with restricted public dissemination (e.g., student journals), irrelevant article types (e.g., obituaries or advertisements for upcoming academic conferences) and articles not referring to Benjamin Libet (e.g., articles

referring to the socialite “Libet Johnson” or the Polish construction company “SA Libet”). Our final sample consisted of 89 articles.

We recorded basic descriptive information (e.g., authorship, publication type) from all of the articles. The authors of the articles were classified according to their background after an online search was executed to identify them. We recorded all available author information present in the articles and in individualized online searches, including their name, title (e.g., Ph.D., M.D.), affiliation, source of article (i.e., type of media it was printed in) and topics of interest (e.g., neurobiology). If there was significant uncertainty about the identity of the author, we classified the author as unidentified. The articles were classified according to their source (i.e., magazines, newspapers, news agencies or website of a newspaper), location (i.e., country of publication), type (i.e., traditional articles, book reviews, press release or letter to the editors) and target audience (i.e., general or specific) based on the information available on the official website of the source. Length of articles and publication date were based on information provided by Factiva.

Coding

The articles were analyzed using QSR NVivo 9 software. A subset of the sample ($N = 9$, representing roughly 10% of the final sample) was used to develop and test a coding scheme for content analysis.

To isolate content focused on Libet et al.’s experiment from more general content about free will, we separated proximal content from distal content. Proximal content captured all content directly related to Libet et al.’s experiment or Libet himself based on: (1) direct citations of Libet; (2) direct references to the experiment or to Libet by the author of the article; and (3) direct reference to the experiment or to Libet by another source that was cited in the article. Distal content captured all other content that was not explicitly about Libet et al.’s experiment or Libet himself (e.g., other neuroscience studies on free will). The final coding scheme consisted of the following parent nodes: (1) description of Libet et al.’s experiment; (2) discussions about free will; (3) implications of the free will debate; and (4) other themes (see Fig. 1 for detailed coding scheme). All discussion about Libet et al.’s experiment was proximal by nature, the other codes could contain proximal and distal content. A rich coding strategy (non-exclusive coding) was adopted. Headlines were coded using a simple topic classification.

Four rounds of subsequent coding of the body content (each consisting of approximately a quarter of the sample) were conducted by V.N. and the coding guide was further refined after each one of these rounds. After each round, a first reviewer (V.S.) ensured external validation of the coding scheme and a second reviewer reviewed all coding (V.D. or E.R.). Disagreements were settled with the input of the team member who was not involved in the coding review (V.D. or E.R.) and the final agreement was established by consensus. Our data is presented using descriptive statistics for the quantification of the occurrence of content. Qualitative content is provided to illustrate content and presented to reflect nuances in meanings.

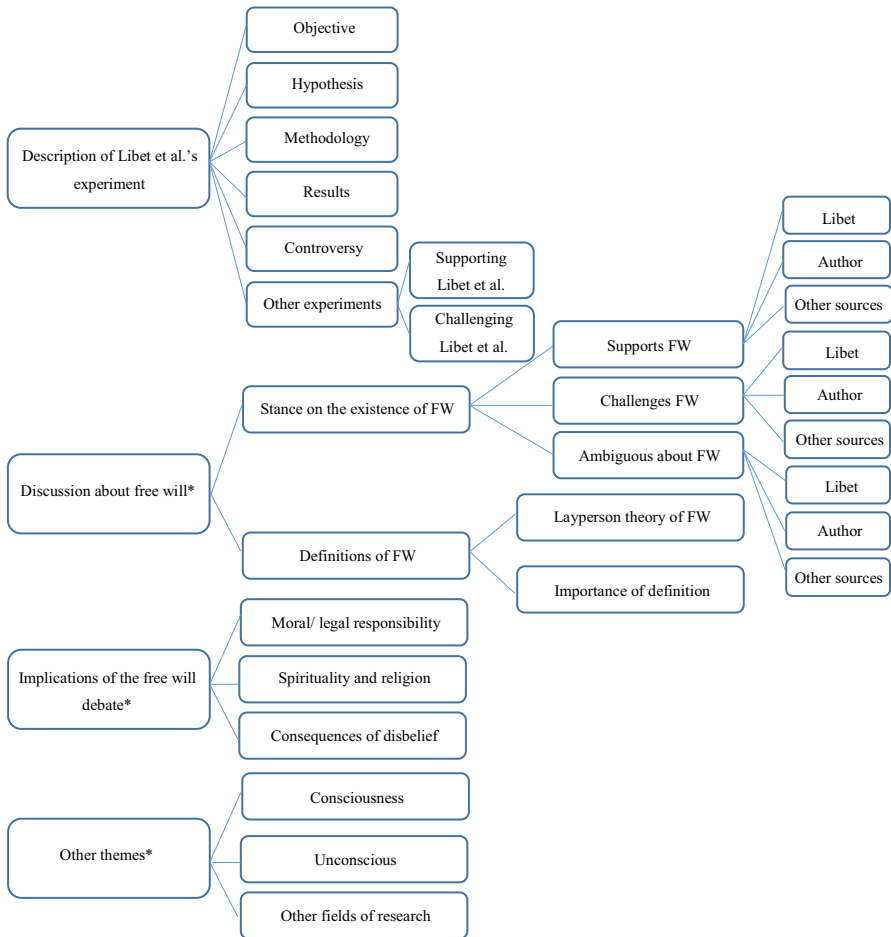


Fig. 1 Detailed coding scheme. *Asterisk* Content coded both under distal and proximal content (see “Methods” section for explanations). *FW* free will

Results

Sample and Basic Information About the Articles

The final sample consisted of 89 articles published between 1983 and 2015. The first 16 years contained 10 articles (11%) and the last 17 years contained 79 (89%) (Fig. 2). Spikes in the number of publications were noted in 2002, 2007 and 2011. Most of the articles were published in the United Kingdom (UK) ($N = 41$; 46%) or in the United States of America (US) ($N = 31$; 35%), with the remaining articles ($N = 17$; 19%) coming from Canada, Ireland, Spain and India. The majority of the articles were published in newspapers ($N = 39$; 44%) and magazines ($N = 37$; 42%), while the rest of the articles ($N = 13$; 15%) were either from news agencies (e.g., Reuters) or were published exclusively on newspapers’ websites or news sites.

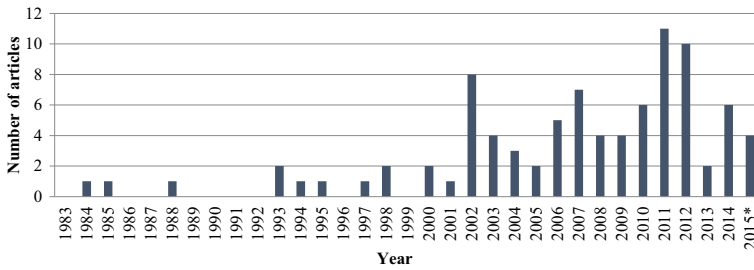


Fig. 2 Number of articles per year

Fifty-five percent ($N = 49$) of the articles came from sources with a specific target audience (e.g., the magazines *Skeptical Inquirer* and *The Christian Century*), whereas 45% ($N = 40$) came from sources with a general target population (e.g., the *Toronto Star*). Seventy percent ($N = 62$) of the articles were traditional articles (e.g., reports, columns, editorials and profiles), 20% ($N = 18$) were book reviews, 8% ($N = 7$) were press releases, and 2% ($N = 2$) were letters to the editor. Forty-nine percent ($N = 44$) of the articles were long (>1000 words), 31% ($N = 28$) were of medium length (between 500 and 1000 words) and 19% ($N = 17$) were short (<500 words). There were a total of 90 different authors. Forty-three percent ($N = 39$) of the authors were journalists, 26% ($N = 23$) had a scientific (formal natural sciences or social sciences) or clinical background (e.g., doctors, psychologists), 14% ($N = 13$) had a background in philosophy, 3% ($N = 3$) had a religious background (e.g., Christian ministers, Buddhist monks), and 6% ($N = 5$) had other backgrounds (e.g., lawyers, politicians). We could not identify the backgrounds of 8% ($N = 7$) of authors.

Headline Analysis

The existence of free will was the most prevalent theme in headlines ($N = 35$; 39%). Eleven percent ($N = 10$) of headlines argued for the existence of free will, 11% ($N = 10$) challenged the existence of free will (sometimes referred to as an “illusion”, a “myth”, or a “delusion”) (Falk 2003; Halligan and Oakley 2000; Harris 2011) and 17% ($N = 15$) were ambiguous about free will’s existence (e.g., “Free will: Now you have it, now you don’t”) (Overbye 2007). Other common themes were the existence of consciousness or the soul ($N = 8$; 9%); the power of the unconscious ($N = 8$; 9%); the implications of free will or neuroscience for the legal system ($N = 4$; 4%) and religion ($N = 5$; 6%). Two headlines (2%) emphasized the importance of the definition of free will for the debate, and only one headline mentioned Libet explicitly. Twelve percent ($N = 11$) of headlines were related to neuroscience or to the brain in general without referring to free will.

Media Coverage of Libet's Experiment

Ninety percent (80/89) of articles referred directly to Libet et al.'s (1983) experiment. Among those that discussed Libet et al.'s (1983) experiment, 86% (69/80) provided details about the experiment's methodology or results (Fig. 3). As few articles focused on Libet et al.'s experiment, there was limited coverage of the study design. An example of this sort of coverage can be seen in 'It was in the 1980s that the late neuroscientist Benjamin Libet saw a spark of brain activity 300 ms before subjects consciously chose to twitch a finger' (Douglas 2010).

Furthermore, even if this was not initially part of the coding strategy, we observed several factual errors in the articles' coverage of Libet et al.'s experiment. For instance, there was confusion regarding the task that participants had to undertake. Several articles claimed that participants had to press a button or a switch, or that the movement was in reaction to a signal. This may be because the authors of those articles confused Libet et al.'s experiment with later experiments that adapted the initial paradigm. Articles also frequently overestimated how far in advance of W the RP was observed. The onset of RP was often claimed to be 'half a second' (Tallis 2002) before W, even though the average difference between RP and W was 350 ms. The closest measurement to half a second reported within Libet et al.'s paper was 550 ms, which was the difference between the RP and the movement itself. One article also claimed that Libet was the one noting the time on the clock, rather than the participants self-reporting their own perceptions of the timing.

While 58% (46/80) of articles presented Libet et al.'s experiment without any criticism, 43% (34/80) mentioned that there were controversies or disagreements surrounding its methodology or implications:

Actually, there is some debate about whether neural activity really does precede conscious awareness; critics of Benjamin Libet's work point out that

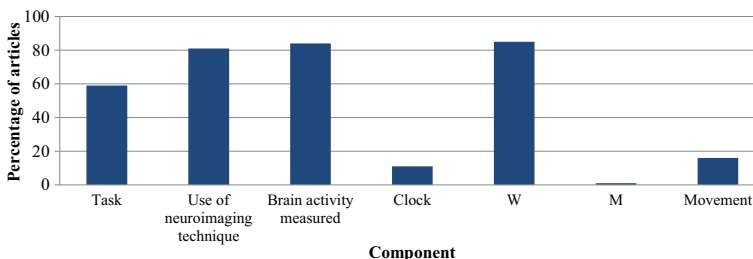


Fig. 3 Components of Libet's methodology and results presented in articles referring to the experiment 69/80 articles provided details about Libet et al.'s (1983) experiment. Of articles referring to the experiment, 47 (59%) mentioned that participants had to move their hand (Task); 65 (81%) mentioned that brain activity was recorded (use of EEG or other neuroimaging technique); 67 (84%) referred to the onset time of RP (brain activity measured); 9 (11%) articles mentioned that participants had to look at a clock to record their timing of W and M (Clock); 68 (85%) articles noted that participants reported the time of their awareness of wanting to move (W); 1 (1%) mentioned that participants reported the time of their awareness of moving (M); 13 (16%) articles reported the time that participants actually moved (Movement)

it may take time for people to turn awareness of a decision into the relatively complex report of it demanded in his experiments. But even if brain activity does come first, this is only at odds with the idea of free will if we believe either in a personality distinct from, and which ought to control, the brain, or conversely that what we observe as our material body describes the totality of who we are, rather than being one manifestation of it (Halliwell 2009).

Twenty-six percent (21/80) of articles presented other neuroscience experiments supporting Libet et al.'s results or conclusions, and 8% (6/80) presented experiments that challenged them. Only one article presented at least one of both. Two articles mentioned that Bengson's experiment (2014) built on Libet et al.'s, but they did not specify whether the results supported or contradicted Libet et al.'s. Experiments such as those by Fried et al. (2011); Haggard et al. (2002); Maeda et al. (2002); and were cited as supporting Libet et al.'s work, whereas experiments such as those by Maye et al. (2007); Schurger et al. (2012); and Trevena and Miller (2010) were said to challenge it. Every article that was cited as supporting Libet et al. except for one was said to challenge free will, while all of the experiments cited as challenging Libet et al. were represented as supporting free will. Some authors made bold claims about the replicability of Libet et al.'s experiment, such as that 'Dr. Libet's results have been reproduced again and again over the years, along with other experiments that suggest that people can be easily fooled when it comes to assuming ownership of their actions' (Overbye 2007).

Media Coverage of Stances on the Existence of Free Will

Stances on Free Will

Claims about the existence of free will were coded depending on their source (Libet, the author of the article, or other sources) and position (challenged/myth, supported/real, or ambiguous). Other sources included scientists (e.g., Daniel Wegner), philosophers (e.g., Daniel Dennett) and groups specified by the authors (e.g., "neuroscientists" or "compatibilists"). Libet and other sources could be quoted directly or indirectly.

Our analysis of the proximal content (Fig. 4a) revealed that 59% (17/29) of the quotes attributed to Benjamin Libet supported the existence of free will, and 34% (10/29) did not. Two of 29 quotes attributed to Benjamin Libet were ambiguous about the existence of free will. Fifteen out of 29 (52%) quotations attributed to Libet mentioned the veto power, and 48% (14/29) did not. All but one of the quotes attributed to Libet supporting free will mentioned the veto power; none of the quotations attributed to Libet that challenged free will mentioned the veto power. Only 2 (7%) articles explicitly noted that Libet's interpretation of his experiment differed from the popular one. Seventy-four percent of the claims attributed to other sources than Libet (29/39) reported that Libet et al.'s experiment challenges free will, 18% (7/39) reported that Libet et al.'s experiment supports it, and 8% (3/39) were ambiguous (e.g., provide pros or cons or it was hard to tell which position they supported) about the experiment's implications for the existence of free will. Sixty-

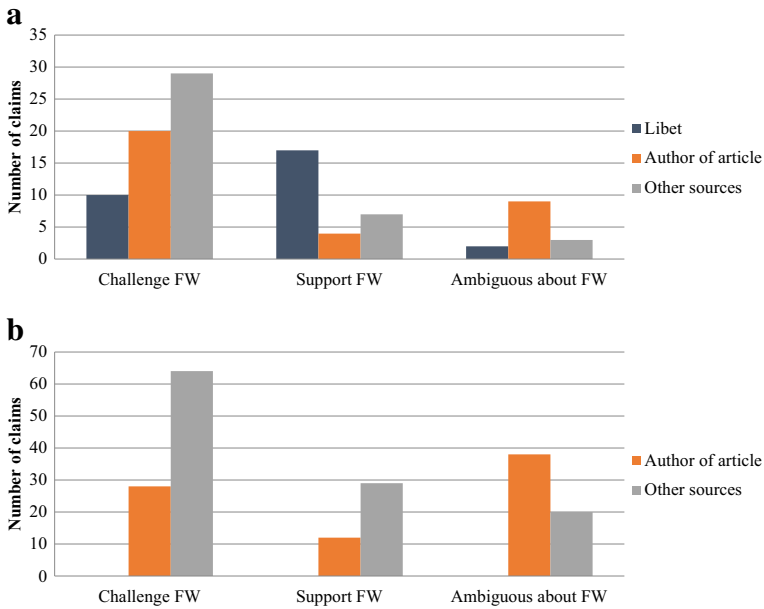


Fig. 4 **a** Proximal content: Number of claims about the impact of Libet's experiment's for stances on free will based on the position(s) reported, and source(s) of claim; **b** Distal content: Number of claims for stances on free will based on the position(s) reported, and source(s) of claim

one percent (20/33) of the articles' authors reported that Libet et al.'s experiment challenges free will, 27% (9/33) were ambiguous about its implications for free will, and 12% (4/33) reported that Libet et al.'s experiment supports free will. Overall, 58% (59/101) of statements regarding the implications of Libet et al.'s experiment claimed that it challenged the existence of free will, 28% (28/101) claimed that it supported free will, and 14% (14/101) were ambiguous about this question.

Analysis of the distal content (Fig. 4b) revealed that 57% (64/113) of the claims attributed to sources other than Libet reported that the existence of free will is challenged, 26% (29/113) reported that the existence of free will is supported and 18% (20/113) of claims attributed to other sources were ambiguous about this question. Moreover, 49% (38/78) of the claims from the authors of the articles were ambiguous, 36% (28/78) challenged the existence of free will, and 15% (12/78) supported the existence of free will. Overall, 48% (92/191) of the distal claims regarding the existence of free will were challenging, 30% (58/191) were ambiguous, and 21% (41/191) were supportive. For illustrative examples of arguments invoked in the discussion about the existence of free will, see Supplementary Table 1.

Definitions of Free Will

Folk Concept of Free Will

The folk concept of free will (how laypersons conceptualize free will in everyday life) was present in 10 (11%) articles. The folk concept of free will was often associated with dualism and was typically portrayed as naïve and simplistic in the media sample. For example, one article described the lack of public understanding about the debate on free will as follows: ‘[l]ay folk might be surprised to hear that there are four views of free will, rather than simply the views that you have it or you don’t’ (Cave 2007). The folk concept of free will was also typically described as being at odds with philosophers’ views, such as ‘eighteenth-century philosophers as George Berkeley and David Hume’ who were described as seeing ‘[t]hese common sense views [about the mind, brain, and behavior] [...] as vulgar’ (Hinrichs 1997). However, one article by Eddy Nahmias (2011) presented the folk concept of free will based on empirical research rather than “armchair” assumptions. According to his own research, most non-philosophers tended to be compatibilists, rather than dualists, and that individuals who do not believe that free will exists may misunderstand determinism.

Importance of Definition

An important theme in our sample discussed the importance of having a definition of free will. Thirteen articles (15%) explicitly noted that there was no clear consensus on its definition and/or made the point that the existence of free will depends on its definition. An example of this viewpoint can be seen in an article in the Guardian, in which it states:

Honderich says philosophers have discussed different definitions of freedom for centuries, one of which is perfectly compatible with the sort of determinism Singer describes. That is, if free action is defined as action caused by your character - whatever hereditary and environmental influences contributed to that character - then you are free even if your brain does resemble that of a slug (Spinney 2004).

Implications of the Free Will Debate

The free will debate was presented as having important implications for many aspects of life including personal/legal responsibility, spirituality/religion, and behavior. This was because:

[u]nlike many other academic questions, free will is central to most people’s conception of themselves and touches almost everything that they value - personal relationships, moral responsibility, law, politics, religion, public, and so on. Abandoning this notion seems to destabilise our thinking in all these areas at once (Harris 2011).

We will explore each of these themes in turn.

Moral Responsibility and Legal System

The implications of the free will debate for moral responsibility and/or the legal system were discussed in 34 (38%) articles. The typical reasoning was that even if free will is an illusion, people are still ultimately responsible for their actions. Arguments positing the value of holding people responsible for their actions were present even in articles where the idea of moral responsibility was challenged. Another theme present in our sample explored how society's attitudes towards criminals would be impacted by these discussions about moral responsibility. A typical discussion of this topic is illustrated in the following quote:

Derk Pereboom recognises that our lack of free will means we need to rethink morality - but sees this as no bad thing. It would, he suggests, lead to sensible reforms, such as shifting the focus of the criminal justice system away from retributive punishment and towards re-education and deterrence - or towards protecting society (Cave 2007).

However, findings from neuroscience experiments were not always portrayed as being relevant to the question of moral responsibility. For example:

[a]s Stephen Morse puts it, neuroscience itself can never identify the mysterious point at which people should be excused from responsibility for their actions because they are not able, in some sense, to control themselves. That question, he suggests, is "moral and ultimately legal," and it must be answered not in laboratories but in courtrooms and legislatures. In other words, we must answer it ourselves (Rosen 2007).

Spirituality and Religion

The implications of the free will debate for spirituality and religion were discussed in 12 articles (13%). Religions were overwhelmingly represented as supporting free will. In the proximal content, the results of Libet et al.'s (1983) experiment were portrayed as being compatible with religious (i.e., Christian and Buddhist) views. For instance, Libet et al.'s description of a veto power and:

[t]he ramifications of this research for moral philosophy [were seen as] extremely enticing, [because if] free will exists chiefly in veto power over spontaneously arising intentions, then it is hardly surprising that so many moral and ethical directives are formulated so as to emphasise the importance of inhibition. Most of the Ten Commandments, for instance, are phrased as prohibitions. Suddenly, it seems, the intentions of Judeo-Christian religion and the findings of neurophysiology are in agreement on the nature of the will (Restak 1988).

Interestingly, neuroscience was overwhelmingly used as evidence to challenge religious doctrines and conventional morality in the distal content. For instance:

[t]he implications for those who accept the biological basis of [decision making (sic)] are huge. Many are tempted to gradually surrender to the chemistry and mechanics of matter our deepest-held view of ourselves as free thinkers and as governable by a divine influence, by the spirit of God. That temptation is troubling, since the more you buy into a materialistic basis for everything, the more you succumb to the restrictions and fate of matter. The future starts to look not only spiritually impoverished but even oppressive (Sentinel 2007).

Consequences of Not Believing in Free Will

Another theme in our sample concerned the behavioral and psychological effects of not believing in free will (7 articles, 8%). In these articles, works such as those by Vohs and Schooler (2008) and Rigoni et al. (2011) were cited. An example of this theme is:

Indeed, free will matters in part because it is a precondition for deserving blame for bad acts and deserving credit for achievements. It also turns out that simply exposing people to scientific claims that free will is an illusion can lead them to misbehave, for instance, cheating more or helping others less. So, it matters whether these scientists are justified in concluding that free will is an illusion (Nahmias 2011).

Other Themes

Consciousness

The theme of consciousness was present in 32 (36%) articles. The idea that humans possess a soul separate from the body was portrayed as antiquated and as having been rejected by both philosophers and scientists. Only 2 (6%) of those articles defended the idea that consciousness is separate from matter. Neuroscience and the findings presented by scientific experiments was presented as, “[t]o some, [representing] yet another blow struck against a concept that has already tumbled a fair distance from its former pedestal—the idea that the human organism operates under the management of something special called “the mind”” (Ross 2011).

Unconsciousness

The topic of unconsciousness was discussed in 31 (35%) articles. The articles described numerous examples where humans acted without conscious awareness, such as somnambulists, athletes reacting subconsciously, or writers “writing in a trance”. Neuroscientific findings that supported the idea that the brain processes information subliminally, as in experiments with comatose patients or with individuals who were blind, were also described. Some articles also mentioned other cases where unconscious processes play a role, as in cases of subliminal messaging or racial bias.

Other Fields of Research

Other fields of research (e.g., artificial intelligence, quantum physics, psychology, philosophy) were mentioned in 35 (39%) articles. This theme highlighted the fact that the problem of free will could be studied by other fields than neuroscience, or that it could be tackled with a multidisciplinary approach. Interdisciplinary fields like neurolaw and neurophilosophy were also mentioned.

Discussion

The existence of free will has been a perennial debate in philosophy. Some believe that works like Libet et al. (1983) provide evidence that empirically invalidates the existence of free will (Haggard 2008; Wegner 2002). However, a recent review of Libet-type experiments suggests a much more nuanced picture (Saigle et al. 2015). Due to mounting evidence that an individual's actions can be altered by his or her belief in free will and because neuroscientific evidence is sometimes regarded to have epistemic priority (Farah and Hook 2013; McCabe and Castel 2008; Weisberg et al. 2008), we undertook a systematic content analysis of print media coverage of Libet et al.'s (1983) experiment. This was used as a case study to examine how neuroscientific evidence is used in debates about free will. Our analysis revealed that the positions presented in print media articles are not unified, and that these articles typically present various arguments that both support and challenge the existence of free will. Libet et al.'s findings were strongly associated with the idea that no form of free will exists. The authors of these articles frequently portrayed Libet et al.'s experiment as disproving free will, and referred to other studies from neuroscience and psychology to support this claim (e.g., Soon et al. 2008; Fried et al. 2011; Haggard et al. 2002). On the other hand, the few articles that referenced Libet et al.'s idea of a "veto power" (Libet et al. 1983) tended to present this experiment as supporting free will. A minority of articles presented criticisms about the experiment's methodology and/or alleged implications for the existence of free will. Interestingly, these were sometimes straw man arguments that contradicted Libet et al.'s own claims about the implication of their study (e.g., Libet 1999). This having been said, it is clear that the print media's interpretation of the Libet et al. (1983) experiment heavily stresses that this work presents a challenge to free will. Also, the press coverage of the study design was minimal. Most articles only briefly mentioned the key features of Libet's experiment (i.e., use of neuroimaging, task, RP and W), and sometimes even included factual errors about the study. A possible explanation for these errors is that authors' were confused by subsequent experiments that adapted Libet et al.'s paradigm with slight alterations (Saigle et al. 2015). Another hypothesis is that the highly technical writing of the original article was inaccessible for some. We further discuss: (1) the determinist interpretation of Libet's experiment; and (2) the possible implications of such strong interpretations.

Understanding Why the Media Interprets Libet et al.'s (1983) Experiment as Supporting Hard Determinism

It is surprising that a significant portion of the media interpreted Libet et al.'s research as strongly supporting hard determinism when (a) it runs contrary to the nuanced views presented in the original paper and (b) given the many aspects of the research paradigm that raise serious questions about scientific and methodological validity (e.g., using RP as precursor signals of actual intentions to act, using retrospective self-report measures as the basis for temporal indicators) (Klemm 2010; Mele 2009; Roskies 2006). For example, Mele argues that readiness potentials alone are not causally sufficient for action and that conscious intentions and other mental states can have enough of a causal role in action to retain the concept of free will (Mele 2014). One possible explanation for why the media presents Libet et al.'s findings as supporting hard determinism could be that some neuroscientists have reinforced this view by relying on dualist accounts of the brain-mind relationship and/or not engaging with relevant conceptual work (Harris 2012). For example, some neuroscientists and cognitive psychologists attribute free will to a soul (Montague 2008), even though this is not a common position among philosophers (Mele 2009). Another reason for these deterministic messages in print media could be that the authors did not pay attention to the messages found in the original paper and simply repeated others' views instead. This would be consistent with the rather minimal reporting about the actual study design, methodology, results, and the inaccuracies about the paper present within some articles. Moreover, media articles rarely focused solely on Libet et al.'s experiment (as exemplified by the fact that only one headline mentioned Libet); references to their findings were only one argument invoked in the broader discussion about the existence of free will. This raises questions about the legitimacy of using singular and influential papers in broader discussions.

In addition to the likelihood that some of these inconsistencies about the Libet et al. study could have resulted from suboptimal reporting practices, it is worth noting that significant credibility has been attributed to the biological discourse about free will. Previous research has shown that strong deterministic and essentialist interpretations of research on free will are present in the media's coverage of other neuroscience research as well (Racine et al. 2010). Racine et al. have previously described that a striking feature of media coverage on neuroscience research is its reliance on neuro-essentialist (i.e., we are our brains) and neuro-realist (i.e., neuroimaging techniques have an epistemic supremacy to reveal the "true" nature of psychological or personal phenomena) interpretations (Racine et al. 2010). Likewise, Morse has argued that strong deterministic interpretations rely on a "brain overclaim syndrome" (Morse 2006), which is a pattern of hyperbolic interpretations of neuroscience research that unjustifiably attributes importance to neuroscience discourse. Consequently, neuroscience is given epistemic supremacy to shed light on controversial metaphysical issues, like free will, above other types of evidence.

Possible Implications of Deterministic Interpretations of Libet et al.'s (1983) Experiment

The ethical and societal implications of a deterministic discourse about the belief in free will have been part of empirical investigations for several decades (e.g., Nettle 1959, 1961; Viney et al. 1982, 1988). Recent research in a range of disciplines has suggested that the belief in free will can be manipulated and cause a range of different behaviors and attitudes. For example, reducing beliefs in free will by presenting evidence that support determinism diminishes self-control (Rigoni et al. 2012) and helping behavior (Krueger et al. 2014), modulates reactions to pain withdrawal (Lynn et al. 2013), cognitive reactions to errors (Rigoni et al. 2013, 2015), and neuronal preparation for motor responses (Rigoni et al. 2011). A reduced belief in free will also increases cheating (Vohs and Schooler 2008), punishment responses (Krueger et al. 2014), and aggressive behavior (Krueger et al. 2014). Moreover, research has suggested that beliefs about free will have important practical implications on ethical or socially desirable or undesirable behavior (e.g., a higher belief in free will predicts better job performance (Stillman et al. 2010).

Given the potential for research on volition to influence beliefs about free will and behaviors, questions surface regarding the ethical responsibility of the researchers who are active in this area. Should researchers who claim to have discovered evidence that could have a broad impact on morally acceptable behavior (e.g., cheating) disseminate them broadly? Some of the leading authors in this area have condemned deterministic discourse about volition in the context of addiction out of the fear that individuals struggling with addiction would be less motivated to seek help if their sense of free will was undermined (Vohs and Baumeister 2009). While a moratorium on the reporting of all results of this nature would not be advisable due to censorship concerns, our results do suggest that authors should be cautious when extrapolating the real-world significance of any individual study, especially when it concerns free will. Furthermore, if scholars wish to use this sort of data to support their positions they should clearly state the position that they favor, rather than claiming that their philosophical conclusions arise from the existing data. As we know that there are many epistemological and methodological challenges that temper strong deterministic interpretations (Banks and Pockett 2007; Morse 2007; Pockett and Miller 2007; Wasserman and Johnston 2014), better self-discipline and moderation from scientists themselves could be useful. That is to say that clear commitments to scientific integrity within research itself is needed before any sweeping claims about the implications of findings can be made. Additionally, more engagement with philosophical scholarship could be advisable for neuroscientists. For example, some important philosophical analyses have indicated that the issue at stake in Libet et al.'s experiments is much less about determinism and more about the lack of mental causation in agency (i.e., mental states do not have an effect). This proposed "causal exclusion problem" highlights the contention that the common interpretation of these experiments appears to exclude the subject and his or her mental state(s) from having a causal role in action (Bayne 2011; Roskies 2006, 2010). If neuroscientists were to have more exposure to different

philosophical interpretations of these problems, it could help further or enrich the analyses of their findings.

Since our results show a tendency for neuroscience research to be interpreted as proof that free will does not exist, we recommend that journalists be more skeptical about such sweeping claims. They should refer to other scholarship, notably from philosophy and the social sciences, to help them critically assess such claims. Furthermore, neuroscientists drawing ethical and philosophical conclusions about the implications of their experiments about the existence of free will should be sufficiently informed about philosophical positions on this topic. All actors involved (journalists, neuroscientists, philosophers) may share a responsibility to inform the public and foster the principles of an enlightened and discursive public sphere (Habermas 1968). However, we do realize that pursuing this responsibility may imply a cultural shift in the incentive structures of some of these stakeholders given the existence of structural challenges in promoting multidirectional communication (Racine et al. 2005) such as the lack of incentive for academics to discuss their research with the public (Illes et al. 2010).

Limitations

Our sample was limited to the results of the Factiva database and exclusively focused on articles containing explicit references to Benjamin Libet. However, other articles may have discussed the neuroscientific debate of free will without mentioning Libet. Furthermore, the small sample prevented us from performing advanced statistics (e.g., to compare the number of claims supporting or challenging free will over the years to see if there is a significant difference).

Conclusion

Libet et al.'s landmark experiment suggested that neuronal activity preceded individuals' awareness of their intention to act. Libet and collaborators suggested that this interpretation could place constraints on certain views of free will, but theorized that a veto power could stop an action that was initiated prior to awareness. Soon after publication, this experiment sparked a number of scientific and philosophical discussions that debated its relevance for the possibility or existence of free will. Due to the popularity of this study in scientific and philosophical discussions about free will, we undertook a systematic content analysis of print media coverage of this study. A significant portion of the print media presents the experiment as affirming the absence of free will. Furthermore, other neuroscience research is often cited to support this stance, despite important methodological challenges about the study design. This strong interpretation against the existence of free will, seen in the media, is potentially due to the authors' lack of attention to these methodological challenges or to an over-confidence in biological discourse about free will. Such strong deterministic interpretations could lead to problematic societal implications given the effects of deterministic discourse on attitudes and behaviors.

We recommend that individuals ensure that they are faithfully reporting the results of studies rather than interpretations attributed to them by others.

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Compliance with Ethical Standards

Conflict of interest None to declare.

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