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Review

Brain signals do not demonstrate unconscious decision making: An interpretation based on graded conscious awareness

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ABSTRACT

Neuroscientific studies have shown that brain activity correlated with a decision to move can be observed before a person reports being consciously aware of having made that decision (e.g., Libet, Gleason, Wright, & Pearl, 1983; Soon, Brass, Heinze, & Haynes, 2008). Given that a later event (i.e., conscious awareness) cannot cause an earlier one (i.e., decision-related brain activity), such results have been interpreted as evidence that decisions are made unconsciously (e.g., Libet, 1985). We argue that this interpretation depends upon an all-or-none view of consciousness, and we offer an alternative interpretation of the early decision-related brain activity based on models in which conscious awareness of the decision to move develops gradually up to the level of a reporting criterion. Under this interpretation, the early brain activity reflects sub-criterion levels of awareness rather than complete absence of awareness and thus does not suggest that decisions are made unconsciously.

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0. Introduction

One of the oldest unsolved problems in the philosophy of science concerns the relationship between the mind and the brain (e.g., Baars & Gage, 2010; Dehaene, 2001; Gregory, 2004; Metzinger, 2000; Milner & Rugg, 1992; Rees, Kreiman, & Koch, 2002). Naturally, new insights into this relationship would be expected from studies exploiting the massive recent technological advances in the neurosciences. What may be surprising to many, however, is the conclusion commonly drawn from these studies—namely, that decisions to initiate a movement are actually made unconsciously and merely "bubble up" subsequently into consciousness. As is described in detail in the next section, the evidence supporting this view is that brain

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activity associated with decision making begins before a person reports being consciously aware of having made that decision. One interpretation of this evidence is that our subjective impression of initiating decisions through an extended process of conscious deliberation is mostly an illusion—the brain has already done it before we are even aware of it—and the conscious part of intention formation is largely epiphenomenal (e.g., Libet, Gleason, Wright, & Pearl, 1983; Soon, Brass, Heinze, & Haynes, 2008; for reviews see Libet 1985, Pockett 2004, Roskies 2006, 2010 and Wegner 2002). At most, consciousness is thought to be involved in vetoing these subconsciously-generated decisions (Libet, 1985); that is, although the decision itself evolved unconsciously, its overt execution may later be consciously inhibited (but see Filevich, Kühn, & Haggard, 2013 for evidence that veto decisions are also made unconsciously). This idea of unconscious decision making is regarded by many as one of the most important contributions of recent neuroscientific work, not least because it seems incompatible with free will and thus to have far-reaching political and social implications (e.g., Lavazza & De Caro, 2010; Roskies, 2010).

The thesis that decisions to move are made unconsciously has been quite controversial among both neuroscientists and philosophers (e.g., Klemm, 2010; Lavazza & De Caro, 2010; Radder & Meynen, 2013). Critics within the neuroscience community have tended to highlight specific methodological weaknesses of the key studies (e.g., Breitmeyer, 1985; Haggard & Eimer, 1999; Joordens, Spalek, Razmy, & Van Duijn, 2004; Miller, Shepherdson, & Trevena, 2011; Näätänen, 1985; Ringo, 1985; Trevena & Miller, 2002, 2013; Van de Grind, 2002; and many of the commentaries following Libet, 1985). Philosophers have generally questioned implicit assumptions about the nature of the underlying decision-making processes and claims that the reported biological measures must index them (e.g., Mele, 2009; Radder & Meynen, 2013; Smith, 2011).

In this article we develop a further critique of the idea that neurobiological findings support unconscious decision making. Specifically, we focus on the claim that people are not conscious of their decision-making activity when the associated brain activity begins. We argue that this claim is based on a simplistic, all-or-none view of consciousness that is quite implausible in the light of considerable evidence, as is reviewed below, that consciousness develops in a graded manner instead. We conclude that existing neurobiological findings do not provide strong support for the idea of unconscious decision making and that they cannot do so without much more nuanced measures of conscious awareness.

In Section 1 we briefly summarize two example neurobiological mind-brain studies that have been interpreted as support for the conclusion of unconscious decision making. Although these studies are superficially rather different, they provide fundamentally the same type of evidence for that conclusion. Moreover, the inferences of both studies rest in the same way on a strict all-or-none notion of conscious awareness (Fahle, Stemmler, & Spang, 2011).

In Section 2, we review current theories of decision making, all of which are based on the idea of a graded evidence-accumulation process. We summarize diverse sources of empirical evidence and theoretical precedents supporting this graded view and suggest that—in light of them—it is quite plausible that people's decisions about their own conscious states—like all other decisions—also involve a graded accumulation process.

Finally, in Section 3 we revisit the results of the neurobiological studies used to argue for unconscious decision making and show that they can be interpreted quite differently if conscious awareness is conceptualized as graded rather than all-or-none. Our overall conclusion, then, is that current neurobiological findings do not unequivocally demonstrate unconscious decision making but instead may be quite compatible with people's subjective impressions that they reach decisions through a process of conscious deliberation.

1. Neurobiological evidence for an epiphenomenal view of consciousness

In a seminal study of the relation between brain activity and conscious decision making, Libet et al. (1983) asked their participants to execute a free voluntary motor act—a brisk, abrupt flexion of the right wrist or fingers. The participants were instructed to let the urge to act appear on its own at any time, without preplanning. They were also told to monitor a revolving clock, and to note and later report the time W—the earliest appearance of a conscious awareness of the specific urge, intention, decision or "wanting" to move. Libet et al. (1983) recorded the readiness potential (RP) as well as the electromyogram (EMG) at the activated forearm muscle. The basic finding, idealized in Fig. 1A, was that the onset of the RP preceded the reported time W by hundreds of milliseconds. Libet et al. (1983) concluded that "the brain evidently decides to initiate [...] the act at a time before there is any reportable subjective awareness that such a decision has taken place", and that the "cerebral initiation even of a spontaneous voluntary act [...] can and usually does begin unconsciously" (p. 640), and others have similarly interpreted Libet et al.'s findings as evidence that "no role appears for conscious processes in the control of action" (Obhi & Haggard, 2004, p. 360). Later, Libet (1985) acknowledged that conscious processes "could still have a role either in completing the initiating process ('conscious trigger') or in blocking its progression ('veto')" (p. 536), but he never wavered from his main message that "the initiation of a voluntary act occurs *unconsciously,* before a subject is aware of the wish or urge to act" (Libet, 2003, p. 327, italics in original).

In a recent and conceptually very similar study addressing the same fundamental issue, Soon et al. (2008) asked participants to freely decide, when they felt the urge to do so, between pushing a button with the left or right index finger; at the same time, their brain activity was measured using functional magnetic resonance imaging (fMRI). A sequence of letters was visually presented with a stimulus onset asynchrony of 500 ms, and participants had to remember and later report the letter shown at the moment when their motor decision was consciously made. The authors identified frontopolar and parietal brain regions whose measured activation contained significant predictive information about the identity and timing of the response several seconds before the onsets of the letters that participants reported as having been present when they