



Lost in time... The search for intentions and Readiness Potentials



Ceci Verbaarschot*, Jason Farquhar, Pim Haselager

Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, The Netherlands

ARTICLE INFO

Article history:

Received 15 October 2014

Keywords:

EEG
Intention
Readiness Potential
Voluntary action

ABSTRACT

In 1983 Libet et al. found that the Readiness Potential (RP) precedes the intention to act by 350 ms and the actual movement by 500 ms on average. Using our own replication study, we illustrate how seemingly innocuous technical details are actually crucially relevant to the debate surrounding the interpretation of Libet-style experiments. For instance, using one specific method for determining the RP onset actually led to a reversal of Libet's results (i.e., the intention *preceded* the RP onset) for one of the participants. Claims regarding the causal relation between RP and intention cannot be based on averages, but require individual, case by case analyses, which show no exceptions in the temporal relation between RP and intention. We conclude that, properly speaking, Libet-style results in themselves cannot yet be taken as proof for the type of conclusions that are often formulated regarding the non-existence of free will.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

In 1983 Libet et al. measured the brain activity of six participants using EEG (electroencephalography) while they were performing voluntary movements with their right hand. While making these movements, the participants watched a clock and had to report the time at which they first felt their intention to act. Libet et al. used the Readiness Potential (RP) as an indicator of the neural preparation for a voluntary movement and found that the RP preceded the intention to act by 350 ms and the actual movement by 500 ms on average. This implied, according to Libet et al., that the experience of consciously willing an act arises *after* our brain has already started preparing that act.

A major reason for the substantial interest in Libet-style experiments derives from the possibility that our conscious intentions or decisions to act follow from brain processes of which we are not aware, and hence that our will or decisions are not 'free'. For instance, [Libet \(2004\)](#) says:

Establishing the time of the conscious will relative to the onset of brain activity (the RP) was clearly important. If conscious will were to follow the onset of the RP, that would have a fundamental impact on how we view free will. (p. 125)

[Spence \(1996\)](#) says:

If the findings of Libet and co-workers are replicated, then we must conclude that 'decisions' to act arise prior to our conscious awareness of them. Thus our 'decision' or 'freedom' is illusory (if by these terms we mean conscious phenomena). (pp. 83–84).

* Corresponding author at: Center for Cognition, Donders Institute for Brain, Cognition and Behaviour, Radboud University, PO Box 9104, 6500 HE Nijmegen, The Netherlands.

E-mail address: c.verbaarschot@donders.ru.nl (C. Verbaarschot).

Given these suggested implications, it is understandable that the empirical findings caused excitement in different branches of cognitive science, which resulted in a great number of reinterpretations (Dennett, 2003; Mele, 2010; Rosenthal, 2002) and replications (Haggard & Eimer, 1999; Keller & Heckhausen, 1990; Trevena & Miller, 2002). Even up to this day, many variants of the Libet experiment are being published (Bode, Bogler, Soon, & Haynes, 2012; Fried, Mukamel, & Kreiman, 2011; Matsushashi & Hallett, 2008; Schurger, Sitt, & Dehaene, 2012; Soon, Brass, Heinze, & Haynes, 2008).

The debate about RPs and the implications for the causal efficacy and freedom of conscious will is difficult in part because of the technical issues regarding the RP measurements, and the conceptual complexity when defining the nature of 'an intention'. There is considerable variation in terminology as to what the participant is asked to do in the experiment: whereas Libet, Gleason, Wright, and Pearl (1983) asked for a report of the onset of the *conscious awareness of wanting* to perform a given self-initiated movement, Soon et al. (2008) asked to report the onset of the *urge* to act and Trevena and Miller (2002) asked for a report of *the instant of the decision to "go now"*. In our experiment, we asked our participants to report the onset of their *intention* to act (i.e., the moment in time at which they became aware that they wanted to perform an act). This makes it difficult to establish exactly what the implications of the acquired data are. This indicates that the conceptual interpretation of Libet-style experiments can be seen as quite variable or 'soft'. As more often in cognitive neuroscience, the issue of 'hard data and soft concepts' presents a serious obstacle to reach a consensus in the field, in spite, or perhaps even because of a growing number of empirical studies. However, even speaking of 'hard data' might be saying too much in the case of Libet-type experiments.

Although there are a growing number of replications of Libet's experiment, upon closer examination the exactness of the measurements is open to discussion, which is especially relevant when one takes into account the requirements for establishing a causal relationship between an RP and an act. In order to calculate the RP onset, several manipulations such as averaging and filtering are necessary. These preprocessing steps are commonly found in the literature on Libet-type experiments (Haggard & Eimer, 1999; Libet et al., 1983; Matsushashi & Hallett, 2008; Trevena & Miller, 2002) and seem to be minor technical details in the analysis of EEG data. However, each of these manipulations has its implications for the data, e.g. resulting in a shift of the RP onset forward or backward in time (Trevena & Miller, 2002). Furthermore, getting a reliable estimate of the onset of the intention to act is quite a challenge due to the differences in the participant's understanding of what an intention is and what they need to do and report, as indicated above. In Libet's experiment (and in ours), we are not measuring the actual intention to act but the subjective *report* of this intention. All this makes the theoretical interpretation of the relation between the RP in the supplementary motor cortex and its interpretation in cognitive terminology (i.e., intention, urge, will, decision or even action preparation) quite ambiguous. We would therefore like to suggest that debates about Libet-style experiments are plagued by the problem of 'semi-hard data and soft concepts'.

In this article, we present our own replication of Libet's experiment and use it to illustrate how technical and conceptual issues can influence establishing whether the RP reliably and consistently precedes the intention to act. We will focus on two points that (to our knowledge) have not been addressed in the literature. First of all, by comparing the results of three different ways of measuring the onset of the RP, in combination with three different sets of electrodes used to measure the RP, one can notice large differences in RP–intention timings. For instance, RP timing differences within one user can be found to vary from –898 ms to as little as –47 ms. Although the general order found in Libet's results (first RP then awareness) is replicated, the data are not quite as 'hard' as one may think. Differences in individual participants are obscured when looking at the grand average over all participants (as done in previous research). For instance, although the RP precedes the intention to act in the grand average, we found the opposite pattern of results in one participant (participant 5): the intention actually *preceded* the RP onset. We will discuss the consequences this may have for the interpretation of the data in terms of a causal relationship between the RP and an intended act. Secondly, although we indicate there are several reasons to believe that the 'inverted results' of participant 5 are not valid, we take it up as a thought experiment. Imagine one would find a participant whose intentions would reliably precede the RP, how is one to interpret such a case? Should one be forced to conclude that here we have a case of a causally efficacious consciousness, or even a 'soul' or 'res cogitans'? By examining the Libet experiment with such a hypothetical case we aim to elucidate the debates on the freedom and causal efficacy of conscious will.

In Section 2, we will first go into more detail on the background of our project. Sections 3–5 will describe our replication study and Section 6 illustrates how seemingly minor technical details can greatly influence the reliability and consistency of the time relation between the RP and intention. Section 7 will aim to elucidate the debate on the existence of free will and the causal efficacy of conscious will by discussing the consequences of finding a participant which intention onset precedes their RP onset (as found in our replication study). We will point out that Libet-style results are not as 'hard' as one might have thought and cannot yet be taken as proof for the type of conclusions that are often formulated regarding the non-existence of free will. What possible type of relation the RP has with the act, will be discussed in Section 8.

2. Background

Research in cognitive neuroscience (CNS) often encounters difficulties that could be characterized by the phrase 'hard data, soft concepts'. Despite a plethora of increasingly detailed and sophisticated measurements of brain activity ('hard data'), their relationship with the cognitive processes of interest often is a continuous matter of debate, due to the potential variation in meaning of the cognitive terminology ('soft concepts'). This issue is especially prominent in research concerning

Download English Version:

<https://daneshyari.com/en/article/7289563>

Download Persian Version:

<https://daneshyari.com/article/7289563>

[Daneshyari.com](https://daneshyari.com)