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Unravelling intention: Distal intentions increase the subjective sense of agency

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ABSTRACT

Experimental studies investigating the contribution of conscious intention to the generation of a sense of agency for one's own actions tend to rely upon a narrow definition of intention. Often it is operationalized as the conscious sensation of wanting to move right before movement. Existing results and discussion are therefore missing crucial aspects of intentions, namely intention as the conscious sensation of wanting to move in advance of the movement. In the present experiment we used an intentional binding paradigm, in which we distinguished between immediate (proximal) intention, as usually investigated, and longer standing (distal) intention. The results showed that the binding effect was significantly enhanced for distal intentions compared to proximal intentions, indicating that the former leads to stronger sense of agency. Our finding provides empirical support for a crucial distinction between at least two types of intention when addressing the efficacy of conscious intentions.

1. Introduction

The sense of agency (SoA) is the on-going subjective experience of being in control of our own actions. The SoA is typically explained in terms of a predictive coding model utilising comparison between the predicted and actual sensory feedback resulting from an action (Blakemore, Wolpert, & Frith, 2000; Wolpert & Flanagan, 2001). On this account, voluntary actions generate efferent motor commands, which in addition to causing the intended bodily action generate an "efference copy" signal, utilised in the construction of a forward model predicting the sensory consequences of that performed action. When there is correspondence between the internal model and actual sensory feedback signals, the SoA is maintained.

The observation that the SoA depends upon consistency between the internal model and action outcome has been used to experimentally generate a "false" SoA: subjects will experience themselves as the author of an outcome despite having no actual influence over the event, as long as there is a spatial–temporal correspondence between the intention and the outcome (Engbert & Wohlschläger, 2007; Engbert, Wohlschläger, & Haggard, 2008; Kühn & Brass, 2009; Moore, Wegner, & Haggard, 2009; Wegner & Wheatley, 1999). Such findings have been used to challenge the common-sense notion of free will; that is assuming conscious intention is the causal origin of actions (Wegner, 2002), and has led some researchers to conclude that the experience of intention is mainly a post hoc retrospective inference based on the observed effects of one's own movements (Banks & Isham, 2009; Wegner & Wheatley, 1999).

Experimental studies investigating voluntary action often conceptualise intention as the experience of wanting to perform an action immediately before this action. This is however only a small part of what the concept of intention denotes,

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and we can theoretically distinguish between different kinds of intention with respect to various factors such as temporal features, content, consistency or context (Brass & Haggard, 2008; Pacherie, 2008; Pacherie & Haggard, 2010). When considering the causal efficacy of intention, we need to take these different meanings of intention into account. First, in order to test whether the theoretical distinctions can be empirical verified and then in order to investigate whether different kind of intentions have different functional roles in action generation and in relation to SoA. In the present study we address this issue by distinguishing between *proximal* intentions related to the immediate execution of action, and *distal* intentions, i.e. intentions about actions to be performed at a later point in time (Mele, 2010; Pacherie, 2008; Searle, 1980). Using this terminology, we see that most experimental investigations of intentions and SoA investigate only proximal intentions neglecting the longer-duration distal intentions.

A common quantitative measure of SoA is the intentional binding paradigm (Moore & Obhi, 2012). Intentional binding refers to conditions in which an action, usually a finger movement or a keypress, is followed by an auditory tone. When the action is voluntary, the perceived interval between the two events is shortened, compared to non-voluntary actions (Haggard & Clark, 2003; Haggard, Clark, & Kalogeras, 2002). The perceived time of the press is shifted forward in time toward the tone and the perceived time of the tone is shifted backwards toward the press. The assumption is that the closer the press and tone is perceived the stronger is the SoA.

The aim of the present experiment is to investigate whether difference between when the intention to act is either proximal or distal entails differences in SoA, using an intentional binding paradigm. How SoA is affected when it is the intention that is moved backwards and the action kept constant have, to our knowledge, not been tested before.

2. Material and methods

2.1. Participants

Eighteen healthy participants (11 females) volunteered to participate in the experiment. Their age ranged from 21 to 35 years (mean-age = 24.1 years). All participants gave their written consent before participating and received payment of 150 DKK for participating. The experiment took approximately 1.5 h. The experiment was conducted in accordance with the Declaration of Helsinki and approved by the local ethics committee.

2.2. Experimental design

The experiment utilised an intentional binding paradigm (Haggard et al., 2002; Moore & Obhi, 2012), in which participants face a Libet-style clock face (Libet, Wright, & Gleason, 1982), which they use to time and report events and awareness of action. Participants had to press a key at random times in a self-paced manner. When the key was pressed, a tone would be presented after a 250 ms delay. The clock continued running in a random interval of 600–1000 ms after the last event, and then stop. Afterwards the participants had to report the position of the clock, by directing the clock to the same location where they perceived the tone or the press, depending on the instruction.

While the clock was running, letters were shown in the centre of the clock. The letters consisted of 17 consonants shown one at a time with duration of 500 ms per letter, in a pseudo-random order, which ensured one particular letter would reappear within a range of 3–8 letters (1.5–4 s).

2.3. Procedure

The experiment had seven different conditions, divided into two types of target conditions; proximal intentional conditions and distal intentional conditions, where actions are followed by a tone (see Fig. 1), and three baseline conditions where only action or a tone occurs (see Table 1). The order of conditions was randomized. The conditions ran in blocks consisting of 40 repetitions. Each block was preceded by five training trials to accustom participants to the specific instructions for the upcoming block. Participants were instructed to fix their gaze at the letters in the middle of the clock during all conditions.

2.3.1. Proximal intention condition

Proximal intention conditions were similar to previous experiments using intentional binding (see Moore & Obhi, 2012). Participants monitored the clock and pressed the button as soon as they felt the intention to do so. Each keypress was followed by an auditory tone after 250 ms. After each trial participants had to report either the experienced time of the press or the tone. During the task participant were instructed to monitor the letters in the middle of the clock as well, even though they did not use the letters in this condition.

2.3.2. Distal intention condition

In the distal intention conditions subjects were required to monitor the clock and form an intention (similar to the proximal intention condition), but instead of pressing the button as soon as they have the intention, they only had to notice the letter in the middle of the clock, then wait until the same letter appeared again, and then press the key. In this manner the delay between when an intention is formed and the execution of the action always fell within a range of 1.5–4 s. The press