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Brief article

When errors do not matter: Weakening belief in intentional control impairs cognitive reaction to errors

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ABSTRACT

The belief that one can exert intentional control over behavior is deeply rooted in virtually all human beings. It has been shown that weakening such belief – e.g. by exposure to 'anti-free will' messages – can lead people to display antisocial tendencies. We propose that this cursory and irresponsible behavior may be facilitated by a breakdown of neurocognitive mechanisms underlying behavioral adjustments. In the study reported here, we tested the hypothesis that weakening belief in intentional control reduces cognitive markers of behavioral control. Participants performed a Simon task before and after reading a scientific text either denying free will (no-free will group) or not mentioning free will (control group). Results showed that the post-error slowing, a cognitive marker of performance adjustment, was reduced in the no-free will group. This reduction was proportional to a decrease of the belief in intentional control. These observations indicate that weakening the belief in free will can impact behavioral adjustment after an error, and could be the cause of antisocial and irresponsible behavior.

1. Introduction

In many everyday-life situations we evaluate the impact of our actions and adjust them according to external constraints, such as environmental changes, or internal states, such as desires and intentions. This capacity to exert voluntary control over behavior is crucial for the adaptation to the external environment and also for successful interactions with other individuals (Baumeister, Crescioni, & Alquist, 2011). Empirical data support the idea that the belief that we can voluntarily control our behavior is a biological need and is adaptive for survival (for an overview see Leotti, Iyengar, & Ochsner, 2010).

Belief in intentional control can be weakened after exposing individuals to deterministic messages that deny free will (Baumeister, Masicampo, & DeWall, 2009; Rigoni, Kühn, Gaudino, Sartori, & Brass, 2012; Rigoni, Kühn, Sartori, & Brass, 2011; Vohs & Schooler, 2008). Empirical observations from social psychology also show that reducing belief in intentional control can have negative effects on the way people behave, namely by reducing pro-social and altruistic attitudes and by increasing antisocial and aggressive behavior (Baumeister et al., 2009; Vohs & Schooler, 2008). It has been proposed that a loss of self-control – i.e. the capacity to override one's impulses (Baumeister, Bratslavsky, Muraven, & Tice, 1998) – plays a crucial role in leading to such behavioral changes (Baumeister et al., 2009; Rigoni et al., 2012). More specifically, the exposure to a deterministic message would weaken people's motivation to exert self-control. Since self-control requires individuals to make an effort and spend energy, as

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indicated by increased blood glucose level (Gailliot & Baumeister, 2007; Gailliot et al., 2007), a lack of motivation would lead people to go for more automatic and impulsive courses of action (Baumeister et al., 2009).

Recently, a novel approach has been proposed to assess which parts of the information processing chain are affected by the belief manipulation (Rigoni et al., 2011, 2012). This research investigates how basic neurocognitive processes underlying voluntary behavior are affected by whether people believe they can exert intentional control. It has been found that the Readiness Potential, a neurophysiological marker of intentional action preparation, can be reduced when people are led to disbelieve in free will (Rigoni et al., 2011). Disbelieving in free will also reduces voluntary motor inhibition and the feeling of having deliberate control over a motor action (Rigoni et al., 2012). Taken together, these findings suggest that it is possible to reduce individuals' belief in intentional control, and that weakening belief in intentional control may lead to a degradation of basic motor processes underlying voluntary actions.

Here we present an experiment in which we tested whether reducing belief in intentional control can affect a specific aspect of intentional control, namely action monitoring. Action monitoring can be described as the ability to evaluate the adequacy and success of a performance (see Ridderinkhof, van den Wildenberg, Segalowitz, and Carter (2004) for an overview). How people retrospectively evaluate their actions is crucial to determine future behavior, as well as whether they feel responsible for the consequences of their behavior. Irresponsible and impulsive behavior following exposure to anti-free will messages may result from a breakdown in the evaluation of the consequences of behavior. Since dismissing intentional control leads to cursory and irresponsible behavior (Baumeister et al., 2009; Vohs & Schooler, 2008) and to less intentional involvement in the task (2012; Rigoni et al., 2011), we wanted to test whether monitoring of action effects is reduced by exposure to anti-free will messages.

Experimentally, action monitoring is often investigated by use of conflict tasks (e.g. Stroop task, Simon task, Eriksen-flanker task). For instance, in the Simon task (see Simon, 1990 for a review) participants respond with left- or right-hand key press according to the color of a stimulus presented either on the left or on the right of a fixation point. A conflict occurs when response and stimulus location are incongruent, e.g. when a stimulus that requires a right-hand response is presented on the left of the fixation point. In these tasks, action monitoring processes can be assessed by studying "sequential effects", that is, how performance on trial n is affected by the performance on trial $n-1$. While large sequential effects reflect, at least partly, an appropriate action monitoring (Kerns et al., 2004), absent or diminished sequential effects reveals a degraded action monitoring. For instance, after an error subjects are typically slower (Rabbitt, 1966). This post-error slowing effect indicates a reaction to an error and is thought to partially reflect involvement of control processes (Botvinick, Braver, Barch, Carter, & Cohen, 2001; but see Notebaert et al., 2009). Thus, a large post-error slowing reflects an appropriate action monitoring (Kerns et al. 2004), whereas absent or diminished post-error slowing reveals a degraded action monitoring. Diminished post-error slowing has been observed in patients with schizophrenia (Alain, McNeely, He, Christensen, & West, 2002; Carter, MacDonald, Ross, & Stenger, 2001; Kerns et al., 2005), children with ADHD disorder (Jonkman, van Melis, Kemner, & Markus, 2007; Schachar et al., 2004; Sergeant & van der Meere, 1988; Wiersema, van der Meere, & Roeyers, 2005), whereas one study reported an increased post-error slowing in obsessive–compulsive patients (Fitzgerald et al., 2005; but see Hajcak & Simons, 2002).

Taken together, these findings suggest that processes underlying behavioral adjustment may be disrupted in clinical conditions where intentional control is impaired. Our main prediction is that exposing participants to an anti-free will message that weakens the role of intentional control will impair action monitoring processes. We expect that the reduction of action monitoring mechanisms will be associated with a decrease in the belief in intentional control. To measure the belief in intentional control, we employed the Free Will and Determinism-Plus scale (FAD-Plus; Paulhus & Carey, 2011). The FAD-Plus includes items concerning distinct aspects of beliefs about intentional control, such as beliefs in free will ("*People have complete control over decisions they make*"), scientific ("*As with other animals, human behavior always follows the laws of nature*") as well as fatalistic determinism ("*Fate already has a plan for everyone*"), and unpredictability of human behavior ("*What happens to people is a matter of chance*").

2. Method

2.1. Participants

Forty-four university students (30 females, 14 males), aged 18–32 years ($M = 21.7 \pm 2.8$) volunteered for this experiment, provided informed consent, and were paid 15 euros for participation. The study was conducted according to the Declaration of Helsinki and was approved by the local ethic committee of Aix-Marseille I University, and by the "Comité de Protection des Personnes Sud Méditerranée 1" (number 10 41).

2.2. Experimental design and procedure

The experimental design was divided in a baseline and a post-manipulation session. Further details on the experimental procedure, the task, and ancillary self-report measures are reported in the supplementary material.

2.2.1. Baseline session

First, each participant completed at home the FAD-Plus (Paulhus & Carey, 2011), that measures the belief in intentional control. This scale is composed by 27 Likert-type items (scores ranging from 1 = totally disagree, to 5 = totally agree) and includes 4 subscales (Free Will, Scientific Determinism, Fatalistic Determinism, and Randomness). At least one week after, an experimental session was organized for each participant in the laboratory. Participants first completed the Positive and Negative Affective