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Limits of control: The effects of uncontrollability experiences on the efficiency of attentional control

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ABSTRACT

Two experiments were conducted to explore the effects of experiencing uncontrollability on the efficiency of attentional control. The experience of uncontrollability was induced either by unsolvable tasks (Experiment 1) or by tasks in which non-contingent feedback was provided (Experiment 2). A version of the *Attentional Network Test-Interactions* with an additional measure of vigilance (ANTI-V) was used to evaluate the efficiency of the attentional networks (i.e., alerting, orienting, and executive). Results of both experiments revealed a decreased efficiency of executive attention in participants who experienced stable control deprivation but no negative effects in participants who were able to restore their sense of previously deprived control. Additionally, when participants were asked to perform unsolvable tasks and did not receive feedback (Experiment 1), detrimental effects on the orienting network and vigilance were observed. The motivational and cognitive mechanisms underlying the effects of various uncontrollability experiences on conflict resolution and attentional control are discussed.

1. Introduction

The human natural inclination to perceive oneself as having personal control and a sense of agency has been considered as a basic form of motivation (Bandura, 1977; DeCharms, 1968; Skinner, 1996; Thompson, 1981; White, 1959). The lack or decline of this subjective sense of control may restrict individuals' objective cognitive abilities, efficiency, or resources available to perform successful actions. One strand of research on the effects of control deprivation on cognitive performance has shown that prolonged cognitive engagement in effortful problem solving without success can lead to a state described as cognitive exhaustion (Kofta, 1993; Sedek & Kofta, 1990). This, in turn, impairs individuals' ability to select and integrate incoming information into meaningful cognitive structures or mental models and diminishes their efficiency in dealing with incongruent and often conflictive pieces of information (in terms of incoming stimuli and the contrast between the expected effects of certain actions and their actual outcomes) (Kofta, 1993; Kofta & Sedek, 1999; von Hecker & Sedek, 1999). In addition, preliminary evidence from a dual task paradigm suggests that control deprivation may also affect attentional selection processes (Kofta & Sedek, 1998). Therefore, it seems plausible to hypothesize that the function impaired by uncontrollability experiences is attentional control. A different strand of research has suggested that an experience of control deprivation may also have positive effects on individuals' cognitive efficiency. For instance, Wortman and Brehm (1975) suggested that short periods of control deprivation may actually enhance the efficiency of cognitive processes, whereas prolonged experiences of lack of control can lead to cognitive impairment, as predicted by the learned helplessness theory (Seligman, 1975). As hypothesized, short-lasting uncontrollability experiences have been found to lead to an increased tendency to engage in attribution processes, systematic information processing, and more accurate problem-solving strategies (Mikulincer, Kedem, & Zikha-Segal, 1989; Pittman & D'Agostino, 1989; Pittman & Pittman, 1980). In other words, the nature of the uncontrollability effects on cognitive processes seems to depend on time and on the type and intensity of the uncontrollability experiences. Accordingly, it is plausible to consider that an unstable and temporary state of uncontrollability may restore or even enhance the efficiency of attentional control. It should be noted that research on the impact of uncontrollability on attention is scarce and the functioning of attentional control after various uncontrollability experiences has not been directly explored yet. Nevertheless, the literature seems to suggest that subjective experiences of control deprivation may put an additional load on top-down, endogenous attentional control, understood as the ability to deal with incongruent and often conflictive pieces of information (mainly

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between one's goals or the contrast between the expected effects of certain actions and their actual outcomes; Kofta & Sedek, 1999).

There are several premises supporting the idea of interrelatedness between the experience of personal control and the efficiency of attentional control. One set of premises can be derived from studies on executive attention or executive control (Posner & DiGirolamo, 2000; Posner & Petersen, 1990). First, executive attention is supposed to underlie performance monitoring, which helps to achieve an expected level of accuracy or to achieve one's goals by intensifying attentional control when it is necessary to correct inefficient actions or ineffective strategies (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001). Therefore, exposure to unsolvable tasks or incongruent situational demands should directly affect the intensity of conflict monitoring and the efficiency of attentional control. Second, several authors have argued that executive attention underlies or even determines voluntary control and self-control, in terms of cognitive as well as emotional and motivational (e.g. self-regulation) processes (Derryberry, 2002; Posner, 2012; Posner, Rothbart, Sheese, & Tang, 2007).[1] Third, it has been shown that personal experiences related to a sense of powerlessness (understood as lack of control in a social context) impair executive functions such as updating and inhibition (Smith, Jostman, Galinsky, & van Dijk, 2008), decrease the ability to avoid distractors and focus on goal-relevant information (Guinote, 2007), and reduce the efficiency of using spatial orienting cues to improve executive control (Willis, Rodríguez-Bailón, & Lupiáñez, 2011). These results could therefore lead to analogous predictions of detrimental effects of control deprivation on executive attention. However, this analogy should be taken with caution since, as reported earlier, short-term control deprivation experiences may activate reactance-based motivational mechanisms that can also lead to improved performance (Pittman & D'Agostino, 1989).

In the present study, two experiments were conducted to explore the relationship between the experience of subjective control and the behavioral efficiency of attentional control. On the one hand, the experience of stable lack of any personal control (i.e., the sense of uncontrollability) may temporarily reduce the efficiency of executive attention, decreasing individuals' ability to distinguish relevant from irrelevant information (i.e., an impaired filtering of signal from noise). On the other hand, if control deprivation indeed impairs executive attention, an experience of subsequent control restoration may act as a positive signal of the possibility to restore lost subjective control by engaging executive attention and thus significantly improve performance. Accordingly, we expected a stable experience of control deprivation to lead to deficits in attentional control (Hypothesis 1); by contrast, we expected a control deprivation experience followed by control restoration to be cognitively stimulating, preventing such deficits and even leading to improved efficiency of attentional control (Hypothesis 2).

Our hypotheses focused primarily on the effects of control deprivation on executive attention, defined in terms of Posner's three attentional networks theory (executive, orienting, and alerting networks) as the ability to resolve conflicts or interferences and regulate ongoing actions, thoughts, and feelings (Petersen & Posner, 2012; Posner & Rothbart, 2007). Accordingly, we measured the efficiency of executive attention using a modified version of the Attention Network Test (ANT; Fan et al., 2002; MacLeod et al., 2010). This version provides not only a standard measure of executive control, spatial orienting, and phasic alertness but also a measure of tonic alertness or vigilance, that is, the ability to self-sustain mindful readiness to detect rare and irregularly occurring stimuli (Posner & Petersen, 1990; Robertson & O'Connell, 2010). This task was developed by Roca, Castro, López-Ramón, and Lupiáñez (2011) and is called ANTI — Vigilance (ANTI-V). We considered that the differentiation between these four relatively independent functions of attention (Fan et al., 2002; MacLeod et al., 2010) would allow us to determine whether the predicted effects of control deprivation are indeed specific to executive attention or reflect a more general impact on a broader range of attentional processes. Moreover, we believed that the choice of this task to measure executive control would enable us to explore whether the predicted effect of experiencing uncontrollability on executive control is modulated by other attentional functions.

2. Experiment 1

In Experiment 1, the experience of uncontrollability was activated by using the informational helplessness training procedure developed by Sedek and Kofta (1990), in which uncontrollability is induced by providing a set of unsolvable tasks with no performance feedback. This method has been found to lead to strong performance deterioration effects, induce negative affect, increase subjective feelings of cognitive exhaustion, and impair reasoning processes (Sedek & Kofta, 1990; von Hecker & Sedek, 1999). Therefore, we used it as a powerful and well-established manipulation of uncontrollability. The efficiency of the attentional networks was assessed with the ANTI — Vigilance task.

2.1. Method

2.1.1. Participants

One hundred and five undergraduate students of Jagiellonian University (Kraków, Poland) took part in Experiment 1 in exchange for course credit. Two participants were excluded from the analyses due to a high error rate in the ANTI-V that was close to chance level (50%) and four participants were excluded based on the results of the manipulation procedure (see the Method section). The remaining sample of 99 participants was composed of 80 female and 19 male participants with a mean age of 20.12 years ($SD = 1.46$). All participants reported normal or corrected-to-normal vision and gave written informed consent before the experiment. Participants were randomly assigned to one of three conditions: control deprivation, control restoration, or baseline.

2.1.2. Procedure

Upon arrival, participants were told that the aim of the study was to explore reasoning and attentional skills. After signing the consent form they were seated in front of a computer monitor and asked to perform the first task, which was the uncontrollability manipulation (Informational Helplessness Training; IHT). The manipulation lasted up to 15 min. After completing the IHT task, the attentional network test (ANTI-V) was performed. The task lasted up to 30 min. After the task, participants were asked a set of questions regarding their awareness and the efficiency of the manipulation and debriefed.

2.1.2.1. Informational Helplessness Training (IHT). IHT was used to induce an experience of uncontrollability. It is based on the idea of inducing informational helplessness via a concept-formation task developed by Sedek and Kofta (1990). The IHT task consists of a series of six discrimination problems composed of 12 trials each. In each trial, one figure is presented on the screen at the time. Figures vary on five dimensions: a) size (small or large), b) shape (triangle or circle), c) surface (plain or striped), d) position of a line (at the top or bottom of the figure), and e) size of the letter 'r' in the middle of the figure (small or large). All participants were informed that all tasks were solvable and participants were told that they could resolve the problem, that is, identify the diagnostic feature of the figures to be discovered (for example, the triangle shape) by using the information (i.e., 'yes' or 'no' accompanying the figure presented on the screen). It was explained that 'yes' means presence (i.e., the figure is a triangle) whereas 'no' means absence of the target feature in the figure (e.g., the figure is a circle). In the

[1] Even though self-control and personal control have different sources and their effects on attention and motivation are also diverse, it seems legitimate to assume that attentional control is required to successfully exert both types of mental control, may it be over the environment or over oneself (see also Baumeister, Heatherton, & Tice, 1994; Inzlicht & Schmeichel, 2012; Schmeichel, 2007).