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Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion

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ABSTRACT

Positive effects of exposure to nature have been reported for stress, mood, and executive functioning. In the present research we investigated whether viewing natural scenes can also improve self-regulation. In line with recent theoretical propositions these replenishing effects were investigated in a typical ego-depletion paradigm. In two studies we found indications for beneficial effects of a short exposure to nature on lower order self-regulation (e.g., controlling impulses), but not on a higher-order executive functioning task. Furthermore, we found beneficial effects on mood and heart rate variability, a physiological measure related to exertion of self-control and stress. Importantly, beneficial effects of nature emerged even when participants had not been previously depleted, which challenges the current postulation that nature mostly has restorative benefits. We propose that nature might also have buffering or 'instorative' effects.

1. Introduction

Daily life can place demands on us in many ways. One important way pertains to the exertion of self-control to override feelings, thoughts or inclinations. A recent study demonstrated that, on average, we spend three hours per day exerting self-control (Hofmann, Vohs, & Baumeister, 2012). This finding is especially striking in light of research suggesting that exerting self-control depletes a limited resource, a process also labeled ego-depletion (Baumeister, 1998).

High self-control has been related to many positive life outcomes such as health, academic success and interpersonal effectiveness, and inversely with negative outcomes including aggression and alcohol abuse (Hagger, 2010; Tangney, Baumeister, & Luzio Boone, 2004). Accordingly, finding ways to replenish depleted self-control resources could be beneficial for many aspects of life. Such replenishing effects have been demonstrated, for instance after consuming glucose (Gaillot & Baumeister, 2007) or through increasing positive affect (Tice, Baumeister, Shmueli, & Muraven, 2007).

Recently, Kaplan and Berman (2010) postulated that nature exposure could also improve self-regulation. Viewing nature has already been found to reduce physiological reactivity after stress (Fredrickson & Levenson, 1998; Ulrich, Simons, Losito, Fiorito, Miles & Zenson, 1991), and improve mood (Berman, Jonides,& Kaplan, 2008; Hartig, Evans, Jamner, Davis, & Gärling, 2003) and executive functioning (Berman, et al., 2008; Laumann, Gärling, & Morten Stormark, 2003), but effect studies have not explicitly targeted self-regulation yet. In the present research we therefore empirically tested effects of nature on self-control in two studies, both employing a typical ego-depletion paradigm.

On a secondary note, the general consensus in restoration research is to investigate beneficial effects of nature after resource depletion or stress induction. In our second study we tested whether this pre-condition of resource depletion is actually necessary for nature to exhibit beneficial effects.

1.1. Nature and executive functioning

Attention Restoration Theory (Kaplan, 1995) proposes that each of us possesses a limited resource to direct attention. Tasks that require executive functioning drain this resource, resulting in a condition labeled directed attention fatigue. Executive functioning, a higher-order cognitive process (Suchy, 2009), is involved in a large variety of behaviors, including decision making, planning, and self-control (Cummings & Miller, 2007). Conversely, nature has been suggested to replenish depleted resources, because of its inherent ability to capture attention without effort (Kaplan, 1995). Viewing natural environments, in other words, does not require

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executive functioning and can therefore help replenish the capacity to direct attention (Kaplan & Berman, 2010).

Indeed, a number of studies have found that exposure to natural as opposed to urban environments after a mental fatigue induction can improve executive functioning on a subsequent task. Berman et al. (2008) found that performance on the backward digit span task after being depleted improved more for participants walking in a natural area than for those walking in an urban area. Another study compared performance during and after a walk in a natural area to that after a walk in an urban area (Hartig et al., 2003). They found that, compared to the urban walk, ability to sustain attention improved during the nature walk and remained better after the walk. Similar beneficial effects on performance were found after viewing pictures of natural versus urban environments (Berman et al., 2008; Laumann et al., 2003). A study in student dormitories further revealed that students with a more natural view in their room performed better on tasks requiring executive functioning (Tenessen & Cimprich, 1995). Kaplan and Berman (2010) have suggested that executive functioning shares a common resource – prone to depletion – with self-regulation, which has been described in Ego-depletion theory (Baumeister, 1998).

1.2. Self-regulation and performance

Ego-depletion theory holds that exerting self-control in one task can temporarily decrease the capacity for self-regulation on a subsequent task. A variety of self-regulatory behaviors have been found prone to depletion, including for instance controlling impulses, resisting temptation, and focusing attention. Tasks requiring self-control can be as diverse as physical stamina, not thinking of a white bear, refraining from eating tempting food, or solving difficult math problems while being distracted by noise (for an overview, see: Hagger, Wood, Stiff, & Chatzisarantis, 2010). Baumeister (1998) postulated that these seemingly unrelated behaviors deplete one commonly shared resource.

The depletion of this resource has been at the core of ego-depletion theory. Different theories have been developed to explain the phenomenon of ego-depletion, including the strength model (Baumeister, Vohs, & Tice, 2007) and the process model (Inzlicht & Schmeichel, 2012). The strength model builds on the assumption of self-regulation depending on a limited resource, using a muscle as a metaphor for self-control. Specifically, prolonged exertion leads to fatigue while practice can improve self-control strength in the longer run.

The process model, on the other hand, has challenged the existence of a limited resource. Instead, Inzlicht and Schmeichel propose that exerting self-control leads to shifts in motivation and attention. These shifts are directed away from controlling impulses and toward finding gratification. For instance, after focusing attention in a vigilance task a person will be less motivated to control impulses on a subsequent task. Rather, the motivation to find rewards as well as the attention devoted to reward cues increases. The reward system is often expressed in terms of positive affect and has been posed to exhibit evolutionary significance, related to approach and avoidance behavior (Carver, 2006; Elliot, 2006). Thus, declines in performance are said to be due to shifts in motivation rather than a diminished capacity to exert self-control.

Contrary to ego-depletion theory, however, others have suggested that the exertion of self-regulation does not necessarily weaken subsequent regulatory attempts, but instead can lead to improvements in performance (Koole, Jostmann, & Baumann, 2012). For instance, the harder the task, the more a person will be involved to this and subsequent tasks. Consequently, this results in more effort mobilization to face a subsequent task (Wright & Kirby, 2001). Similarly, it has also been proposed that people adapt to the difficulty level of a certain task, resulting in improved subsequent performance, a process labeled learned industriousness (Converse & DeShon, 2009). Furthermore, it was found that expectations regarding future ego-depleting effects influence performance on the second task more than the actual ego-depletion induction (Clarkson, Hirt, Jia, & Alexander, 2010; Martijn, Tenbült, Merckelbach, Dreezens, & de Vries, 2002).

1.3. Rationale

The aim of the present research is to investigate whether exposure to natural scenes can increase self-regulatory capacity. As was reflected in the sections above, prior self-regulation may affect performance on a subsequent task, but as yet no consensus has been reached regarding the directionality of this effect, with some predicting self-regulation to harm subsequent performance whereas others state the opposite relation.

In the studies presented here, we use a typical ego-depletion paradigm with successive tasks requiring self-control. In Study One, we first establish an ego-depletion effect and subsequently investigate how exposure to natural versus urban environments after initial depletion affects self-regulatory capacity in the subsequent task. If self-regulation harms performance – as is postulated within ego-depletion theory – we expect participants who exert self-control in the induction task to perform worse on the second task than non-depleted participants. Furthermore, if exposure to natural environments –but not to urban environments– replenishes this depleted resource we expect that after viewing a slideshow of nature no decline in performance will be detected.

In Study Two we investigate effects of natural versus urban environments on self-regulation after either a depleting or a non-depleting induction task. The aim is to identify whether beneficial effects of nature on performance only surface after a resource has been depleted, or whether there is a more general positive effect on self-regulatory performance. Beneficial effects of nature without an antecedent depletion or stress induction have only rarely been investigated. Hartig, Böök, Garvill, Olsson, and Gärling (1996) conducted one experiment in which they tested effects of natural versus urban scenes without first experimentally inducing fatigue or stress and still found beneficial effects of nature, which they labeled 'instorative effects'. Parsons and colleagues reported buffering effects of a nature video on a subsequent stressor as well (Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998).

In both studies we manipulate scene type by showing participants a slideshow with photos depicting either natural or urban environments. Generally, in restoration research the duration of exposure to natural environments ranges from 20 to 50 min (Beute & de Kort, 2014). Because ego-depleting effects have been found to vanish between three and ten minutes (Tyler & Burns, 2008), we opted for a shorter exposure than usual in the current study.

Besides self-regulation, effects on mood and physiology are also explored. Within ego-depletion research, many studies have found that self-regulatory demands negatively affect mood (Hagger et al., 2010). Exposure to natural environments, on the other hand, may simultaneously increase positive affect and lower negative affect (Berman et al., 2008; Ulrich et al., 1991).

Both exposure to nature and the exertion of self-control can affect physiology. Heart rate variability – indicating the amount of vagal influence – signals self-regulatory capacity (Thayer, Hansen, Saus-Rose, & Helge Johnsen, 2009) as well as self-regulatory activity (Segerstrom & Solberg Nes, 2007). Conversely, exposure to nature can reduce physiological reactivity (i.e., heart rate and pulse transit time) both after the induction of stress (Fredrickson & Levenson, 1998; Ulrich et al., 1991) and mental fatigue (Laumann et al., 2003).