Running head: EGO DEPLETION AND SUGGESTIBILITY

How Cognitive Resources Alter our Perception of the Past:

Ego Depletion Enhances the Susceptibility to Suggestion

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Abstract

Studies show that engaging in self-control results in deteriorated performance on subsequent tasks. In legal settings, witnesses and/or suspects are likely involved in self-control (e.g., controlling their emotions). The current study tested whether such involvement in self-control would lead to increased suggestibility levels. We found direct evidence for this. Forty-four participants were randomly divided into a high level of depletion condition (regulation of attention) or a low level of depletion condition (no regulation of attention). Also, they were presented with a suggestibility measure (Gudjonsson Suggestibility Scale). We showed that depleted participants were significantly more suggestible than non-depleted participants. Our findings are relevant in situations in which suggestive practices may take place.

Keywords: Suggestibility, Ego Depletion, Self-control, Executive Functions

How Cognitive Resources Alter our Perception of the Past:
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Determining under which conditions suggestion might be detrimental for memory is of chief importance in the legal field. Indeed, a vast amount of studies show that when exposed to suggestions during questioning, both children and adults often accept the suggestive information and incorporate it into their memory (Loftus, 2005; Loftus & Pickrell, 1997; Otgaar, Candel, Merckelbach, & Wade, 2009). The purpose of the current study was to examine whether suggestibility increases when cognitive resources are depleted.

Cognitive resources become depleted when a large quantity of self-control is executed in a relatively brief period of time. Specifically, engaging in acts of self-control impacts a limited pool of self-control that when depleted leads to decreased abilities for prospective self-control (Hagger, Wood, Stiff, & Chatzisarntis, 2010). Baumeister and colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister & Heatherton, 1996; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000) labeled this state of reduced self-control *ego depletion*.

There is an abundance of studies confirming that repeated use of self-control results in deteriorated performance on subsequent self-control tasks. For example, Baumeister and colleagues (1998; Experiment 3) showed that participants who were instructed to not show and feel any emotions during a movie demonstrated impaired performance at solving anagrams than control participants who did not engage in self-control. Muraven, Tice, and Baumeister (1998; Experiment 2) found that the suppression of forbidden thoughts caused participants to give up more quickly on unsolvable anagrams compared to a control group who was not involved in self-

control. Taken together, research into the field of ego depletion has generally found that ego depletion results in impaired performance on subsequent tasks.

Interestingly, in interrogation settings, engaging in self-control is of pivotal significance (see Loftus & Davis, 2006). That is, witnesses and suspects have to control their behavior on numerous occasions during an interrogation. To provide some examples, they have to control their emotions in order to prevent suspicion and monitor their verbal statements so that possible criminal intentions are not revealed. Our interest was to test whether reduced self-control might affect the vulnerability to suggestion.

From a theoretical side, self-control has been conceptualized as one of the self's major executive functions (Baumeister, 1998; Gazzaniga, Ivry, & Mangun, 1998). Moreover, a series of experiments by Schmeichel (2007) revealed that initial efforts at executive control reduce performance on later tasks that require executive control. For instance, in Experiment 1, it was found that participants who were instructed to control their attention while watching a video performed significantly worse on subsequent tests of working memory span compared to participants who did not control attention.

Research suggests that people who possess poor executive functioning skills experience difficulties in their memory accuracy and are at increased risk to develop memories for details/events that were not experienced (i.e., false memories; Peters, Jelicic, Verbeek, & Merckelbach, 2007). Even more important for the current study, there are studies indicating that suggestibility increases when there are deficiencies in executive functions (Alexander et al., 2002; Melinder, Endestad, & Magnusses, 2006; Karpinski & Scullin, 2009; Roberts & Powell, 2005; Ruffman, Rustin, Garnham, & Parkin, 2001).

In a study by Karpinski and Scullin (2009), for instance, children aged 3 to 5 experienced a live event (magic show) and received pressure in which suggestion was used about the event a week later. Also, they received a battery of tasks intended to tap executive functioning. The authors found that children with executive function deficits were more prone to suggestive pressure than children with relatively better executive functions.

Alexander and colleagues (2002) found that predominantly inhibitory deficiencies were related to an enhanced vulnerability to suggestion. In their study, children ranging in age from 3 to 7 years received an inoculation and were suggestively interviewed about the event. Furthermore, children were presented with a task measuring cognitive inhibition. The study showed that inhibition was a significant predictor of children's suggestibility levels.

Our idea between the relation of executive functions (e.g., inhibition) and suggestibility is the following. When people have impaired executive functions, their ability to monitor the sources of their memories is likewise deteriorated. This makes them more willing to accept external suggestions as something that was internally generated. Indeed, a relatively large number of studies show a close link between source monitoring and suggestibility with impaired source monitoring abilities being related to higher suggestibility levels (Bruck, Melnyk, & Ceci, 2000; Giles, Gopnik, & Heyman, 2002; Mitchell, Johnson, & Mather, 2003; Shapiro & Purdy, 2005).

An alternative explanation is that executive functions aid people in ignoring irrelevant information. When there exists deficits in executive functions, people may encode relevant information more poorly resulting in weaker memory traces (Harnishfeger & Bjorklund, 1994). Weaker memory traces make people more reliant on external suggestions (Alexander et al., 2002).

The aim of the present study was to test whether depletion of cognitive resources (i.e., ego depletion) would result in elevated levels of suggestibility. We predicted that participants who performed a high amount of self-control would be more susceptible to suggestion than participants who enacted a relatively low amount of self-control. The rationale behind this is that initial self-control efforts will temporarily reduce subsequent executive functioning (Schmeichel, 2007). This would likely lead to enhanced suggestibility. We used an ego depletion manipulation that has successfully been implemented in previous studies (Alberts, Martijn, Greb, Merckelbach, & de Vries, 2007; Alberts, Martijn, & de Vries, 2011). Specifically, in the present study, participants were instructed to solve difficult calculations while being auditory distracted during the task.

As a suggestibility measure, we used the Gudjonsson Suggestibility Scale (GSS; Gudjonsson, 1984). This scale has often been used in suggestibility and memory research (e.g., Gudjonsson & Henry, 2003; Gudjonsson & Young, in press; Smeets, Leppink, Jelicic, & Merckelbach, 2009). In this task, participants are presented with a short story and are asked to recall everything they can remember about the event. Then, they receive suggestive questions about the event. The reason for using the GSS is that in essence it is a source monitoring task in that people have to decide whether the presented suggestion refers to an internal or external source. As mentioned before, research shows that people who are susceptible to suggestion have difficulties in source monitoring thereby erroneously deciding that the suggestion referred to an internal source (Bruck et al., 2000; Giles et al.,2002; Mitchell et al., 2003; Shapiro & Purdy, 2005). Furthermore, source monitoring is highly associated with executive functioning (Glisky, Polster, & Routheaux, 1995). Based on this, it is

highly probable that participants who are ego depleted are more likely to assent to suggestion, than participants who are not ego depleted.

Method

Participants

A total of 44 undergraduate students (M_{age} = 22.41, *SD* = 6.33; 12 men) were involved in the present study. They received course credit or a financial reimbursement (€5) for their participation. They were tested in separate laboratory rooms at the university. Sessions lasted for approximately 30 min. The study was approved by the standing ethical committee of the Faculty of Psychology and Neuroscience, Maastricht University.

Materials

Ego depletion manipulation Ego depletion was induced by means of an attention control task. During eight minutes, participants were instructed to solve calculations. In the high level of depletion condition, participants had to solve difficult calculations (two digits calculations) while being distracted with auditory interfering stimuli through headphones. Since participants had to attend to the calculations and had to override their impulses to listen to the interfering stimuli, this task required self-control. In the low level of depletion condition, participants received easy calculations to solve (one digit calculations) without distraction.

Gudjonsson Suggestibility Scale (GSS) The present study used a shortened Dutch version of the GSS (Merckelbach, Muris, Wessel, & van Koppen, 1998; Smeets et al., 2009). We made use of the GSS 1 version. Participants listened to a short story about a criminal case. After this, they were asked to write down everything they could remember about the event (i.e., immediate recall). Finally, they received 20 specific questions (of which 15 were misleading and 5 are memory questions) twice.

That is, after the first presentation of these questions, the experimenter confronted the participants with explicit negative feedback on their performance. Following this, they received the 20 specific questions again. The following scores can be inferred from the GSS: 1) Immediate recall: The amount of correct items immediately after the presentation of the story (range: 0-40), 2) Yield 1: The extent to which participants accept the misleading questions before being presented with negative feedback (range: 0-15), 3) Yield 2: Identical to Yield 1, except that it refers to the Yield score after the negative feedback (range: 0-15), 4) Shift: The number of changes after being exposed to negative feedback (range: 0-20), and 5) Total suggestibility: The combined score of Yield 1 and Shift (range: 0-35).

Gudjonnson Compliance Scale (GCS) The current study employed a Dutch version of the GCS (Cronbach's $\alpha = 0.71$; Giesbrecht, de Ruiter, & Jelicic, 2008; Gudjonsson, 1989). The GCS is a self-report questionnaire consisting of 20 true/false statements that reflect people's tendencies to comply (e.g., "I give in easily to people when I am pressured"). Higher scores refer to a higher tendency to comply. The GCS was included to exclude the possibility that our effects were driven by compliance instead of ego depletion.

Mood To rule out the possibility that our effects were caused by mood differences, we included the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988; Cronbach's $\alpha = 0.92$) in the current study. Briefly, the BMIS is composed of 16 adjectives which tap eight distinct mood states (happy, loving, calm, energetic, anxious, angry, tired, and sad) with 2 adjectives each. The instruction was to rate "How well each adjective or phrase describes your present mood" using a 5-point Likert scales with 1 referring to "definitely do not feel" and 5 meaning

"definitely feel". Participants had to rate their mood at the start of the experiment and after the depletion manipulation.

Manipulation check We included a physical measure of self-control to asses whether our ego depletion manipulation was effective. More precisely, participants were asked to squeeze on a handgrip before and after the ego depletion manipulation. Squeezing a handgrip has been proven to be a reliable measure of self-control (Muraven et al., 1998). Using a stopwatch, we measured the time (in second) that participants squeezed the handgrip.

Design and Procedure

The current study made use of a between-subjects design with Condition (high level of depletion vs. low level of depletion) as our between-subjects variable. Participants were randomly allocated to each condition (n = 22 in each condition). At the beginning of the experiment, participants were told that this study was about memory performance and that several tasks needed to be completed for the study. After signing a consent form, they had to fill the first mood questionnaire (BMIS). Following this, they had to perform the physical self-control task (squeezing the handgrip). Specifically, they were asked to place the handgrip in their dominant hand and a coin was placed between the handles at the moment they squeezed the handgrip. They had to squeeze the handgrip as long as they could. The experimenter started measuring time when placing the coin and stopped timing when the coin fell out.

Next, participants received the GSS and were presented with the short story. Then, they were instructed to write down everything they could recollect about the story. Following the immediate recall phase, level of depletion was induced by letting participants solve difficult or easy calculations. When the depletion task was completed, participants had to indicate their mood again and had to squeeze the

handgrip once more. Next, the participants were presented with the misleading questions. Finally, they were asked to fill in the GCS and were asked questions about whether they knew what the experiment was about.

Results

We first checked whether any participants knew what the experiment was about. Two participants indicated that they had background knowledge about the GSS and the content of this study. They were excluded from further analyses.[1]

GCS

We conducted an ANOVA on the compliance ratings, yet the analysis fell of short of statistical significance ($F < 1$) indicating that our two groups did not differ with respect to compliance.

Mood

To examine whether participants differed in their mood states before and after the ego depletion manipulation, we conducted an ANCOVA with mood ratings obtained at the first time as a covariate. We found that our covariate was significant ($F(1,39) = 77.34$, $p < .001$, $\eta^2_p = .67$). Furthermore, our analysis yielded a significant main effect of Condition ($F(1,39) = 6.58$, $p < .05$, $\eta^2_p = .14$) showing that when the mood questionnaire had to be filled in for the second time, participants in the high level of depletion group had lower mood ratings ($M = 3.72$, $SD = 0.51$) than participants in the control group ($M = 4.02$, $SD = 0.48$). Hence, to control for possible mood effects, we inserted mood ratings filled in for the second time as a covariate in our main analyses.

Manipulation check

To test whether our depletion manipulation was effective, we conducted an ANCOVA on the second handgrip time data and with the first handgrip time as

covariate. Results showed that the covariate was significant ($F(1,39) = 39.86$, $p < .001$, $\eta^2_p = .51$). Importantly, we found a significant main effect of Condition ($F(1,39) = 5.85$, $p < .05$, $\eta^2_p = 13$) showing that the high level of ego depletion group performed worse ($M = 42.60$ s, $SD = 19.58$) on the second handgrip compared to the control participants ($M = 63.77$ s, $SD = 34.38$). This indicates that our depletion task was effective in depleting self-control.

Ego depletion and suggestibility

For our main analyses, we performed ANCOVAs with the second mood questionnaire ratings as covariate. For the immediate recall, our analysis did not reach conventional levels of significance ($F(1,39) = 1.67$, ns). When we conducted ANCOVAs on the memory questions before and after the negative feedback, no significant results emerged (Fs < 1).With respect to the Yield 1 scores, we found that our covariate was not significant ($F < 1$). Interestingly, we found a significant main effect of Condition ($F(1,39) = 5.59$, $p < .05$, $\eta^2_p = .13$) with the depleted group assenting more to the misleading questions than the control group (see Table 1). Although we found that at Yield 2, participants in high level of depletion concurred more to suggestion than control participants, this difference was not significant ($F(1,39) = 2.76$, ns). For the Shift score, we found a marginally significant main effect of Condition ($F(1,39) = 3.38$, $p = .07$, $\eta^2_p = .08$) with more shifts in the high level of depletion group than in the low level of depletion group. Concerning the Total suggestibility, we found that our covariate was not significant ($F < 1$). More interestingly, our analysis revealed a significant main effect of Condition ($F(1,39) = 5.73$, $p < .05$, $\eta^2_p = .13$) with participants being more suggestible in the high level of depletion group than participants in the control group.

Discussion

In the current study, we investigated whether the depletion of cognitive resources would result in increased suggestibility. We found convincing evidence that this is indeed the case. That is, our study is the first to show that participants were more suggestible when they were ego depleted than when they were not. These findings might have serious ramifications for situations in which suggestive practices take place.

Before turning into the practical significance of these findings, we want to emphasize that our findings were probably not due to other factors. Specifically, we failed to find any indication that mood states may have driven our ego depletion-suggestibility effects. Strikingly, we also showed that our ego depletion manipulation was effective as participants in the high level of depletion group gave up more quickly when squeezing the handgrip relative to participants who were not depleted. Obviously, this implies that our manipulation was strong enough to deplete the cognitive resources of the participants. One might argue that our effect was caused by participants in the high level of depletion group being less motivated and more fatigue than control participants. However, recent evidence shows that lack of motivation and fatigue are not irreconcilable with the concept of ego depletion. Instead, it is assumed that such factors might be mediating the effect of self-control on task performance (Hagger et al., 2010).

We found that on all suggestibility measures (Yield 1, Yield 2, Shift, and Total suggestibility), the high level of depletion group had higher scores than the control group. However, we found that these differences were only significant for the Yield 1 and Total suggestibility scores and marginally significant for the Shift scores. It is likely that an increase in our sample would lead to more power and would also result in significant effects for the Shift scores. However, when looking at the strengths of

our effect sizes, our results reveal that even with the current sample size, we obtained medium effects. Overall, it thus seems that ego depletion targets different kinds of suggestibility measures and cannot be pinpointed to a single suggestibility measure (e.g., only Yield).

Depleting self-control does probably not result in weaker memory traces as we did not find evidence that ego depleting participants remembered less correctly than the participants who were not depleted. Our main finding suggests that our ego depletion manipulation has likely affected the executive functions which made participants less able to monitor the sources of their memories. This made participants more inclined to accept the external suggestions. Studies show that deficits in source monitoring are likely to result in enhanced vulnerability to suggestion (Bruck et al., 2000; Giles et al., 2002; Mitchell et al., 2003; Shapiro & Purdy, 2005).

Although the current findings are promising, some important limitations remain. First, the present study used a specific depletion manipulation. In order to test the generalizability of our finding, future research should consider using different ego depletion manipulations, like for example emotion regulation and thought suppression. Second, our findings suggest that retrieval processes were influenced by limited resources. At this point it remains unclear whether the depletion of resources will also affect encoding processes. This could be tested by depleting resources before encoding of information. Third, although previous research has demonstrated that ego depletion effects were only induced by tasks involved in executive control, instead of tasks that are merely experienced to be effortful (Hagger et al., 2010), it would be interesting to examine whether enhanced susceptibility to suggestion can exclusively be attributed to drainage of executive resources.

To conclude, our study shows that suggestibility increases when cognitive resources are depleted. These findings are relevant in settings in which suggestive interviews might take place. In such settings, interviews might appear stressful and witnesses and/or suspects are likely involved in self-controlling their behavior, emotions, and thoughts (Davis & Donohue, 2004, Gudjonsson, 2003). For example, they have to analyze incoming suggestions and compare these with already existing autobiographical knowledge. Our study provides concrete evidence that such engaging in self-control makes people prone to suggestion and stresses the importance of including executive process in the legal context.

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Footnote

[1]The two participants were both in the high level of depletion condition. When the two participants were included in the analyses, the main pattern of findings did not change.

Table 1

Mean scores of the GSS as a function of condition (standard deviations in parentheses), F-values, and effect sizes (partial eta squared)

	High level of depletion	Low level of depletion	*F*	η^2_p
Immediate recall	23.25 (5.43)	20.89 (5.48)	1.67	0.04
Yield 1	4.50 (3.02)	2.50 (1.95)	5.59*	0.13
Yield 2	5.20 (3.33)	3.55 (2.67)	2.76	0.07
Shift	3.20 (2.29)	2.09 (2.11)	3.38	0.08
Total suggestibility	7.70 (4.84)	4.59 (3.53)	5.73*	0.13

* $p < .05$