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Short report

The effects of ego depletion on belief bias

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Abstract

We investigated the effects of experimentally diminished self-regulatory resources on a subsequent reasoning task in which participants evaluated conclusions of conditional syllogisms either on the basis of their semantic believability or logical validity. We hypothesized that the depletion of self regulatory resources (ego-depletion) interferes more with logic based evaluations relative to belief based evaluations. This hypothesis was in part motivated by the strength model of self-control (Baumeister et al., 1998, 2007) and the default-interventionist model (Evans, 2006, 2007). Contrary to our predictions, the results showed that participants whose self-regulatory resources were depleted performed more accurate on logical reasoning as compared to belief based reasoning.

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This short report will describe the experimental design and summarize the preliminary statistical analysis we conducted.

Methods

Participants and Design

Thirty-six undergraduate psychology students from the University of Plymouth (23 females and 13 males) participated in this study (ages ranging between 18 years and 50 years; M = 22.23, SD = 7.13). All students received course credit for their participation.
The study employed a mixed 2 (ego depletion condition: depletion vs. no depletion) x 2 (instruction: belief vs. logic) x 2 (conflict: congruent vs. incongruent) repeated measures design. The ego depletion condition was a between-subjects variable and the remaining factors were within-subjects variables with repeated measures.

Materials and Procedures

Ego depletion procedure. We adapted an ego depletion procedure from Baumeister et al. (1998, experiment 4). Participants were randomly assigned either into a control condition (n = 17) or an ego depletion condition (n = 19). Participants in the control condition received the instruction that they had to cross out every instance of the letter *e* in a complicated German text[1] which was printed on an A4 sheet of paper. The remaining participants received identical instructions but were requested not to cross out the letter *e* if it was followed by a vowel or if was embedded in a word in which a vowel appeared two letters earlier (see appendix 1 for the verbatim instructions and an example). The underlying rational for the different instructions was that participants in the experimental condition would presumably scan the text for each *e* but when they recognised one they had to inhibit their initial response of crossing it out in order to check if one of the afore mentioned criteria were met. In other words, they had to "consult multiple rules and monitor their decisions carefully" Baumeister et al. (1998, p. 1260). Consequently, participants in the ego depletion condition had to regulate their responses whereas those in the control condition simply responded each time they found an *e*.
After 5 minutes participants were informed that the task was over and that they had to perform a reasoning task which was presented on a computer screen in front of them.

Syllogistic reasoning task. E-Prime software (Schneider et al., 2002a,b) was used in order to present 64 conditional modus ponens syllogisms to participants. We adapted the methodology of Handley & Newstead (2010): The syllogisms were either logically valid or invalid. In addition, half

[1] We used some sections out of "Die fröhliche Wissenschaft" by Friedrich Nietzsche (1882). In order to prevent confusion all umlauts were replaced by vowels.

of these syllogisms displayed a believable conclusion whereas the remaining half had an unbelievable conclusion (see appendix 2; for further details see Handley & Newstead, 2010). Moreover, for 32 syllogisms participants were instructed to evaluate the believability whereas for the other half they had to evaluate the logical validity. An example of a trial sequence is depicted in Figure 1.

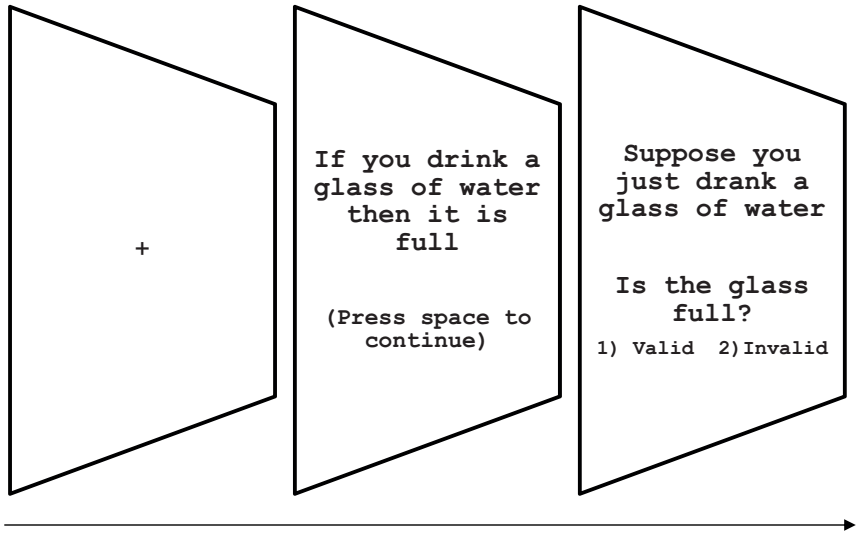

Figure 1. An example of a trial sequence in the reasoning task. The fixation cross was presented during 500 milliseconds, followed by the major premise of the conditional syllogism.

Participants gave a binary response by pressing the "1" and "2" button on a keyboard in front of them. It was stressed that they had to react as fast and as accurately as possible. To make sure that participants comprehended the instructions correctly they performed 8 practice trials before the experimental trials began.

Analysis and Results

We formatted and restructured the data using the AGGREGATE and RESTRUCTURE procedures in SPSS 17.0 (but see Lacroix & Giguère, 2007).

A 2 (ego depletion condition: depletion vs. no depletion) x 2 (instruction: belief vs. logic) x 2 (conflict: congruent vs. incongruent) repeated measures ANOVA was performed on the reaction times. There was a statistically significant main effect for INSTRUCTIONS, $F(1, 34) = 14.56$, $p < .001$, $\eta_p^2 = .30$. Participants took longer to evaluate believability ($M = 3.53$ seconds, $SE = 1.37$) as compared to logical validity ($M = 3.26$ seconds, $SE = 1.27$). Moreover, we found a significant main

effect for CONFLICT, $F(1, 34) = 16.98$, $p < .001$, $\eta_p^2 = .33$. Participants reacted faster to non-conflict items *(M* = 3.26 seconds, *SE* = 1.25) relative to conflict items *(M* = 3.54 seconds, *SE* = 1.39). However, none of the interactions were significant.

In order to examine differences in accuracy another 2 (ego depletion condition: depletion vs. no depletion) x 2 (instruction: belief vs. logic) x 2 (conflict: congruent vs. incongruent) repeated measures ANOVA was performed with percentage of correct responses as the dependent variable. There was a statistically significant main effect for CONFLICT, $F(1, 34) = 24.80$, $p < .001$, $\eta_p^2 = .42$. Participants responded more accurate to congruent items (94%, *SE* = 1.5%) as compared to incongruent items *(81%*, *SE* = 3%). Furthermore, our analysis revealed an interesting interaction between EGO DEPLETION CONDITION and INSTRUCTION, $F(1, 34) = 4.53$, $p < .05$, $\eta_p^2 = .12$. Depleted participants, on average, responded more accurately when instructed to reason logically relative to when they were instructed to evaluate the believability of syllogisms. This pattern was reversed for non-depleted participants (higher accuracy under belief instructions as compared to logic instructions). These results are depicted in Figure 2. Non of the remaining main effects and interactions were significant (all F‘s < 1).

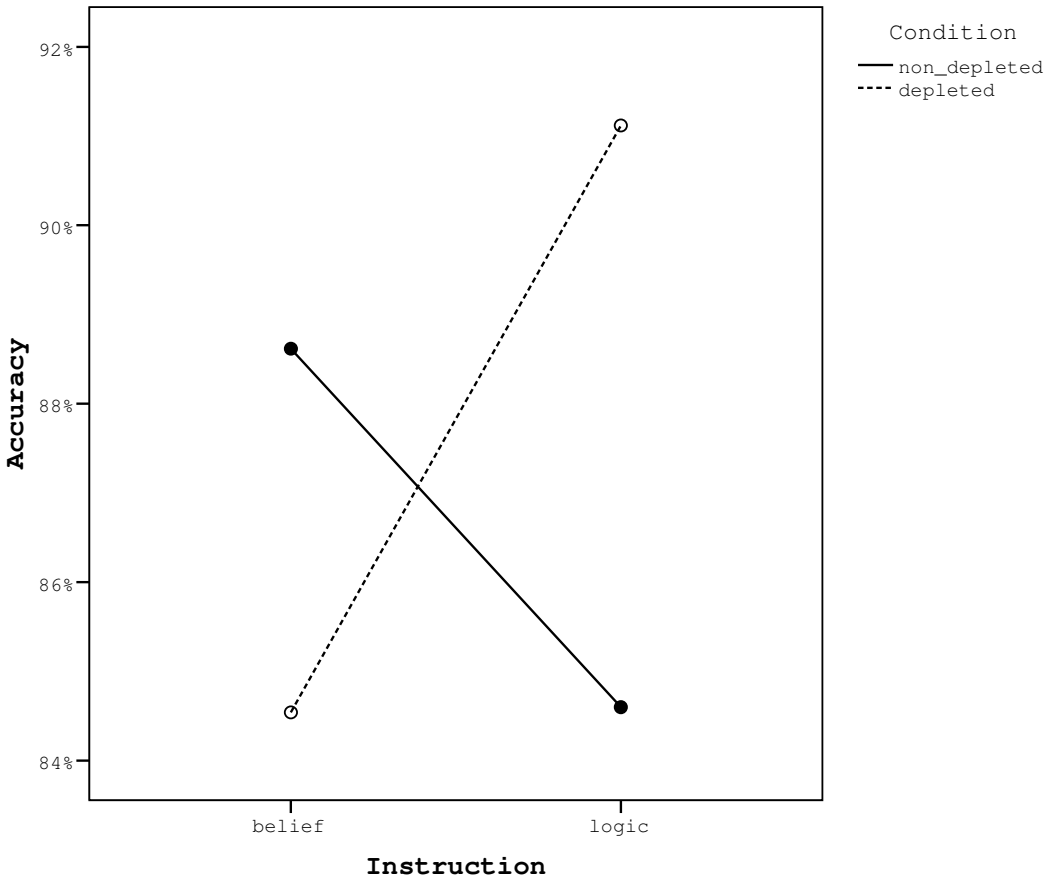

Figure 2. Interaction between condition and instruction.

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Appendix 1

Instructions for the control condition:

Your task is to cross out each occurrence of the letter "e" in the following text. For example, in the following sentence:

Die Lehrer vom Zwecke des Daseins

You would have to cross out the following letters:

Die Lehrer vom Zwecke des Daseins

Instructions for the ego depletion condition:

Your task is to cross out each occurrence of the letter "e" in the following text, except if this letter is followed by a vowel or is embedded in a word in which a vowel appears two letters earlier. For example, in the following sentence:

Die Lehrer vom Zwecke des Daseins

You would have to cross out the following letters:

Die Lehrer vom Zwecke des Daseins

Appendix 2

Incongruent problems	Congruent problems
A	B
If you cook water then it becomes cold Suppose you cooked water Is the water cold? Logically valid = Yes ✓ Believable = No ✗	If you cook water then it becomes hot Suppose you cooked water Is the water hot? Logically valid = Yes ✓ Believable = Yes ✓
C	D
If you cook water then it becomes cold Suppose you cooked water Is the water hot? Logically valid = No ✗ Believable = Yes ✓	If you cook water then it becomes hot Suppose you cooked water Is the water cold? Logically valid = No ✗ Believable = No ✗

Table 1: An examples of the different problems used together with the correct response under logic and belief based instructions.