Saving Resources for Future Demands—The Role of Instruction, Cognitive Load and Metacognition*

Agnieszka Fanslau, Mirosław Brejwo, Hanna Brycz
University of Gdańsk, Gdańsk, Poland

Two studies test the hypothesis of conserving resources while performing depleting physical tasks and the modifying role of metacognitive self (MCS). A total of 216 undergraduate students performed two types of physical tasks (a body support on forearms—the first experiment; and a cold water test—the second experiment) in anticipation vs. no anticipation of the future task conditions. Among individuals with high-MCS much weaker persistence could be observed than among those with low-MCS. These results support theories of adaptive goal disengagement suggesting that how individuals apply their resources may stem from other reasons than ego depletion.

Keywords: conserving resources, ego depletion, metacognitive self, biases

Self-Control

Self-regulation revolves around establishing and fulfilling human goals that give meaning to life. The most important element for effective self-regulation is self-control. It allows people to control impulses, and alter thoughts, feelings, and behaviors. Finally, to resist temptations that may pose a threat to important goals. It relies mostly on controlled processes, thanks to which individuals regulate urges, sustain attention, or follow rules.

Series of studies that have been conducted over two decades demonstrated the fact that the ability to self-control derives from a source comparable to a kind of strength rather than skill or knowledge (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000). Therefore, it is prone to exhaustion. In other words, the source of self-control is limited in the sense that drawing from it causes a period of limited performance until it regenerates, as does the strength of the muscle used. A limited resource from which every act of self-control draws becomes depleted through use (Baumeister et al., 2007). This phenomenon is called ego depletion. The self’s resources become drained presumably because the first act of self-control depletes some common resources that are needed to perform better at the second act of self-control. Ego depletion has been linked to multiple behavioral problems, including overeating (Vohs & Heatherton, 2000), ineffective self-presentation (Vohs, Baumeister, & Ciarocco, 2005), intellectual underachievement (Schmeichel, Vohs, & Baumeister, 2003), or impulsive overspending (Vohs & Faber, 2007).

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Agnieszka Fanslau, Ph.D., Assistant Professor, Social Science Department, University of Gdańsk, Gdańsk, Poland.
Mirosław Brejwo, MA, Ph.D. Student, Social Science Department, University of Gdańsk, Gdańsk, Poland.
Hanna Brycz, Ph.D., Full Professor, Social Science Department, University of Gdańsk, Gdańsk, Poland.
What is more, every act of self-control can be seemingly unrelated to each other. For instance, regulating one’s emotions can reduce performance on subsequent tasks, such as squeezing a handgrip exerciser, sustaining mental representations in working memory, or naming the colour of printed words in a Stroop task (Johns, Inzlicht, & Schmader, 2008; Muraven, Tice, & Baumeister, 1998; Schmeichel, 2007).

However, certain characteristics of an individual or group of people may provide greater sensitivity on the one hand, or resistance on the other hand, to the effects of ego depletion. For example, high trait self-control demonstrates a protective effect on behavior post-depletion (Dvorak & Simons, 2009). Moreover, individuals high on conscientiousness, as well as facet level self-discipline and deliberation make less dysregulated choices after being depleted (Maples-Keller, Berke, Miller, & vanDellen, 2016).

Subjective perceptions of resource depletion and personal or lay beliefs about willpower may predict performance patterns in the sequential tasks as well in such a way that believing that willpower is unlimited can eliminate the effect (Johns & Dweck, & Walton, 2010). Moreover, the degree to which individuals view specific self-regulatory challenges as effortful has been shown to moderate the effect of ego depletion such that only individuals who report needing to use effort to engage in self-control demonstrate behavioral disinhibition (vanDellen, Hoyle, & Miller, 2012). Individual differences in self-monitoring, mood, and self-affirmation can mitigate against poorer self-control either (Alberts, Martijn, & de Vries, 2011; Tice, Baumeister, Shmueli, & Muraven, 2007; Schmeichel & Vohs, 2009).

Saving Resources

Because of the crucial but limited nature of self-control, people must be reasonable in managing it (as with other limited resources) (Hobfoll, 2002). The way to do this can be saving resources for future demands, which sometimes means that people perform poorly at the current task. In other words, they may be motivated to conserve self-control resources, and the motivation to save these resources can be increased by their loss in the past, as well as by the anticipated high requirements of future tasks (Muraven, Shmueli, & Burkley, 2006). It is not true, therefore, that any deficiency in self-control indicates a failure in self-regulation—self-control may fail not because resources have been exerted, but because the individual is more interested in using them in the future (for more important tasks). Hence, it appears that the reason self-control fails, especially after the previous exertion of self-control, is because people become more unwilling (they simply choose not to regulate themselves), and not less able, to exert self-control. This is a certain paradox of self-regulation: Human foresight and a desire to use self-control can lead to its breakdown, at least in some situations. For example, when participants in a study worked hard, because they had been asked to do so, they may not feel like working very hard afterwards. It can be due to the belief that they were engaged enough in the study and deserved a break. Another way to think of this is that after engaging in an initial act of self-control, people feel justified in slacking off (Kivetz & Simonson, 2002). Moreover, the following task itself can be perceived as too effortful, energy consuming, or boring to exert too much strength on it—that may reflect the notion that initial effort rather demotivates people from continuing and expending further effort.

Some personality traits or physical condition may moderate the effect of ego depletion as well. Special abilities like the need for cognitive closure (Webster & Kruglanski, 1994), or metacognition, provide individual differences to internal or external motivation to pursue the given task at hand. The role of kind of motivation together with metacognitive processes may alter, attenuate, or reverse ego depletion phenomena.
Metacognition

Studies on the capability to gain conscious insight into one’s thinking processes are a domain of psychology and do not have a very long history (Flavell, 1979: “cognition of one’s cognition”; Efklides, 2008: metacognitive experiences; Koriat, 2000: metacognition). Speculations on metacognition indicate its considerable importance in decision-making metaability, forming and changing attitudes, achieving of long-term objectives (See, Petty, & Fabrigar, 2008). The specific insight into one’s own behavior and bias plays an exceptional role. To know how each psychological bias demonstrated in the literature is displayed in one’s behavior is the criterion of perceiving oneself accurately. For example, a bias called the illusion of control (Langer, 1975) consists in a deceptive confidence that our influence on the often random real-life events (such as winning a lottery) is greater than it actually is. Every bias is in fact a certain statistical generalization. It is known, however, that most of people manifest that tendency. When a group large enough is asked to assess whether the given tendencies are or are not expressed in their behaviors, one can expect to find individuals characterized by higher and lower accuracy of perceiving themselves in reference to the complex self-knowledge. The higher accuracy is probably related with the earlier conscious perception and the understanding of one’s behaviors, with seeking sensible reasons for these behaviors and with building a kind of metaknowledge concerning the manifested biases. The effect of the process described requires earlier reinterpretation and self-awareness (Gazzaniga, 2011). It is the knowledge about one’s knowledge on the subject of biases in one’s own behavior.

Thus, in this study, we focus on a construct called “metacognitive self” (MCS), which reflects self-awareness of biases. Metacognitive self is rooted in intrinsic motivation and a reflective, deliberate way of thinking about oneself (Bar-Tal, Brycz, Dolinska, & Dolinski, 2017). High-MCS individuals (as compared with low-MCS individuals) are more often motivated to use self-diagnostic information, which boosts self-knowledge and psychological self-improvement (Brycz, Wyszonimirska-Góra, Bar-Tal, & Wisniewski, 2014; Brycz, Wyszonimirska-Góra, Konarski, & Wojciszke, 2018). Moreover, experimental studies (Brycz & Karasiewicz, 2011) have indicated that high-MCS individuals are more intrinsically motivated to work under conditions of overload have a higher need for achievement and are more accepting of values, such as self-directedness and achievement.

Metacognitive self also includes an emotional aspect. It is strongly and positively correlated with seeking future goal-oriented self-experiences, which is crucial for emotion regulation (Brejwo, Brycz, & Imach, 2018). Besides, MCS is positively correlated with a number of other similar constructs, such as Ghorbani, Watson, and Hargis's (2008) self-regulatory metacognition, and Beer and Moneta’s (2010) positive metacognitions construct. Further studies have revealed negative correlations between the MCSQ-21 and MCQ-30 (Wells & Cartwright-Hatton, 2004). The MCQ-30 measures maladaptive metacognitions, such as positive beliefs about worry, a strong tendency for rumination, and other thoughts associated with depression and various psychiatric disorders. Research has shown that the MCS plays an adaptive role, and is negatively correlated with rumination and psychiatric disorders (Brycz, Konarski, Kleka, & Wright, 2019). These authors also found that the higher the MCS is, the more conscious, agreeable, and emotionally stable the individual appears to be. Thus, the MCS might be understood as the human ability to perceive the functioning of psychological rules, biases, illusions, and is correlated with positive dispositions and emotions.

The goal of the two experiments presented beneath was to investigate the role of instruction (to save
resources vs. no instruction), ego depletion, and metacognitive self for the motivation to persist during physical activities.

**Study One**

**Predictions**

Some research shows that high-MCS participants work more sturdily than low-MCS individuals (Brycz & Karasiewicz, 2011). But latest studies pointed out the crucial role of autonomous motivation among high (but not low) MCS participants (Brejwo et al., 2018). We predict that the following study may strengthen the thesis about the need for autonomy in performing tasks successfully among them.

**Participants and Procedure**

A number of 115 participants (66 women) took part in the Study One. All of them were undergraduate students of various courses of study between 18 and 28 years of age ($M = 20.95; SD = 1.793$). After giving consent to participate in the study and a statement on the absence of health contraindications, they filled in the short version of MCS questionnaire (MCS-24; Brycz & Konarski, 2016). Then, they took part in a group warm-up led by physical education teachers. After that they were randomly assigned to either the experimental or control conditions. They worked individually; each of the participants was asked to perform the exercise of body support on the forearms for as long as possible. The measurement was made with an accuracy of one second. Participants in the experimental group were additionally told (before they begun the exercise) that they would take another test of performance (namely they would be asked to repeat the physical exercise). Therefore, they anticipated the second trial. After completing the exercise participants from both the experimental and control groups learned their times of performance (at this point, participants from the control group learned that they would make a second attempt as well). After 30 seconds from the end of the first attempt, they began the second one. Again, the measurement was made with an accuracy of one second. After that, participants were thanked and debriefed. No one reported awareness of the conservation hypothesis.

**Results**

Analysis of homogeneity of variance with the Levene test for individual variables indicated no significance, hence the parametric measurement was initially used. The results of linear regression analysis do not indicate the presence of a strong effect of resource conservation, the impact of MCS on expended effort, or the impact of interaction of explanatory variables (MCS × group) on resource conservation.

However, simple effects between the means measured by the $t$-test for dependent measurements (the same people performed the first and second physical tasks) implemented using the bootstrap method with stratified sampling prove, that low-MCS participants, in general, put more effort into completing the first and second tasks (the result of the first trial—[minus] the result of the second trial $M = 17.82$) than high-MCS participants (the result of the first trial—[minus] the result of the second trial $M = 14.46$), $t = 4.38$, $p < 0.001$.

What is important, in the case of low-MCS subjects, the second task was performed significantly worse than the first task (ego depletion)—the experimental group: $M_{1st measurement} = 83.00$ vs. $M_{2nd measurement} = 65.00$, $t = 2.775$, $p = 0.01$; the control group: $M_{1st measurement} = 96.00$ vs. $M_{2nd measurement} = 76.00$, $t = 2.775$, $p = 0.011$

In contrast, high-MCS subjects performed the second task significantly worse in the control group: $M_{1st measurement} = 79.65$ vs. $M_{2nd measurement} = 61.76$, $t = 3.302$, $p = 0.003$, while they performed poorly both tasks in the experimental group: $M_{1st measurement} = 69.80$ vs. $M_{2nd measurement} = 62.00$, ns. (see Figures 1 and 2).
Discussion

Saving resources induced by the instruction does not translate into an increase in the performance in the second attempt in the experimental group most likely due to cognitive overload. The level of MCS modifies the results in such a way that high-MCS participants in the experimental group perform sports tasks significantly worse both in the first and in the second trial. In turn, low-MCS participants follow the instructions to perform the task for as long as possible in the first attempt. And although the performance deterioration can be seen in the second trial (the overload effect), they perform both physical tasks better than participants with high-MCS.
Study Two

Predictions

In line with the first study, we believe that the resource saving effect will not occur. The role of MCS should remain the same as in the previous experiment. That is, high-MCS predisposes to a strong need for autonomy. The motivation to follow external instructions may be higher among low-MCS (but not among high) participants.

Participants and Procedure

A number of 101 participants (58 women) took part in the Study Two. All of them were undergraduate students of various courses of study between 18 and 30 years of age ($M = 21.49; SD = 2.023$).

Students participated in the study individually. After giving consent to participate in the study and a statement on the absence of health contraindications, they filled in the short version of MCS questionnaire (MCS-24; Brycz & Konarski, 2016). They then were randomly assigned to either the experimental or control conditions. The differences between these groups were that they received different instructions. The experimental group learned that the task would be to keep the hand in cold water for as long as possible, and then watch a video (described as very funny) and control their emotions while watching it (anticipated self-control condition). The other half of the participants were instructed that the task would be to keep the hand in cold water for as long as possible, and then watch a funny video, but without asking to inhibit their reactions to it (anticipated non self-control conditions).

At this point, the participants were asked how much effort they expect to exert on the movie task (“How much effort do you plan to exert on Task 3?” rated on an 11-point scale ranging from 0 = “No effort” to 10 = “All my effort”), and how much energy that task would demand (“How much energy do you expect the last task will require?” rated on an 11-point scale ranging from “very little” to “very much”). It was designed to assess their perception of the future tasks.

The participants then were told to place their whole hand in cold water (4 degrees Celsius) and to keep it still in it for as long as they could. They were also told that they should only remove their hand when they could not bear the cold any more. Thus, participants were instructed to fight against the urge to remove the hand. The experimenter started timing using a stopwatch the moment their hand was fully submerged and stopped timing once the entire hand was removed from the water. The measurement was made with an accuracy of one second. The water temperature was maintained using a mixture of ice and water. The room temperature was maintained at 24 degrees.

After the task, they were asked whether they were trying to conserve strength for the final task (“How much were you trying to conserve your energy for the third task?” rated on an 11-point scale ranging from “not at all” to “very much”). They were also asked about their performance on the cold water task (“How much effort did you exert to keep your hand in the water?” rated on an 11-point scale ranging from “no effort” to “all my effort”).

After the cold water test, all participants were informed that there was no time left for the last task. Finally, they were thanked and debriefed. No one reported awareness of the conservation hypothesis.
Results

Manipulation check. Consistent with the experimental design, participants viewed future task that required self-control (emotion inhibition while watching a funny movie) as demanding more energy than future task that was not described as requiring self-control. Participants in the future self-control condition reported that they expected the second task to require more energy than did participants in the no future self-control condition ($M_{E} = 6.68$ vs. $M_{C} = 4.63$; $t(99) = -3.944, p < 0.001$). Likewise, participants who expected the second task to be demanding, reported that it was important to conserve the energy for that task much more, than did participants in the no future self-control condition ($M_{E} = 3.56$ vs. $M_{C} = 2.65$; $t(99) = -1.66, p = 0.05$). The former also reported to save more energy for the second task than the latter ($M_{E} =3.20$ vs. $M_{C} = 2.08$; $t(99) = -2.197, p < 0.05$)

Dependent measure. The time participants held their hand in the cold water was analyzed using the t-test. We found that individuals who anticipated that the second task would be demanding for their self-control (the experimental group), tended to remove their hand from the water sooner than those who did not expect to exert self-control, $M_{E} = 87.68$ vs. $M_{C} = 121.51$; $t(99) = 2.180, p < 0.05$.

The main effect for the MCS was revealed as well. Participants with high level of MCS held their hands in cold water for much shorter period of time than participants with low level of MCS, $M/high = 78.68$ vs. $M/low = 130.065$; $F(1, 97) = 12.095, p = 0.001$, $eta^2 = 0.111$.

However, we found significant effects for the mean’s comparison. Low-MCS participants kept their hands in cold water much longer in spite of the instructions (conserving resources $M = 116.77$ vs. no instruction $M = 116.36$, $F < 1$; $t = 1.216$, ns.) than their high-MCS counterparts (conserving resources $M = 59.00$ vs. no instruction $M = 98.36$, $F = 5.07$, $t = 2.07, p = 0.044$).

Low-MCS individuals, who were told to perform a certain task, really did their best. High-MCS participants followed the instruction and conserved their resources or simply they were not motivated enough to perform the task very good. The second explanation seems more reasonable as even in a control group they perform poorer (less time spent on keeping hand in cold water) than low-MCS participants either in the control or experimental group (see Figure 3).

Discussion

The manipulation to conserve resources for future demands was successful only to some extent. Participants who expected the second task to be demanding for their self-control (the experimental group) tended to remove their hand from the water sooner than those who did not expect to exert self-control. However, the instruction did not make any difference for individuals low in MCS—above all they followed the instructions and kept their hands in cold water for “as long as they could”, regardless of whether they expected to use resources in the next task or not. In turn, high-MCS participants withdrew their effort much sooner both in the experimental and control conditions. It seems, therefore, that they are much more insensitive to outside pressure than their low-MCS counterparts.
General Discussion

The results of both experiments support the thesis about the modifying role of individual differences against ego depletion effects. In particular, we direct our attention to the metacognitive self (MCS), which reflects the self-awareness of biases. The feature is rooted in intrinsic motivation and a reflective, deliberate way of thinking about oneself (Bar-Tal et al., 2017). As in the case of emotional overload (Brejwo et al., 2018), people with high-MCS are less involved in imposed tasks than people with low-MCS. Strong insight into one’s biases goes hand in hand with openness to experience and extraversion. It can also be assumed therefore that people with high-MCS work much better in conditions of autonomous choice, and much worse in a prescriptive situation, which can be explained by Self Determination Theory (SDT) (Deci & Ryan, 1985). Imposing instructions and tasks is counterproductive in general, but for individuals with strong MCS, who display greater self-awareness, introjected regulation predicts rapid dropout.

Conclusion

Two studies proved common effect of ego depletion. The instruction preventing from ego depletion does not work in the first experiment. The results show a disputable role of conserving resources that should prevent from ego depletion. Rather individual differences may play crucial role for the administration of resources’ conservation. High metacognitive self individuals (MCS) do not follow external orders at all, and they perform the task at the lowest level. In contrary, low metacognitive self participants do their best when they are led by external order. The level of self-awareness of biases matters. The more people are aware of their biases the more autonomy they need for completing the task at hand.

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