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IMPLICIT THEORIES OF WILLPOWER AND „EGO DEPLETION“

Research paper

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## **Implitsiitsed teoriad tähtejõust ja “ego kurnamine”**

### **LÜHIKOKKUVÕTE**

Käesoleva uurimistöö eesmärgiks oli kontrollida, kas implitsiitsed teoriad tähtejõu iseloomu kohta mõjutavad enesekontrolli kurnamist Eesti ja Vene-Eesti koolikeskonnas. Kõik ülesanded viisime läbi arvutikeskonnas. Õpilased (16-18 aastat) täidatud küsimustike: implitsiitsed teoriade, isikuomaduste ja positiivismi kohta. Pärast seda nad sooritasid kahte enesekontrolli nõudliku ülesandeid: stopp signaal ülesanne ja Stroop test. Puudus implitsiitsete teooriate mõju enesekontrolli kurnamisele katse ajal. Samuti ei avastanud me osavõtjate ego kurnamist. Selle asemel ilmnes vastupidine efekt: lõpusignaali ülesande eksperimendigruppi osavõtjad said Stroopi testis paremaid tulemusi kui kontrollgrupp. Implitsiitsete eneseregulatsiooniteooriate uurimiseks on vaja teha rohkem uurimistööd enesekontrolli ja ego kurnatuse olemuse kohta.

**Märksõnad:** ego kurnamine, tähtejõud, enesekontroll, implitsiitsed teoriad.

**Implicit theories of willpower and “ego depletion”****ABSTRACT**

The goal of this research was to check, if personal theories about the nature of willpower will moderate depletion of self-regulating ability in Estonian and Russian-Estonian school environment. In computer environment high school participants (age 16-18) filled out questionnaires about implicit theories of willpower, personality traits and positivity, then completed two self-control demanding tasks: stop signal task and Stroop task. There was no significant effect of implicit theories on self-control depletion during the experiment. We also did not observe ego depletion in our participants, but instead got a reverse effect: participants from self-control demanding condition performed at Stroop task better than control group. The nature of self-control and ego depletion need more research before studying the influence of implicit theories on self-regulation.

**Keywords:** ego depletion, willpower, self-control, implicit theories.

## INTRODUCTION

### **Importance of replication in psychology field**

Recently was raised a question about necessity of replication in psychology field. It is a debate about quality and credibility of theories in all areas of psychology. Successful replication can be seen as a way to move psychology closer to the shape of natural sciences, to a field with repeated results, based on strict theories (Kepes & McDaniel, 2015). Dedicating resources to replication of already established effects can protect science from fraud and draw a line between theories and dogmas (Pappas & Friedman, 2012).

It does not always work like that: while necessary, replication studies are not very popular as scientific work. Many researchers feels as if it would be a waste of their time and resources, to conduct a study that was already completed by someone else, instead of making an original work. Publishing failed replications is something researchers are especially reluctant to do (Makel, Plucker & Hegarty, 2012), even if it may provide science with important information.

Generalizability of psychological effects across experimental contexts presents another problem. Even a very accurate copy may still fail to produce same results as the original due to various circumstances like sampling bias or unaccounted factors (Cesario, 2014).

Still, the necessity of replication studies is widely recognized, and some dedicated researchers form big projects on this theme, like international team Many Labs Replication Project, that already replicated at least 13 studies, both classic and contemporary, with result of 10 successful replications (Yong, 2013).

This work has a similar goal: to replicate a part of studies about strength model of self-control, particularly if implicit theories about willpower can moderate depletion of self-control.

### **Research of self-control**

Studying mechanisms of self-control bring new understanding to the nature of everyday human behavior. Some authors make a distinction between self-control and self-regulation, arguing that they are not equivalent to each other. "Self-regulation" is usually defined as a goal-directed behavioral function. It is associated with achievement-related behavior, regulation and sorting of goals and ambitions. "Self-control" is used as a purely controlling function, created to override harmful or unnecessary urges and behaviors (Hofmann, 2012). Self-control can be seen as a narrow part of self-regulation system, often depicted as a conscious, effortful subsystem of partly automatic self-regulation (Muraven & Baumeister, 2000).

Perhaps the most influential early research about the role of self-regulation is the longitudinal study by Walter Mischel that took 40 years to complete and created a solid basis for numerous future studies. Mischel and his colleagues developed now famous “marshmallow test” and studied small children’s ability to delay gratification by exerting self-control. Children aged 4 to 7 tried to resist the temptation to eat a small marshmallow immediately, so they could get two marshmallows later. For 40 years, Mischel and his team monitored the life development of those children who took part in the “marshmallow test” in 1960th and 1970th. Children that managed to resist the temptation of eating one sweet immediately, turned out to be more successful as adults. They got higher SAT scores, better self-esteem, kept stable jobs, coped with stress easier and even had better health with less tendency for substance abuse, than those who failed to exert enough self-control at the “marshmallow test” (Mischel, Ayduk, Berman, Casey, Gotlib, Jonides, Kross, Teslovich, Wilson, Zayas & Shoda, 2011).

Further studies of self-regulation processes revealed a lot about crucial role of self-control in life. It plays part in acquiring new skills, setting difficult goals (Kanter & Ackerman, 1989) and job performance (Porath & Bateman, 2006). The nature of self-control itself is more ambiguous, and after a series of experiments, Roy F. Baumeister proposed a *strength model of self-control*.

### **Ego depletion and strength model of self-control**

Roy F. Baumeister started his study on self-control around 1990s and his research is still going, drawing more and more attention to this topic. During experiments, Baumeister and his team discovered the changing nature of self-control: after using self-control to resist some temptation (eating a cookie), participants expressed less control at the next task (willing themselves to solve unsolvable puzzles). Participants in control condition that faced no temptations spent much longer time trying to solve puzzles. Baumeister called this effect “ego depletion”: “...a temporary reduction in the self’s capacity or willingness to engage in volitional action (including controlling the environment, controlling the self, making choices, and initiating action) caused by prior exercise of volition” (Baumeister et al., 1998, pg. 1253). From here starts the notion that self-control may rely on some limited energy source. Some studies found that state of ego depletion negatively affects logical reasoning (Schmeihel, Vohs & Baumeister, 2003) and prompts criminal behavior even in individuals with high self-control (Muraven, Pogarsky & Shmueli, 2006)

Further research of ego depletion effect led Baumeister to creation of *strength model of self-control*. In this model, self-control is viewed similarly to a muscle: it gets tired, needs time to rest and replenish its strength and can be exercised. Findings suggested that self-control depends on a very limited energy resource that is depleted not only by acts of self-control, but by almost any

conscious actions and physiological factors like stress or lack of sleep. At the same time, there appeared to be possibilities to replenish self-control resource and counter ego depletion. Strong motivation or monetary reward negated effect of ego depletion, allowing participants to perform much better on the second consequent task, but did not restore the energy stock. When faced with unexpected third task participants performed even worse, then on the second with no motivational boost (Baumeister, Vohs & Tice, 2007). Exploration of strength model also discovered connection between self-control capacity and level of glucose in bloodstream: participants who received high sugar containing products restored their self-control resource fully. From there it was suggested that self-control directly relies on blood glucose level (Gailiot & Baumeister, 2007). There is some evidence that ego depletion is moderated by implicit theories about self-control (Job, Dweck & Walton, 2010) or personality traits (Uziel & Baumeister, 2012).

Replication of Roy F. Baumeister's findings to this date is contradictory, with some obtaining supportive results (Hagger, Wood, Stiff & Chatziantis, 2010) and others not so much (Seeley & Gardner, 2007). This suggests that nature of strength model of self-control is more complicated than it is established now.

### **Implicit theories about willpower**

One explanation of irregular results of reproducing ego depletion studies is that in some conditions Baumeister's strength model does not work as expected. Factors like motivation and expectation of monetary rewards already demonstrated significant moderating effect on ego depletion, and some researches went even further, proposing alternative theories about nature of strength model of self-control. Job, Dweck and Walton (2010) came up with an assumption that individual self-control capacity depends on implicit theories a person holds about the nature of willpower. In general, if the person believes that performing difficult tasks and/or exerting self-control has a depleting effect on their willpower, they will show weakened self-regulation ability on subsequent task. Alternatively, in the case the person believes that difficult tasks are in fact strengthening their willpower then their performance at subsequent tasks will show no ego depletion. Researchers termed these *limited-resource theory* and *nonlimited-resource theory* respectively.

Job et al. (2010) conducted a series of experiments, where they measured and/or manipulated beliefs about willpower in their participants and made them complete a depleting task and subsequently Stroop task. In their study, people with limited resource theory displayed diminished self-control on Stroop task, making more mistakes, while people with nonlimited resource theory performed significantly better.

In the present study, I am trying to reproduce ego depletion and check whether implicit theories about willpower will have moderation effect. I am using experimental design similar to that of Job et al. (2010), with slight adjustments: instead of letter-crossing task that they used for the first depleting task, I use Stop Signal task.

*Hypothesis 1:* Participants in experimental group that complete depleting version of the first task, will perform worse at the second task, than control group that competes non-depleting version of the first task.

*Hypothesis 2:* Participants that hold nonlimited-resource theory about willpower will not experience ego depletion, and those with limited-resource theory will.

## METHOD

### Sample

Present research used two samples of student participants combined, 118 individuals in total, age 16-18, both drawn from two Tartu secondary schools, Estonian-speaking school and Russian-speaking school. Sampling procedures for both groups used same protocols, translated in corresponding languages. Obtained data was pooled together and further analyzed as a single sample.

I had to exclude some participants' results from final analysis due to incomplete data provided and low engagement in the task, further explained in Analysis section. Final sample consists of 104 participants in total. Russian-speaking group had 36 participants (21 female, 15 male), who were randomly separated into condition groups, with 14 people in experimental condition group and 22 in control group. Estonian-speaking group had 68 participants (52 female, 16 male), and was randomly divided into experimental group with 33 and control group with 35 participants.

School administrations signed their agreement to conduction of the research on school territory, and provided computer classes for experimental procedure. Participation in the research was voluntary, with no monetary incentive provided. Each participant signed an informed agreement form in advance, and those, who would not reach age of 18 years at the moment of the experiment, obtained an additional agreement from their parents.

### Procedure and materials

Experiments were carried out in school environment, in computer classes, all tasks were computer based. First, participants filled out all four questionnaires, then moved onto Stop Signal Task. The

program randomly assigned them into experimental and control groups. Experimental group had stop signals appearing sometimes in the second part of the task and had to exercise self-control in order to refrain from responding at these trials, while for control group the second part of the task was the same as the first one. After completing that task, everybody moved on to Stroop task. The whole experimental procedure took about 40 minutes.

### ***Questionnaires***

1. The “Short Five” personality inventory (Konstabel, Lönnqvist, Walkowitz, & Verkasalo, 2012); a shortened version consisting of 34 items.
2. The 8-item positivity questionnaire (Caprara, Alessandri, Eisenberg, Kupfer, Steca, Caprara, Yamaguchi, Fukuzawa & Abela, 2012).
3. Implicit theories of willpower (12 items; Job et al., 2010)
4. Single item self-esteem scale (Robins, Hendin & Trzesniewski, 2001).

The whole questionnaire consisted of 55 items and took approximately 15 minutes to fill out.

### ***Tasks***

*Stop signal task* is used to measure impulse control and requires suppressing the automatic urge to act. Instructions direct a participant to react quickly and carefully to a simple visual stimulus, choosing one of two options of response or to withhold a response at all under a certain condition. In the first part of our version of the task, the program was presenting participants with simple picture of an arrow, pointing either left or right. A participant had to press corresponding arrow key on the keyboard. After 30 trials the second part started, with additional instructions. The main task of selecting arrow keys corresponding to presented image remained the same, but now participants were introduced with a possibility of a red circle appearing after a short period of time around the image. In that case, participants had to resist the urge to respond and simply wait, until image changes to a new one. The second part consisted of 100 trials. Only experimental group received stop signals (red circles) in one third of these trials.

*Stroop task* is a recognized test that demands self-control to suppress initial automatic response in favor of correct response. The version in this study used numbers and letters: program screen presented participants with series of numbers (1, 2, 3) or letters, from one to three items each. Participants had to press a number key on their keyboard according to the amount of items presented, not according to the digits shown. As with previous task, participants were urged to respond as quickly and carefully as possible. After 10 practice trials, participants completed 100 actual trials.

Experimental procedure used a computer program, designed and provided by University of Belgrade, Serbia.



### Dependent and independent variables

Dependent variable is a number of correct responses for incongruent trials at Stroop task. Independent variables are self-control depletion condition, implicit theories of willpower z score and gender. Language was not used as a factor because of small size of Russian sample.

## RESULTS

For data analysis I used a generalized linear mixed model with random intercepts fit by maximum likelihood.

I had to exclude several cases from the analysis for various reasons: incomplete data sets, outliers for response time variable, accuracy less than 80% for first part of stop signal task. Abnormally high speed of response and very low number of correct responses indicate either low engagement in the task or failure to understand instructions.

Participants were sorted into three groups by z score of their implicit theories questionnaire results: unlimited resource theory  $Z_{imp} = 0,8$ ; limited resource theory  $Z_{imp} = -0,8$ ; undecided  $Z_{imp} = 0$ .

Covariates on individual level: response time and order of trial.

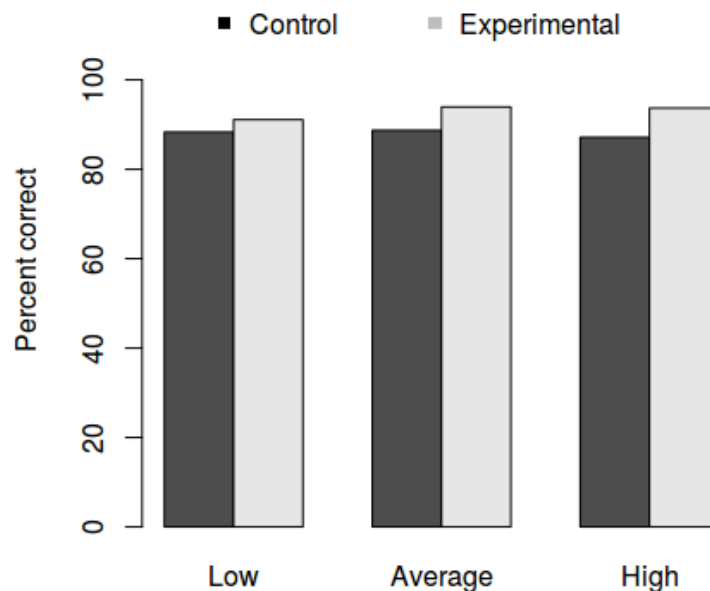
Results are presented in *Table 1*.

**Table 1.** Influence of fixed effects on rate of correct responses at incongruent trials of Stroop task

	Estimate	Std. Error	z score	p value
(Intercept)	-0.0233982	0.2869051	-0.082	0.9350
Group: exp	0.3808039	0.1651058	2.306	0.0211 *
Order of trial	0.0042415	0.0023089	1.837	0.0662
Response Time	0.0030216	0.0004217	7.166	7.72e-13 ***
z (implicit theories)	-0.0537322	0.1223654	-0.439	0.6606
Gender: male	-0.1778263	0.2102964	-0.846	0.3978
GRPexp: z (implicit theories)	0.1756653	0.1656036	1.061	0.2888
Interaction				

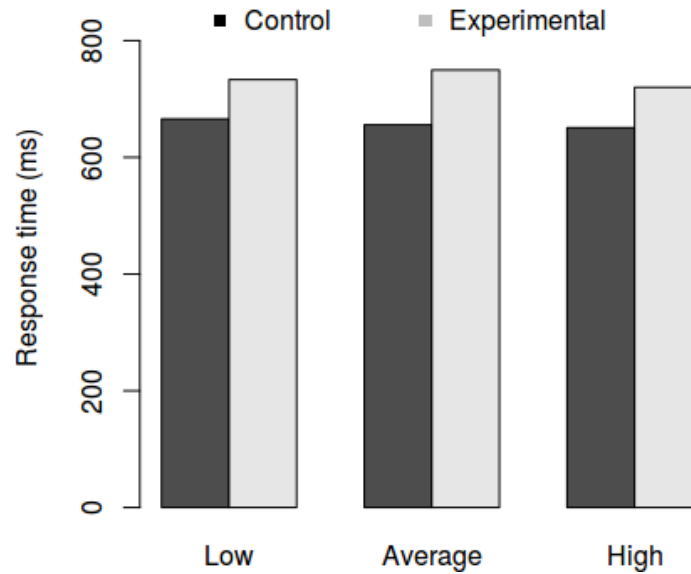
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Depletion condition had a significant effect on percentage of correct responses to incongruent trials of Stroop task ( $\beta = 0.3808039$ ,  $SD = 0.1651058$ ,  $p \leq 0.05$ ). Despite expectations of initial hypothesis, participants in experimental condition performed better at Stroop task ( $M = 0.9637$ ,  $SD = 0.0288$ ) than participants in control condition ( $M = 0.9435$ ,  $SD = 0.4884$ ). There was no significant effect of implicit theories score ( $p \geq 0.05$ ). Response time at the Stroop task also presented a significant positive effect ( $\beta = 0.0030216$ ,  $SD = 0.0004217$ ,  $p \leq 0.05$ ). Gender had no statistically significant effect.



**Fig. 1.** Participants in experimental group had higher percentage of correct answers on incongruent trials of the Stroop task. There was no statistically significant difference between scores of participants with limited-resource theory (Low), nonlimited-resource theory (High) and undecided (Average).

Participants in experimental group also took more time to complete Stroop task ( $M = 690.570$  ms,  $SD = 137.3257$ ), compared to participants from control group ( $M = 624.338$ ,  $SD = 104.7221$ ). Participants with nonlimited-resource theory spent slightly less time on the task, in both experimental and control conditions, but there was no statistically significant effect.



**Fig. 2.** Participants in experimental group spent more time completing the Stroop task, than participants in control group. There was no statistically significant difference between scores of participants with limited-resource theory (Low), nonlimited-resource theory (High) and undecided (Average).

Obtained results did not show ego depletion in participants and no significant effect of implicit theories about willpower was found.

## DISCUSSION

To conclude obtained results, this experiment could not confirm either of initial hypotheses. No ego depletion was observed during the experiment therefore it was not possible to verify whether implicit theories about willpower can moderate ego depletion. The data gave the opposite result from what was expected: participants in experimental group performed significantly better, then participants in control group. There are several possible explanations to observed results.

### Small time period

First, it is possible that this self-control depleting task was simply too short. First task took only about 15 minutes, which may be too small amount of time for participants to feel any effect on their self-control.

Recently, a group of researchers held a series of experiments, which explored effects of control-demanding cognitive work over prolonged period of time (up to 6 hours). Participants exhibited diminished self-control only starting from 4.5 hours of cognitive work and only in difficult task

condition, while participants in easy task condition did not show signs of ego depletion (Blain, Hollard & Pessiglione, 2016).

### **Cognitive control theory and adaptation**

Another possible explanation for experimental group performing better and taking more time to respond could be participants' adaptation to the task. This approach takes off from cognitive control theory (Botvinick, Barch, Carter & Cohen, 2001), which assumes that in the case when two responses activate simultaneously, cognitive system purposefully overrules one of conflicting responses in favor of another. After some time cognitive system can adapt to presented conditions or instructions and ignore unnecessary information without active conscious effort. While this process takes up additional cognitive resources, as it is not directly conscious, supposedly it does not deplete self-control resource. Several recent studies used cognitive control theory to explain faults of replications of ego depletion experiments (Dewitte, Bruyneel & Geskens, 2009; Dang, Dewitte, Mao, Xiao & Shi, 2013). Dewitte et al. (2009) proposed that in the case of similar sequential tasks cognitive control enhances self-control and reverses ego depletion effect. Their experiments confirmed their hypothesis that cognitive control mechanism allows temporary adaptation to specific conditions and improves self-control at subsequent task, as long as subsequent task needs similar cognitive processes for solution. Dang et al. (2013) went further in this topic, and confirmed that cognitive adaptation mechanism can moderate ego depletion even with different sequential tasks. In their study, as long as participants successfully adapted to the first depleting task, they experienced no lowering of self-control at the second task.

### **Learned industriousness**

Another explanation for my results follows the theory of learned industriousness by Eisenberger (1992). This theory suggests that demanding tasks may stabilize or even improve self-regulation at following task. A research by Converse and DeShon (2009) obtained results that support this theory: participants in high-effort condition persisted on the subsequent task longer. In other words, they exerted self-control for longer period of time, than participants from low-effort group. This is directly opposite result from expectations of strength model of self-control and supports my findings.

Together with adaptation theory, this suggests there may be more processes at play in strength model of self-control besides depletion-recovery, like adaptation process in particular.

## Conclusion

In future, it could be useful to adjust this experimental design to elicit ego depletion more reliably and check hypothesis about relationship of implicit theories of willpower and ego depletion again. Increasing time spent on depletion task should increase mental fatigue and diminish self-control. Making depletion task more complicated should reduce adaptation to the task, allowing self-control to diminish. Overall, depletion task and subsequent task should differ in structure as well, so completing depletion task would not serve as a practice for subsequent one. This apparently happened in my case, as both tasks here share many features: simple visual stimuli, demands on speed and accuracy, same manner of response by pressing keys with the dominant hand. They also share the same intuitive strategy for success that lays in withholding from response for some time to be sure in correct reaction. Perhaps changing the style of Stroop task could be useful, for example saying answers aloud, instead of pressing keys.

Counting personal ego depletion score for each participant could provide more understanding about nature of ego depletion and individual factors that influence it. A repeated measures design, where all participants complete all conditions in different order, could be used for this purpose.

The mechanism of implicit theories affecting self-control is also not quite clear. However, before researching its relationship with ego depletion, it is necessary to study ego depletion itself further.

More research is needed to clarify processes of self-control. It seems like ego depletion is susceptible to moderation by some additional factors besides motivation, blood glucose and others, suggested by Baumeister and his colleagues. It is possible that ego depletion as concept is not very useful and strength model of self-control has more complex structure, than it is assumed now.

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*Käesolevaga kinnitan, et olen korrektselt viidanud kõigile oma töös kasutatud teiste autorite poolt loodud kirjalikele töödele, lausetele, mõtetele, ideedele või andmetele.*

*Olen nõus oma töö avaldamisega Tartu Ülikooli digitaalarhiivis DSpace.*

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