

ON HORSES, HUMANS AND SUGAR:
TOWARDS A DESIRE-CENTERED VIEW OF SELF-
CONTROL

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To the memory of my father

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Abstract: Past research demonstrated that following exertion of self-control, people perform worse on subsequent tasks requiring self-control (Baumeister, Vohs & Tice, 2007). Previous research also demonstrated that following a brief sugar-based mouth-rinse this effect is eliminated. According to the currently most widely accepted theory these phenomena are due to a “limited resource” that gets depleted (and replenished) in the course of exerting self-control. Nevertheless, the “resource” is only metaphorical and implied, thus the exact mechanism of the observed self-control deterioration is still unknown. Self-control can be described as a battle between self-control strength and impulse strength (e.g. Schmeichel, Harmon-Jones & Harmon-Jones, 2010). The present research proposed a need for the shift in focus from the self-control strength towards the impulse strength. More specifically, the current research hypothesized that the intensification of the temptation (strengthening of the competing, momentary desires and weakening of the focal goal) is the mediator of the observed “depletion” effects and the reversal of the same is the mediator of the observed “replenishment” effects. The results provided only partial support to these ideas. Experiment 1 found that the decrease in motivation about the focal goal partially mediated the decline in self-control, in a procrastination experimental paradigm. Experiment 2A found that the decrease in the perceived value of the reimbursement for the focal goal completely mediated the observed sugary-mouth-rinse “replenishment” findings in the unsavory drink paradigm. Experiment 2B found that in the cookie-snacking paradigm the most extreme restrained and non-restrained eaters perceived the cookies as more delicious but restrained eaters consumed fewer cookies, while non-restrained eaters consumed more cookies when “depleted”. Altogether, it appears that the role of temptation-strength (desire-intensification and goal de-intensification) is a promising avenue of research in the self-control literature.

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CHAPTER I

INTRODUCTION

According to folk wisdom, forbidden fruits are more desirable, harder to resist and more enjoyable once we indulge in them. People can resist their objects of desire for a while, but at one point, this object might eventually become so attractive and desirable, that people will succumb to the temptation. Of course, the object of desire is not physically changing its form during the course of this event, but in our mind it does, and we experience it as more inviting: We virtually feel drawn to it.

Objects of temptation can take two main forms. The most common forms of temptation are attractive, but it benefits us to avoid them. So, we are resisting approaching these stimuli; however, devastatingly, at one point, we end up approaching them, perhaps because they became so irresistibly attractive. The less common forms of temptation are repulsive, but it benefits us to approach (persevere on) them. So, we are resisting avoiding these stimuli; however, devastatingly, at one point, we end up avoiding them, perhaps because they became so irresistibly repulsive.

Think about a friend who is counting calories, but after a strenuous day in the office, on her way home, she eats two large slices of pepperoni and sausage pizza. Most likely, she “blames” it on the pizza and argues that somehow, the pizza smelt, looked (and soon after having the first bite also tasted) more delicious than she experiences it usually, such as during a quick lunch break. Try to convince her that the pizza cannot smell and taste better at different times; tell her, she indulged because she was crunching numbers for eight hours, and a mystery-self-control-resource inside her got “depleted”, so she did not have enough “strength” to resist the pizza. She would probably look at you in disbelief.

And, yet, this is what the currently most popular view of self-control, the Limited Resource model (Baumeister, Voice & Tice, 2007), successfully argued for, during the past two decades: People break their diets and exercise routines, not because they possibly experience their temptations as looming larger, but because they lost some mysterious resource to resist these temptations.

Since Freud, self-control has often been depicted as a battle of two strengths: the horse (*desire strength*) and the rider (*self-control strength*) that tries to tame the animal (Irvin, 2006). Nevertheless, after briefly acknowledging this state of affairs, the limited resource model of self-control solely focused on the rider and ignored the horse. The taming can fail and the horse can gallop away for at least two reasons. It is true that the rider might become tired and becomes unable to control the horse. However, it is also possible that the rider is still strong, but the horse becomes uncontrollable (for several possible reasons). The aim of the current work was to bring the horse back to the focus and provide this way a more nuanced view on what is really happening during this battle of wills between desire and self-control.

The current work focuses on such situations where following self-control exertion at time 1, self-control becomes impaired at time 2. The aim is not to falsify the resource model; based on our limited knowledge about the mysterious “limited resource” such an attempt is currently not even possible. Instead, the current work argues that although it is possible that the decreased self-control performance at Time 2 is due to a *decrease of self-control strength*, it might also (or maybe even solely) be due to the *increase of the desire strength*. Specifically, I predict that individuals who engaged in self-control earlier, start experiencing the world differently: their momentary desires loom larger on them than their longer term goals do. Briefly, the central idea of the current work is that after people successfully resisted a forbidden fruit, for a short period of time, the next potential forbidden fruit(s) will be experienced as more desirable and will become *the* Biblical forbidden fruit(s) that people will succumb to.

CHAPTER II

REVIEW OF LITERATURE

The “Limited Resource” Model of self-control

The metaphoric Limited Resource Model of self-control is currently still the most popular and widely accepted theory of self-control (Hagger, Wood, Stiff & Chatzisarantis, 2010). The model hypothesizes that there is a mysterious, “inner resource” of self-control of which people become “depleted” once they initially engaged in some form of self-control, so they become less able to exert self-control on a later occasion. Baumeister and colleagues likened this resource to the physical muscle of athletes, bringing up the analogy that when athletes exercise, their muscles fatigue and after some time fail to function properly, needing rest/replenishment (Baumeister & Heatherton, 1996).

The default experimental paradigm of self-control research is the dual task method. This became popular through a study in which researchers assigned some participants to eat cookies and others to eat radishes while the “delicious aroma of fresh chocolate and baking” filled the air of the laboratory (Baumeister, Bratislavsky, Muraven & Tice, 1998, p. 1254). Shortly afterwards they gave unsolvable puzzles to all of them and found that those who tasted radishes quit much faster than those who tasted cookies

(Baumeister, Bratislavsky, Muraven & Tice, 1998). The researchers concluded that this happened because both tasks (resisting a desirable food item and working on the unsolvable puzzles) required self-control and, apparently, using self-control in one task makes people less successful in a subsequent task that also requires self-control.

This result was conceptually replicated close to 200 times (see Muraven, 2012 for review) and a recent meta-analysis found strong evidence that engaging in self-control makes subsequent self-control less successful (Hagger, Wood, Stiff & Chatzisarantis, 2010). Nevertheless, still no clear and convincing evidence (and theory) exists for *why* this phenomenon happens. Several potential logical and testable explanations exist, but throughout these sixteen years since the seminal cookie study, research in this area was virtually paralyzed by Baumeister's initial explanation, the Limited Resource Model. Following a series of baffling findings that could not fit into this theory, recently, several competing theories emerged (e.g. Inzlicht & Schmeichel, 2012).

The Criticism of the Limited Resource Model

The evidence for the Limited Resource Model appeared to be the strongest when Gailliot and colleagues (2007) claimed to have found the physical basis of the limited self-control resource: blood-glucose (Gailliot, Baumeister, DeWall, Maner, Plant, Brewer & Schmeichel, 2007). Specifically, they reported findings that people's glucose levels dropped significantly after they engaged in self-control (Study 1). This drop in glucose was correlated with the significant drop in performance on the second task of self-control (Study 2). Most importantly, if participants were given a drink sweetened with glucose,

their performance on the second self-control task increased significantly; however this did not happen if the drink was sweetened with artificial sweetener (Study 3).

These findings were replicated (e.g. Masicampo & Baumeister, 2008), nevertheless others have criticized the research on both a theoretical level (Hagger, Wood, Stiff & Chatzisarantis, 2010) and a methodological level (Beedie & Lane, 2012). Furthermore, upon closer re-analysis of the original data, Kurzban (2010) did not find the same pattern of results as Gaiot and colleagues (2007) did. Most importantly, very recently, three independent groups of researchers (Molden, Hui, Scholer, Meier, Noreen, Agostino & Martin, 2012; Hagger & Chatzisarantis, 2012; Sanders et al., 2012), in three independent laboratories, falsified this metabolic glucose-replenishment theory and shed serious doubt on the Limited Resource Model of self-control in general.

Molden and colleagues (2012) found that simply rinsing one's mouth with glucose for five seconds, has the same effect as digesting glucose: eliminates the depletion effect or in other words, makes subsequent self-control better. Most importantly, when they measured blood-glucose level following the recommendation of Beedie and Lane, (2010), no difference was observed: the glucose level did not become lower following initial engagement in self-control and the glucose level did not become higher after one gargled a drink with real sugar.

Hagger and Chatzisarantis (2012) reported very similar results to Molden (2012) and they linked this with the neuroscience finding that oral glucose receptors activate reward- and motivation related brain regions. They indeed found that when participants

sensed glucose in their “oral cavity”, the mentioned brain regions were activated. They argued that the results Gaijot et al. (2007) observed are the direct effect of these neural activations and not glucose metabolism.

Very recently, Sanders and colleagues eliminated the slightest doubt about any potential metabolic effect of glucose (Sanders, Shirk, Burgin & Martin, 2012). They conceptually replicated Molden’s study (2012) with the modification that their participants rinsed their mouth simultaneously with the second task of self-control. Regardless, they replicated the previously described findings: performance on the second task of self-control improved.

These three papers by Molden (2012), Hagger (2012) and Sanders (2012) pose a rather big blow to the idea that glucose is *the* physical basis of the limited resource of self-control. More importantly, however, they suggest that sensing real sugar improves self-control through a different, indirect, mechanism – rather than restoring a limited resource. The most likely possibility is that sensing glucose in one’s mouth serves as some kind of a reward what, according to Hagger (2012), might increase motivation.

The reward idea is supported by several findings. First, if participants are offered a reward, they do not show signs of depletion in the second task (Muraven & Slessareva, 2008). Second, the way the experimenter communicates with the participants is important: A warm, open, friendly experimenter is less depleting than a cold, distant experimenter (Muraven, Gagne & Rosman, 2008). Furthermore, providing detailed feedback about one’s performance, compared to no feedback which by default happens in

all self-control studies, also eliminates the depletion effect (Wan & Sterntal, 2008). The most baffling finding is that participants who were asked to rank personality traits and values based on whether they are descriptive of them or not (even if the traits were not positive) were better on Task 2 than those participants who engaged in a task that did not involve thinking about themselves. The authors argued that most healthy individuals have good opinion about themselves, so thinking about oneself might automatically bring to mind the positive aspects, which could be inherently rewarding and uplifting (Shmeichel & Vohs, 2009).

Even watching a brief, funny movie segment (Tice, Baumeister, Shmueli & Muraven, 2007) or having a brief 10-minute break following the first task of self-control (Tyler & Burns, 2008), makes performance on the second task of self-control better compared to when no break is given. Nevertheless, when Vohs and colleagues (2011) subjected individuals to a 24 hour total sleep deprivation, it did not add to the damage of depletion, so the effect is not simply about being tired.

At first blush, the described “replenishments” of the depleted self-control resource appear to be very diverse. One thing in common though is that to some degree all of them are rewarding (ranging from the evolutionarily important taste of sugar to a simple acknowledgment of good progress on the task). Whatever the explanation is, as Inzlicht and Schmeichel (2012) stated, all of the reviewed findings place a serious doubt on the “sufficiency and necessity of the resource metaphor” (p.453); consequently these two

authors are urging for its urgent replacement with a more mechanistic, less metaphorical theory.

Indeed, recently, several alternative theories of self-control emerged. The debate is not with the method or the results of the studies conducted within Baumeister's dual task paradigm. The debate is with the dominant theory that argues to be explaining these results. The Limited Resource Model states that people have a self-control resource that becomes depleted by each act of self-control, so at each subsequent occasion it operates with lesser quality/intensity. According to Baumeister (2011) the depletion of this self-control resource is manifested in the observations that people become *weaker* to resist their temptations/impulses later. The evidence is strong that people become weaker resisting temptations; the problem is that no real evidence exists that these observations are related to some resource that becomes depleted. No one, so far, found such a resource, let alone observed the act of depletion happening. So, what then is responsible for the worsened performance on the second task? As Schmeichel, Harmon-Jones and Harmon-Jones (2010) stated, the results that are argued to "demonstrate the existence of the resource" (Baumeister & Muraven, 2000) actually "suggest that prior efforts at self-control influence subsequent self-control by reducing self-control strength, increasing impulse strength or by some combination of these two factors" (Schmeichel, Harmon-Jones & Harmon-Jones, 2010). In other words, two different accounts are equally plausible explanations of the same research finding of the dual task paradigm.

Baumeister and Heatherton (1996) acknowledged that self-control is about the battle of longer-term goals and momentary desires. However, they assumed that engaging in self-control does not change the desires and the feelings of the person, but it only weakens the resources needed for successfully battling these desires. Several recent research findings suggest a new model of self-control that proposes that affects and desires *do* change following exertion of self-control.

In the following section I will describe one theory and a series of experiments that I will be relying on in my proposed studies: the Process Model of Self-Control (Inzlicht & Schmeichel, 2012) and the experiments that found intensification of approach motivation (Schmeichel, Harmon-Jones & Harmon-Jones, 2010), as well as the intensification of affects and desires (Vohs et al, 2011).

The Process Model of Self Control

Inzlicht and Schmeichel (2012) suggest that no resource is depleted in the dual task paradigm studies of self-control; resources are just re-allocated based on the current needs of the person and/or current situational factors. More specifically, these authors suggest that after engaging in self-control at Time 1 two general changes take place: 1) a shift in motivational orientation (from inhibiting desires to fulfilling desires) and 2) a shift in the focus of attention (from cues of control to cues of reward).

More concretely, Inzlicht and Schmeichel (2012) suggest that after exerting self-control, people are less likely to *notice conflict* (attention shift) and/or are less likely to *experience the need* for control (motivation shift), both leading to a smaller exerted

control activity. A second possibility is, according to these authors, that after exerting self-control, people are also more likely to *notice rewards* (attention shift) and/or more likely to *experience* desires (motivation shift), both leading to larger indulgence in desires on the expense of control (Inzlicht & Schmeichel, 2012). To put in everyday terms, the lack of self-control on Task 2 (according to these authors) happens, because after controlling themselves, people do not notice that they have to control themselves or they simply do not want to control themselves. On the flip side, they might be noticing desired objects/activities more or they simply come to want them more. Consistent with the fact that emotion and motivation are difficult to tease apart and interact to produce behavior, a recent extension to the Process model (Inzlicht, Schmeichel & McRae, 2014), added a third component: a shift in affect (increased affect to “want to” goals and decreased affect to “have to” goals).

The Desire/Feeling Intensification Experiments

An alternative, but related possible explanation of the depletion findings is that after people engaged in self-control, all their urges and feelings are strengthened (Vohs et al, 2011). Schmeichel and Harmon-Jones (2010) were the first to directly demonstrate, but without formulating a theory *per se*, that after engaging in self-control task, approach-motivated impulses increased. Their studies, however concentrated only on positive stimuli that people tend to approach and self-control is clearly not only about resisting the indulgence in something pleasant (food, alcohol, sex etc.), but also persisting in something that is unpleasant (exercise, difficult tasks etc.).

Vohs and colleagues (2011) were the first to find that all types of affective reactions (feelings and desires) were intensified following self-control exertion. After participants engaged in self-control, they reported having larger affective reactions to both positive and negative images (Study 1) and they provided more extreme ratings to presumably neutral Chinese symbols (Study 2). Not only their feelings towards stimuli increased, but their desires intensified too. Depleted participants consumed more cookies in a taste-rating study and they also indicated higher desire to eat another cookie on each subsequent occasion. Most importantly, their desire ratings mediated the number of cookies consumed (Study 3). Overall, these three studies directly show that engaging in activities requiring self-control strengthens feelings and evaluations of stimuli, as well as desires related to them.

Most of the early self-control studies can be interpreted in at least two ways. Baumeister and Heatherton (1996) argued the observed findings are the result of the depletion of some, still unknown, limited resources. However, the very same results can also be explained with the strengthening of the experienced “impulses” (Schmeichel, Harmon-Jones & Harmon-Jones, 2010).

The described two explanations, the self-control depletion and the desire intensification, are virtually mirror-images of each other and, in terms of outcome variables, they have the exact same predictions. Nevertheless, as they are based on vastly different mechanisms, they have dramatically different consequences for developing interventions to improve people’s self-control. Most likely, a detailed knowledge about

both will be needed to develop the best cures in situations where people face self-control dilemmas. Unfortunately, however, we currently know very little (if anything) about the “limited self-control resource”, so no hypotheses regarding the resource can be tested and falsified directly. At the same time, specific hypotheses can be formulated, tested and falsified about the strength of “impulses” (affects and desires).

The Present Research

The purpose of the present work was to investigate more directly whether the intensification of affects and desires towards the object of resistance is (potentially one of) the driving force(s) behind the consistently observed findings of decreased self-control performance following self-control exertion. The goal of the current work was not to pit the proposed *desire increase* model against the *self-control decrease* model. It is not *yet* possible. Both models predict the exact same outcome: lower self-control at Time 2. The existence and strength of the resource is only inferred from the experimental results of the dual task paradigm, but measuring the “resource” directly is not possible. On the other hand, the existence and strength of desires can also be inferred from the same results, but most importantly, we can also measure them directly. Thus, the aim of the current studies was to investigate the potential importance of incorporating desire strength in future models and studies of self-control.

I predicted that following exertion of self-control, people *will* experience their feelings and desires more intensively. Specifically, following self-control exertion what was initially perceived as unpleasant will be perceived as even more unpleasant and what

was perceived as pleasant will be perceived as even more pleasant. Consequently, these stimuli will lead to desires that are harder to resist, so people will be more likely to avoid or approach them, respectively. As mentioned earlier, I do acknowledge that it is difficult to separate motivation and emotion; thus I also acknowledge that behaviors are the result of the interaction of the two.

Nevertheless, I left open the opportunity that my results will confirm the original assumption of the Limited Resource Model, namely that affect and desire remain unchanged following engagement in self-control. In either case, the studies are a crucial, research-direction defining contribution to the question of what “depletion” *really* is or stated more tongue-in-cheek: is “depletion” really depletion or just looks like depletion?

The first study examined the mechanism of “depletion”, measuring if and how the experiences of individuals change and if and how this change leads to change in their behavior. I choose for this purpose the procrastination paradigm, because it provides the best opportunity to start investigating whether the action is mostly on the desire/temptation side, or whether it is mostly on the goal side.

The second and the third study examined the mechanism of self-control “replenishment” (via the sugar-gargling manipulation), after initial exertion of self-control. Based on the most recent evidence, sugar can hardly “replenish” any physical resource. Nevertheless, even a brief encounter with sugar dramatically changes cognitions and behavior. Given that sugar is evolutionarily rewarding, a brief taste of

sugar (but not artificial sweetener) might be changing the experience of the world. It might do it directly through bringing back the elevated affect and desires to normal; this would support the Affect Intensification findings by Vohs and colleagues (2011). However, it might change the experience of the world indirectly, through re-orienting motivation; this would support the Process Model. The Limited Resource Model would predict that gargling sugar does not change affect and desires, as they do not change as a result of “depletion”. Either possibility would significantly contribute both to the study of self-control in general and to the question of the role of glucose in self-control in particular.

CHAPTER III.

EXPERIMENT 1: WHY “BUSY WORK” MAKES PEOPLE PROCRASTINATE?

A growing number of results points into the direction that following exertion of self-control, individuals perceive tempting/desirable stimuli as more desirable and/or they perceive uncomfortable/dreadful stimuli as more undesirable (Vohs et al, 2011; Inzlicht & Schmeichel, 2012). If this is the case, desire intensification might be the proximate driving-force of the observed effects, referred to as “depletion” in the past. A study testing this possibility, however, was never conducted so far. Specifically, I predicted that following engagement in self-control, practicing for a difficult and not very interesting test will appear to be even less desirable and/or tempting alternatives, such are colorful magazines or videogames, will appear to be more desirable. Furthermore, I also predicted that these evaluations will directly drive the performance on the subsequent, second self-control task and will lead to the effect of longer procrastination.

Participants

Sixty-seven undergraduates (49 women, ages 18 to 50, median age 19), recruited through the subject pool of a large Southwestern University, participated in the study. Participants received course credit in exchange for participation. All participants were treated and all data were handled following the guidelines of Oklahoma State University IRB.

Two individuals (females, age 18 and 20) were both univariate outliers on the measure of procrastination and multivariate outliers (on the two key measures of

procrastination and temptation-conflict); consequently they were excluded from the sample. The final sample consisted of 65 participants randomly assigned to two conditions. The low self-control condition consisted of 32 participants (26 women, median age 19), while the high self-control condition consisted of 33 participants (21 women, median age 19).

Procedure and Materials

General procedure

The procedure closely followed the general procedure of the classic dual task paradigm (Baumeister et al, 1998), with a small modification: In between the two self-control tasks the proposed mediators were measured. First, self-control exertion was manipulated (assigning participants to high vs. low self-control). Then participants completed the ratings (the measures of the proposed mediators). This was followed by the second self-control task, where self-control exertion was measured. Finally, participants answered various additional questions.

Self-control task 1: The perceptual vigilance task

After completing the consent form, participants were told the following:

“This study looks at the relationship of attention and success in life. However due to the early stages of this research you will participate in few unrelated brief studies.”

The first part of the study followed the procedure described in the seminal paper of self-control by Baumeister, Bratislavsky, Muraven and Tice (1998, Experiment 4) as well as the mouth-rinse study by Molden and colleagues (2012, Study 1 &2). All participants first received a page from an advanced statistic textbook and they were asked

to “cross out every E”. After they finished this first page, all participants received a second, similar page and, based on random assignment, half of them were asked to follow the same rule and “cross out every E” (*no/low self-control exertion condition*) while the other half were asked to follow a different rule: cross out every E that is neither adjacent to nor one letter removed from another vowel” (*high self-control exertion / “depletion condition*). To make the task even harder for the high exertion individuals, the text was lightened at some parts of the page. The copy for the low exertion individuals was sharp and legible. All participants were stopped after 8 minutes on the first crossing-E-s task and after 12 minutes on the second crossing E-s task. When participants finished both attention tasks, they were escorted to a different room and told that a different experimenter will be with them shortly.

Rating of magazines and tasks

The second experimenter greeted the participants and said the following, pretending to be asking for a favor:

“Ok... we are actually a bit rushed at this moment. However, before we go to the next task, we would like your help in two other quick little studies. The Bookstore is considering the introduction of the sale of magazines on a discounted price. So they asked us to give a quick survey to students on how you feel initially when you see certain magazines. They are also interested how much you would pay the most if these magazines are offered on discounted price. We only have about 2-3 minutes for you to glance over these magazines quickly and provide a rating on few dimensions (how interesting or how well designed they appear to you). There is really no time for you to read or look at them too much. So just spend about 10-15 seconds on each before rating.”

Participants were asked to open the door once they were done, however all of them were interrupted after 3 minutes, and were given 1 minute extra time in case they had not finished rating all magazines – at which point they were interrupted to maintain the cover story of being rushed on time. (The magazines were selected on the basis of being the top 10 favorite magazines of a different group of college students according to their answers to the open ended question: “*List your 3 favorite magazines.*”)

Next the experimenter said the following:

“Alright... We have a second quick task before doing the main one. As you will hear soon, the University Career Services is planning to introduce a new measure that will help in students’ career orientation. They would like to hear students’ first impression of the tasks: how novel, difficult, exciting they are. We really have only a minute or two. Please, glance over each task and rate them on those dimensions as well as try to guess how many tasks you would practice from each task-type before taking the actual career test. Do not try to solve or mull over these tasks at this point, because we are short on time. Just provide your first impressions on each task.”

Again, participants were asked to open the door once they were done, however all of them were interrupted after 3 minutes, and were given 1 minute extra time in case they had not finished rating all magazines – at which point they were interrupted to maintain the cover story of being rushed on time. All participants completed both rating tasks, but the order of the two tasks was counterbalanced across participants.

(See *Appendix A* for the Task rating and *Appendix B* for the magazine rating)

Self-control task 2: Resistance to procrastination

The second self-control task measured resistance to procrastination. The instructions given to the participants were based on Vohs and colleagues (2008, Experiment 3). To introduce the instructions, the experimenter played a tape to the participants on which a voice of a college aged female said the following:

“The Career Center is about to introduce a new test that was developed at the University of Minnesota about nine years ago and was highly successful in helping students with their career choices after College.

The test was found to be highly predictive of skills important for real-world success.

However, simply solving the tasks without any practice, has no predictive power.

Research found, that performing practice problems for 15 minutes significantly improved performance and led to the best prediction of future success, but practicing for more than 15 minutes didn't.

So, we want to provide the opportunity for everyone to practice before they begin the actual test. I am going to leave the room for the next 15 minutes. To maintain consistency the testing will start after 15 minutes. However, we can't force people to practice. So, these magazines and the Gameboy are here for you to use if you so wish.”

Before leaving, the experimenter made sure that the Gameboy was turned on and that the magazines were also on the table.

Additional measures

After the 15 minute practice time was over, participants were interrupted and were asked to complete some additional measures. Most importantly, they were asked to

rate the strength of their desire to play with the Gameboy and to look at the magazines during the practice, their determination to practice for the test, as well as the degree of conflict they experienced between their desires for the Gameboy/magazines and practicing for the test. They were also asked to list and rank all other desires they experienced during this practice time; desires were defined to the participants the same way as Hofmann (2013) defined them to his participants, specifically: “*any subjective experience that had a sense of wanting or longing to do or consume a certain thing; this may include but is not limited to doing nothing, sleeping, eating, drinking, tobacco or other substance use, sexual desire, doing any kind of a sport, hygiene, social contact or media use*”. Finally, participants were checked for suspicion as well as asked for their demographical data. Suspicion was measured by asking participants about their opinion on the purpose of the research as well as if they think the separate studies were related to each other and if yes, how.

(See *Appendix C* for all the additional questions of Experiment 1.)

Dependent measures

In summary, the following dependent measures were taken:

1. The rating of the magazines and the rating of the practice tasks
2. Procrastination time: the time participants spent on any non-practice activity
3. Rating of experienced desires (for magazines, and Gameboy separately)
4. Listing and rating of spontaneous desires
5. Rating of motivation (determination to practice the tasks)
6. Rating of experienced conflict between desires and goal of practicing

Results

Data Screening and Transformation

Missing values

The second self-control task (resistance of procrastination) was measured as the amount of time participants worked on a laboratory task framed as practicing for an upcoming test that is predictive of career-choice. To reduce experimental bias/errors and increase precision of coding, participants were videotaped so that they could be coded subsequently

The video camera malfunctioned several times, due to an unknown technical error, and one of the experimenters made an error in recording on five occasions (turning on/off the camera at wrong times). Videos of 19 participants were completely missing. For the same reason, for nine additional participants, about half of their session was recorded.

In summary, at least one part of the 15 minute session was recorded for 48 participants, however only 39 participants had their entire session recorded. Therefore, to retain as much data as possible, the otherwise unitary task was divided into two parts of equal length, each 7.5 minutes long. Analyzing the data this way, the roughly first 7.5 minutes of the procrastination task was recorded for 46 participants, the roughly second 7.5 minutes of the task was recorded for 41 participants.

The reason I am using the word “roughly” (and not “exactly”) is because of the described pure randomness of how the data were missing. Based on the clock of the

recording it can be determined whether the available part of the recording belonged mostly to the first 7.5 minutes or mostly to the second 7.5 minutes, and participants were coded correspondingly. In the case of the videos that were completely available, the exact first 7.5 minutes and the exact second 7.5 minutes were used.

An analysis on three newly created variables (all missing: yes vs. no; first part missing: yes vs. no; 2nd part missing: yes vs. no) revealed that participants with missing procrastination times (compared to participants with available procrastination times) did not differ on any of the key variables (desires, focal goal, and experienced conflict). Given this fact, as well as the nature of the missing data (apparently random video-malfunctions,) it was concluded that the values were “missing completely at random”.

Two initial analyses were conducted (for the main hypotheses) with two different missing data handling techniques.

- 1) *Imputation*. The mean procrastination time was calculated for the first 7.5 minutes of the task and the second 7.5 minutes of the task separately for both the no depletion and high-depletion group using the 46 and 41 available values respectively (excluding outliers: three during the first section, none during the second section). During the first 7.5 minutes *low self-control exertion* participants procrastinated, on average, for .47 minutes ($SD = .85$), while *high self-control exertion* participants procrastinated, on average, for .86 minutes ($SD = .90$). During the second 7.5 minutes *low self-control exertion* participants procrastinated, on average, for 1.62 minutes ($SD = 2.86$), while *high self-control exertion* participants procrastinated, on average, for 2.27 minutes ($SD = 2.80$). For

the missing session(s) the respective group average was entered and the total procrastination was calculated by summing the two sessions. The decision to use sub-group mean imputation instead of simple mean substitution was based on the review of current debates on missing values. Sub-group-mean substitution is considered to be a “better estimate and preserves more variance than giving everyone with a missing value the overall mean” (Acock, 2005); thus, although not ideal, it is preferred to simple mean substitution (Meyers, Gamst & Guarins, 2013, p. 53).

- 2) *Deletion*. All cases with missing procrastination values were deleted. Analysis was conducted on 39 participants.

Both the imputation and the deletion method has merits and drawbacks. Specifically, the deletion method provides less biased estimates, but has lower power, because of the decreased sample size. The complete imputation method with means of sub-groups slightly reduces variability, but significantly increases the power of the analysis because of the increased sample size (Pelham, 2013).

Normality

Even after eliminating the outliers, the absolute skew value for the measure of procrastination, calculated based on the recommendation of Tabachnick and Fidell (in Field, 2013), was almost 4, (skew = 1.118, SE = .299), thus transformation was needed (Pelham, 2013, Field, 2013). A square-root transformation greatly reduced skewness (skew = -.030, SE = .299), thus, these data were used for all analyses; however, for the ease of interpretation, the original row values of means and SD-s are reported.

Main Results

Self-control exertion and resistance to procrastination

Previous research found that manipulating self-control exertion (no/low vs. severe) leads to differential resistance to procrastination. Specifically, Vohs (2008, Experiment 3) found that those individuals who initially engaged in self-control, compared to those who initially did not engage in self-control, were more likely to procrastinate in a subsequent task.

To test this hypothesis, I conducted a t-test with self-control exertion (yes vs. no) as the independent variable and procrastination as the dependent variable. Procrastination was operationalized as the time participants engaged in any other activity than practicing the GRE/GMAT problems, measured in seconds and rounded to the nearest quarter minute.

The results, on the full, imputation sample (described in details above) replicated the classic findings. Individuals who previously engaged in self-control were more likely to procrastinate than individuals who did not engage in self-control but the effect size was small ($M = 187.71$, $SD = 172.37$ vs. $M = 103.27$, $SD = 101.68$); $t(63) = 2.304$, $p = .025$, $r = .28$, $d = .58$.

The analysis conducted on the sample using the deletion method yielded results in the same direction as the fully imputed sample: Participants who previously engaged in self-control were more likely to procrastinate than participants who did not engage in self-control. Using all 39 subjects the results were only marginally significant (M

=200.71, $SD = 213.32$ vs. $M = 123.22$, $SD = 225.17$); $t(37) = 1.102$, $p = .061$, $r = .18$, $d = .36$. However, after removing the most extreme score ($z = 2.85$), which the scatterplot identified as not only outlier, but “extreme”, the analysis yielded significant results ($M = 200.71$, $SD = 213.32$ vs. $M = 88.11$, $SD = 174.07$); $t(36) = 2.277$, $p = .029$, $r = .35$, $d = .76$. Consequently, all further analyses were conducted on the largest dataset, which had sufficient power to detect the effect found by previous studies (for example, Vohs et al, 2007).

Self-control exertion and the intensification of affects and desires

The central question of the current studies was the mechanism of the so called “self-control depletion”, the worse performance at the second task of self-control following self-control exertion at an earlier task. I hypothesized that this is driven by proximate, perceptual/affective changes of environmental stimuli in the competing tasks (the focal task and the more desirable alternatives). Specifically, I hypothesized that this higher procrastination after initial engagement in self-control is, at least partially, driven by perceiving/experiencing the focal task as less appealing and/or the perceiving/experiencing the alternative activities as more appealing.

Play becomes more fun?

Based on the work of Schmeichel et al (2010) and Vohs et al (2011), I predicted that tempting stimuli in the environment will become more desirable.

The magazines and the Gameboy. Participants were asked to rate the ten magazines on three dimensions, each on a five point scale: dislike/like, dull/interesting,

not exciting/exciting. These three scores were combined into a single “liking” score. When rating each magazine, participants were also asked to gauge the maximum amount they would be willing to pay if the magazine was offered at the Student Union. Their options were: “I would never buy it.” (1), 80% discount (2), 50% discount (3), 25% discount (4), 10% discount (5) and “I would buy it even for full price.” (6).

Liking. Participants rated the magazines based on how much they like them, in general, how interesting and how exciting they are (all on a five point scale, ranging from “not at all” to “very much”). The analysis of each question separately, using all magazines, yielded non-significant results. Specifically, participants who previously exerted self-control, compared to those who did not exert self-control, were not different in their ratings and the responses were actually in the opposite direction as predicted: dislike/like ($M = 3.41, SD = .42$ vs. $M = 3.50, SD = .43, t(64) = .849, p = .399, r = .10, d = .21$); dull/interesting ($M = 3.42, SD = .44$ vs. $M = 3.53, SD = .55, t(64) = .905, p = .369, r = .11, d = .23$); not exciting/exciting ($M = 3.27, SD = .46$ vs. $M = 3.44, SD = .61, t(64) = 1.270, p = .209, r = .16, d = .32$).

Nevertheless, Hofmann (2013) asserted that self-control researchers should try to investigate more closely what is tempting or not tempting for each individual participant, instead of simply assuming that certain stimuli are tempting for everyone. Therefore, an average score was created, for each participant separately, from the magazines they rated higher than average. Contrary to prediction, participants who previously exerted self-control, compared to those who did not exert self-control, did not rate these liked magazines differently ($M = 4.11, SD = .34$ vs. $M = 4.05, SD = .94$); $t(63) = .348, p = .729, r = .04, d = .09$.

Wanting. For each participant an average wanting/buying score was also calculated, which, according to previous literature does not correlate with liking measures (see for example Berridge, 2010). Using this score, significant difference emerged, however, in the opposite direction from that which was predicted: Participants who exerted self-control reported to be willing to pay, on average, maximum 59.43% (SD = 19.34) of the regular price, while those who did not exert self-control reported to be willing to pay on average, maximum 70.71% of the regular price (SD = 18.79), $t(63) = 2.348, p = .022, r = .28, d = .20$.

Participants were also asked at the end of the second self-control task to rate (retrospectively) their experienced desire to look through the magazines and to play with the Gameboy. The high and low self-control exertion groups did not differ in their experienced desires for the magazines ($M = 2.67, SD = 1.47$ vs. $M = 2.47, SD = 1.44$), $t(63) = .548, r = .07, d = .14$; and the Gameboy ($M = 2.64, SD = 1.92$ vs. $M = 2.25, SD = 1.85$), $t(63) = .827, r = .10, d = .21$.

Spontaneous desires. Hofmann and colleagues (2012) found evidence that several desires arise in people spontaneously throughout the day. Although several participants procrastinated, only a few of those looked at the magazines or played with the Gameboy. Thus, a possibility exists that the intensification of spontaneous, self-generated desires is at least partially driving the effect of procrastination during the second self-control task. To test this idea, participants were asked to list and rate the desires they experienced during the 15 minutes practice.

On average, during the 15 minutes practice time, participants experienced 2.3 desires and the average strength of the strongest desires was 4.6, with 1 being no desire at all and 7 being irresistible. On average, again, no difference was found between the low self-control exertion group and the high self-control exertion groups, in case of the number of experienced desires ($M = 2.50, SD = 1.32$ vs. $M = 2.87, SD = 1.34$; $t(63) = 1.148, p = .255, r = .14, d = .29$) and intensity of the strongest desire ($M = 4.567, SD = 1.69$ vs. $M = 4.562, SD = 1.56$; $t(60) = 0.10, p = .992, r = .01, d = .02$).

In summary, I found no evidence for the intensification of positive affect towards the magazines, Gameboy and spontaneously generated desires. However, counterintuitively, I did find a decrease in willingness to pay for the (liked) magazines. This paradigm was successfully used as a measure of approach motivation in the past (Toure-Tyler & Fishbach, in press), nevertheless, a possibility exists that this tendency does not signal a decrease of approach motivation but, instead, an increase of avoidance motivation.

Work becomes less fun?

Vohs and colleagues (2011) found that following self-control exertion participants rated affective (IAPS) images more extremely: Specifically, participants in the high self-control exertion condition (compared to participants in the low self-control exertion condition) rated pleasant images as more pleasant and they rated unpleasant images as more unpleasant. Although just an assumption, but, in general, practicing difficult mathematical word problems taken from practice books aimed for senior undergraduate students, are probably at least mildly unpleasant for most undergraduate sophomores (the

majority of the participants in this study). To test whether the devaluation of the task at hand is driving the effect of lower performance on the second task of self-control, participants were asked to rate the practice-tasks on how interesting, exciting and challenging they were. Participants were also asked to gauge how many tasks they would likely practice from each in preparation for the real test.

Contrary to prediction, no difference was found between the two self-control groups in the ratings of how exciting the participants rated the tasks ($M = 2.88$, $SD = .48$ vs. $M = 2.91$, $SD = .59$; $t(58) = .220$, $p = .827$, $r = .03$, $d = .06$), nor in how challenging they rated the tasks ($M = 2.96$, $SD = .66$ vs. $M = 3.12$, $SD = .75$; $t(57) = .890$; $p = .377$, $r = .12$, $d = .24$) nor in the average number of practice problems they would practice from each ($M = 2.19$, $SD = .75$ vs. $M = 2.32$, $SD = .91$; $t(49) = .545$; $p = .588$, $r = .08$, $d = .16$). All results were non-significant, $p > .05$. In other words, regardless of how much self-control participants exerted earlier, they did not perceive the tedious task differently.

Not wanting to work?

Inzlicht and Schmeichel (2012, 2014) hypothesized that one possible explanation for the classic findings that self-control at Time 2 becomes worse after people engaged in self-control at Time 1 is *not* that people are lacking self-control resources and are unable to control themselves but, instead, they do not *want* to control themselves or in other words they “shift their motivation“. To test this hypothesis, I asked participants the question “*How strong was your determination to practice for the upcoming test?*,” on a scale of 1 (no determination at all) to 6 (extremely strong). Participants in the high-self-control exertion condition, indeed, reported significantly less determination to practice

for the upcoming test than participants in the low-self-control exertion condition ($M = 3.21$, $SD = 1.71$ vs. $M = 4.06$, $SD = 1.46$), $t(63) = 2.155$, $p = .035$, $r = .26$, $d = .54$.

Mediation Analysis on Motivation

As none of the predicted affect intensification results turned out to be significant, the proposed mediation analysis using the intensification of affect was not conducted. Nevertheless, in light of the findings and in order to better understand them, a mediation model, using the reported “motivation to practice” as a mediator was conducted. Testing this model is important because it corresponds to an already proposed mechanism of self-control (Inzlicht & Schmeichel, 2012), described in more detail in the introduction.

I used the SPSS PROCESS tool (Hayes, 2013) to assess the mediation model in which determination or motivation to practice was the mediating variable. The 95% confidence interval of the indirect effect was calculated using 1000 bootstrapping resamples (Hayes, 2013). The mediation analysis revealed that the indirect effect of self-control exertion on procrastination through motivation was not significant, given that the bootstrapped confidence interval did contain a zero; $b = 14.43$, BCa CI (-3.70, 55.28). However, the total effect of self-control exertion (high vs low) on the amount of procrastination was significant ($p = .024$). Also, the direct effect of self-control exertion on procrastination when accounting/controlling for the participants’ determination to practice, compared to the total effect, became smaller and non-significant ($p = .067$). This suggests that the effect of self-control exertion on subsequent self-control performance, at least in this procrastination task, is not independent from the effect of motivation. At the same time, the non-significant indirect effect suggests that, aside from

motivation, other variables, not taken into account in this model, contributed to the observed results. See *Figure 1*, below, for details.

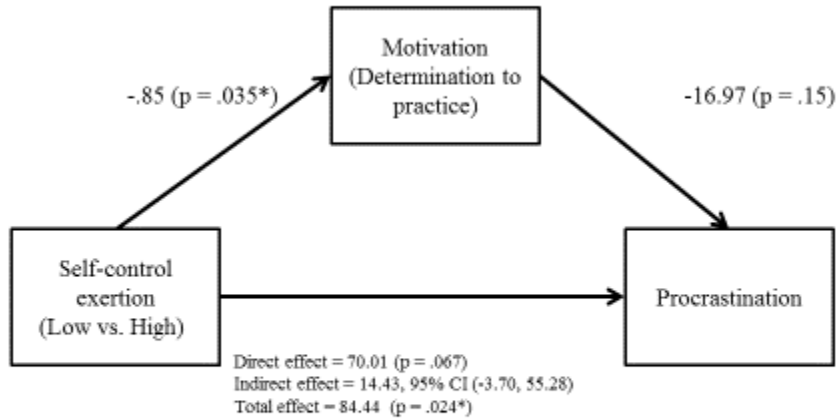


Figure 1. Indirect effect of Self-control exertion on Procrastination through Motivation to Work.

Based on the current results, it appears that decreased motivation to work does play a role in procrastination after self-control exertion; however, there might be other variables that at least moderate this observed effect.

The role of temptations

I originally predicted that the temptations participants experience will mediate the observed self-control “depletion” effect. However, I proposed to measure this variable as a widening gap between the evaluation of the focal goal as well as the evaluation of the competing alternatives (magazines and Gameboy). Participants did not show the predicted intensification of affect and desires following exertion of self-control, thus, the mediation analysis was not conducted on these data.

Nevertheless, recently Hofmann (2013) measured temptations differently, and I did have data to do the same. The results I reported so far were all on continuous variables and these variables, individually, probably did not capture all aspects and dynamism of desires and temptations during that 15 minute practice time the participants spent in the testing room, surrounded by a flashing Gameboy, 10 new, popular magazines and their beloved smartphones. Hofmann (2013) found effects of temptations on happiness, by splitting participants into two groups: “no temptations” (if they did not experience desires and/or experienced desires but no conflict between their desires and their focal goal) and “temptations” (if they experienced desires and they also experienced some conflict between their desires and their focal goal).

I used this classification method on the current data. Specifically, if participants reported no desires at all for both the Gameboy and the magazines, I classified them as having “No-temptations”. I also classified participants desires towards the Gameboy and magazines as “Non-temptations” if they indicated experiencing desires to one or both of these objects but they reported experiencing “no conflict at all” with practicing the problems. On the other hand, I classified participants as experiencing “Temptations” if they indicated both experiencing one or both desires and also experiencing at least some conflict (meaning that they circled 2 or higher on the conflict question).

If the intensification of desires and specifically temptations (the experienced conflict between the experienced proximal desires and the focal goal) are driving the classic effects of self-control exertion, then one way to look at this phenomenon is: Those individuals who do experience temptations should show more signs of “depletion” (self-

control deterioration in the second self-control task) than those who do not experience temptations.

A 2 (self-control exertion: low vs. high) x 2 (temptations: yes vs. no) ANOVA was conducted to test this hypothesis. The results yielded only a significant main effect of self-control exertion: Individuals who exerted self-control, compared to individuals who did not exert self-control, procrastinated for a longer time ($M = 187.71$, $SD = 172.31$ vs. $M = 103.28$, $SD = 114.68$), $F(1, 65) = 4.925$, $p = .030$, $\eta_p^2 = .075$. Although, individuals who experienced temptations compared to those who did not experience temptations, procrastinated more ($M = 168.13$, $SD = 157.96$ vs. $M = 129.51$, $SD = 146.90$), this result was not significant ($p = .356$, $r = .13$, $d = .25$) and the interaction was also not significant ($p = .959$).

Second, in order to investigate whether temptations at least somehow moderate the observed decreased motivation to practice for the test, following self-control exertion, a 2 (self-control exertion: low vs. high) x 2 (temptations: yes vs. no) ANOVA was conducted. The results, again, only yielded a main effect for self-control exertion: Those who exerted self-control compared to those who did not exert self-control, reported lower determination to practice ($M = 3.21$, $SD = 1.71$ vs. $M = 4.06$, $SD = 1.46$), $F(1, 65) = 4.26$, $p = .043$, $\eta_p^2 = .065$. The effect of temptations on motivation was in the predicted direction, of medium, but non-significant ($M = 3.25$, $SD = 1.50$ vs. $M = 3.92$, $SD = 1.69$), $F(1, 65) = 2.5$, $p = .119$, $\eta_p^2 = .039$. The interaction effect was, again, non-significant ($p = .990$).

Discussion

Individuals who exerted self-control reported decreased motivation to work on the task at hand and they indeed procrastinated more, however the decreased motivation just partially accounted for the increase in procrastination. Furthermore, contrary to prediction, no observable difference was found in the perception of environmental stimuli or in the reported experienced temptations.

The current results are puzzling in the light of the new findings and the process model reviewed in the introduction, which are currently the existing candidates for the explanation of what drives the mysterious “depletion” effect. Neither of the two mechanisms that according to existing evidence were the most likely candidates was fully supported. First, the intensification of affects, desires and temptations (observed by Schmeichel et al, 2010 and Vohs et al, 2011) was not supported, neither in the case of the proximate tempting stimuli, nor in the case of the focal goal. Second, the motivational shift - decreased motivation for exerting control, and increased motivation towards acting on impulse, proposed by Inzlicht and colleagues (2012, 2014) - was not fully observed either. Instead, in the current study a general decrease in motivation towards both work and play was observed. Participants who exerted self-control reported lower determination to practice for the upcoming test and they also reported lower buying prices for magazines. Briefly, it appears that following self-control exertion, participants experienced a general tendency for a decrease in approach motivation (or possibly an increase of avoidance motivation or maybe both). However, this was not reflected in their behavior: During the times when they were not practicing the tasks, there was rarely a moment when they did nothing. They always did *something* (looking the advertisements

in the magazines, playing with the GameBoy and most often, checking their smartphones.)

Deriving firm conclusions about the underlying mechanisms of procrastination is difficult, based on the paradigm of the current study. Procrastination is a self-control dilemma, where the focal goal can be described as something that individuals would prefer to avoid, but they use self-control to overwrite this tendency and persevere instead. However, complication in the explanation arises because procrastination is not simply about not doing something unpleasant, but usually also about doing something pleasant instead at the same time.

Thus, when a decrease in self-control is observed (operationalized as longer procrastination), it is not clear what is driving the effect: an increase in the approach motivation towards the tempting stimuli, an increase in the avoidance motivation towards the focal goal, or, alternatively, the relative value of the goal and the temptations are perceived differently. (The latter idea is entertained to some degree in the newest self-control theory by Kurzban, 2014–, which was, of course, not available to be tested in the current dissertation).

To start gaining a clearer picture about these possible mechanisms, two additional studies were conducted. In Experiment 2A the focal goal was assumed by previous researchers to be about the overwriting of the natural tendency to avoid something unpleasant (drinking unsavory beverages). In other words, the only goal participants faced was to push oneself to do something unpleasant. In Experiment 2B the focal goal was assumed by previous researchers to be about the overwriting of the natural tendency

to approach something pleasant (overeating cookies). In other words, the only goal participants faced was to push oneself to not do something pleasant

CHAPTER IV

EXPERIMENT 2: SUGAR FOR HEALTH?

The purpose of Experiment 2 was to investigate the mechanism of how sugar “replenishes” the “depleted” resource or, in other words, why is performance on a second self-control task better after a sugary mouth rinse. Two studies were conducted in which the focal goals were the opposite of each other. In Experiment 2A participants were assessed for how many cups of unsavory drinks they consumed in order to obtain monetary compensation (as well as subtly suggested potential health benefits). In Experiment 2B participants were assessed for how many cookies they consumed (with the assumption that they normally try to restrain themselves from overeating cookies, unless they lack self-regulatory resources). Briefly, in Experiment 2A participants were assumed to have to overwrite their avoidance tendency (under normal circumstances) while in Experiment 2B participants were assumed to have to overwrite their approach tendency.

Previous research found that after participants exerted self-control, but rinsed their mouth with a sugar-based beverage compared to an equally sweet non-sugar based beverage, they displayed behavior similar to those who did not exert self-control (Molden et al, 2012; Hagger et al, 2012; Sanders & Martin, 2012). The role of sugar is unknown, thus the current studies aimed to shed more light on the mechanism of the mysterious sugar- rinse effect too.

For the ease of comprehension and to avoid unnecessary repetitions (given the large overlap between the two studies), I first report the general and specific procedure of

these two studies and then turn to the description of the participant sections and results of each experiment separately.

Procedure

General procedure

The procedure followed closely the general procedure of the recent dual task and mouth-rinse paradigm (Molden et al, 2012), with a small modification: during the second self-control task the proposed mediators were measured. First, all participants exerted self-control (by completing a task that required high self-control). Then participants were randomly assigned to rinse their mouth with sugar-based or an equally sweet non-sugar based drink. This was followed by the second self-control task, where self-control exertion was measured. Finally, participants answered various additional questions.

Self-control Task 1

The first self-control task in both Experiments 2A and 2B followed the same method and procedure as the first self-control task of Experiment 1, with one exception: All participants completed the difficult version of the E-crossing task. This ensured that by definition all participants exerted self-control resources. The task was described in detail in the method section of Experiment 1. This task reliably requires the exertion of self-control, as demonstrated by numerous studies in the past (for example Baumeister, Muraven et al, 1998; Molden et al, 2012); therefore I did not include a control condition without the mouth-rinse or a no/low self-control exertion task.

Immediately following Task 1, participants were thanked and escorted by the first experimenter to a second room where the second experimenter introduced them to the second self-control task, disguised as a tasting task. Specifically, in Experiment 2A

participants tasted and rated unsavory drinks and in Experiment 2B they tasted and rated cookies.

The Mouth Rinse

Before the detailed explanation of the task the experimenter gave participants a small 2 ounce plastic cup with either sugar or Equal sweetened water. A double-blind design was used: The experimenters were blind to the experimental condition of the participants. The lead researcher mixed the drinks, placing them in a blue and green bottle, and the experimenters administered the drinks according to a master sheet which listed the randomized order the bottles should be used.

In *Experiment 2. A* the solutions were prepared from 6 little 1 g sacks of Equal per 100 mL of water in the non-sugar rinse condition and 6 little 2.86 gr sacks of Domino sugar in the sugar-rinse condition. These amounts of sugar and Equal were decided on based on the fact that they were closest in sweetness to each other according to the vote of 6 undergraduates who were not participants in the study.

In *Experiment 2 B* (which was conducted five months earlier than Experiment 2A), the two mouth rinses were prepared from 6 sacks of Equal per 100 mL of water in the non-sugar rinse condition and from 4 sacks of Domino sugar, to approximate Molden's suggestion for 6.4 Equal :12.8 sugar per 100 mL (Molden, private email). The rinses also contained a small drop of lime juice in Experiment 2A, but not in Experiment 2B. Previous studies used a drop of lemon juice.

Participants were asked to rinse their mouths with their assigned solution for 5 seconds and once finished spit it into a different little cup. In case they were unable to take in all the 2 ounces of the rinse, they were asked to repeat the procedure for a second

time so that the entire mouth rinse is gone. The cover-story for the mouth-rinse in both studies was that the upcoming tasting experiment requires that everyone's taste buds are equated, or in other words the starting taste in the mouth is the same.

Self-control task 2

After the participants completed the mouth-rinse, the experimenter discarded the cup and returned with a tray containing 20 numbered little cups of unsavory drinks (in Experiment 2A) or a plate with 20 pieces of cookies (in Experiment 2B).

Experiment 2A: The drink rating instructions.

The experimenter placed a tray with the 20 cups of drinks in front of the participants. The drinks were prepared from mixing a regularly prepared unsweetened, orange flavored, KoolAid drink with vinegar in the following proportions: 8 ounces of KoolAid : 2 ounces of vinegar for cups 1 to 10 and 6 ounces of KoolAid to 2 ounces of Vinegar for cups 11 to 20.

For full disclosure I have to note that the experiment started by mixing 4 different types of Minute Maid Fruit Juices with vinegar in the 6 ounce to 2 ounce proportion, in order to make the drink rating cover story more believable. However these drinks were overly delicious: 8 out of the first 9 participants consumed all 20 cups and one participant consumed 17. Therefore, a decision was made to use the method reported by Vohs (2007): mixing vinegar and orange flavored KoolAid. Consequently, the first 9 participants were discarded, and those cases were considered as a Pilot study.

To minimize experimenter effects, the experimenter played a tape-recorded instruction read by the same female voice as the earlier instructions. *“These new sport-drinks are very similar to health drinks that are currently popular in Japan. Although*

their taste might be unfamiliar to most Americans, they are good for you. Because of their novelty, you will earn a nickel for every cup you completely consume. Your task is to provide your taste preferences by rating the drinks on several dimensions, such as how sweet, refreshing, tasty they are. Please, as you taste the drinks, fill out these evaluations for each numbered drink separately. Make sure that you return each cup to its original place. You can drink as many or as few as you want and you can help us even if you just rate them based on few sips. However, you will earn the nickel per cup only if you consume the entire cup. And again, although they might taste unusual, these drinks are good for your health. Please, open the door once you are done and I'll be with you shortly.”

Nevertheless, in each case, the experimenter returned after 10 minutes and terminated the rating.

(See Appendix D for the drink rating task.)

Experiment 2B: The cookie rating instructions.

The experimenter placed a plate with the 20 pieces of cookies (5 types of sugar cookies broken into four pieces each) in front of the participants and said the following: “We are collaborating with the university dining services and they would like to have your opinion about their food items, in order to make decisions about what to offer in the future. Your task is to provide your preferences by rating these five cookies on how appealing they are to you on several dimensions. First, how attractive they are based on just looks and following that how delicious are they based on first bite. You will be also

asked to rate them based on how creamy, salty, sweet, moist, they are and finally, how delicious you find them overall.”

After giving participants the rating sheet, the experimenter added: “Please, taste the cookies and fill out these evaluations. To determine the rankings, most individuals try more than one sample from each cookie, before they make the final ratings, however, it is not necessary.” Experimenters were explicitly instructed to not say anything about how many cookies the participants should eat for an accurate tasting. They were told that if a participant would ask, the answer should always be: “*It is up on you*”.

After answering any other questions the participants had, the experimenter left the room (leaving the participant alone) and asked the individual to open the door once finished. Nevertheless, in each case, the experimenter returned after 5 minutes and terminated the rating.

(See *Appendix F* for the cookie rating task.)

Additional questions.

Finally, each participant was asked questions on their eating and dieting goals and habits (most importantly they were asked about the degree they are concerned about monitoring the quantity and type of food they are consuming, how frequently they are doing that, as well as about their goals regarding their current weight). As part of the manipulation-check questions, besides probing for suspicion, participants were specifically asked questions about their thoughts about the ingredients of the mouth-rinse, as well as (in Experiment 2A) the ingredients of the “sport drinks”.

(See *Appendix E* for additional questions of Experiment 2A and *Appendix G* for additional questions of Experiment 2B.)

Experiment 2A: Sugar for Medicine

Participants

Sixty-seven undergraduates (49 women, 18 to 43 year old, median age 19), recruited through the subject pool of a large Southwestern University, participated in the study. Participants received partial course credit in exchange for participation. All participants were treated and all data were handled following the guidelines of Oklahoma State University IRB.

One participant was allergic to orange and thus she did not complete the second self-control measure (the main dependent variable) and therefore was deleted from the set. Another participant did not follow the instructions or the experimenters did not record her data correctly (as the participant circled all ratings without trying the drinks, as evidenced by the fact that 20 ounces remained from the 20 ounces) and therefore was deleted from the set. In the case of two participants, the lead experimenter failed to mix vinegar into their drinks and as they received only a regular KoolAid drink, which cannot be considered unsavory, they were deleted from the set.

Participants were randomly assigned to rinsing their mouths with a sugar-based drink (33 participants, 24 women, 18 to 43 year old, median age 19) or a non-sugar based drink (34 participants, 25 women, 18 to 24 year old, median age 19). In the final sample there were 63 participants: 32 participants in the sugar condition (23 women, 18-43 years old, median age 19) and 31 participants in the non-sugar condition (22 women, 18-24 years old, median age 19).

Results

Data Screening and Transformation

Missing values. The second self-control task, the number of unsavory drinks consumed, was assessed by two highly correlated procedures, to reduce errors and increase precision: the number of cups consumed and the ounces of drinks consumed. The “ounces of drinks consumed” measure had seven missing values, because at the start of the experiment this measure was not recorded, as well as because one experimenter failed to record it on one occasion. Nevertheless, as each cup contained 1 ounce of drink, there was a high correlation between these two measures ($r=.911$). An average difference score between the two columns (number of cups and number of ounces consumed) was calculated for the Equal and sugar rinse groups separately, excluding those conditions where participants consumed all 20 drinks and thus necessarily had zero difference between the two columns. This difference score was calculated to be 3.4 for the Equal rinse group and 3.8 for the sugar rinse group. In other words, on average, participants sipped an amount of drinks equal to 3.5 cups in total, in addition to the number of completely consumed cups. Therefore, the missing values were handled by a variation on the *mean substitution procedure*, adding 3.4 to the number of cups consumed by the Equal rinse group (as a gauge to the number of ounces they consumed) and adding 3.8 to the number of cups consumed by the sugar rinse group (as a gauge to the number of ounces they consumed). Specifically, this means that if a participant had a score of 1 in the “number of cups” column, they received a score of 4.4 in the “ounces of drink column” if they rinsed with Equal and 4.8 if they rinsed with sugar.

One participant did not answer the two adequacy of payment measures. Given the fact that this was the only participant with a missing value on this variable, his answers were filled on these two variables with the average values for his sub-group.

Outliers. The rating of the adequacy of the compensation for the drinks revealed several extreme outliers. This was due to the fact that several individuals expressed great dissatisfaction with the 5 cents per 1 ounce cup we paid; and they voiced their dissatisfaction by citing unrealistic prices which they would consider appropriate payment for participation (500 dollars or 10,000 dollars per cup for example). It was decided not to remove these individuals from the analysis, however their scores were windsorized to be equal to the highest non-outlier number in their corresponding group. Specifically, 500 cents per cup for the Equal group and 100 cents per cup for the sugar group.

Normality. The “number of cups consumed” measure was positively skewed (skewness = 1.097, SE= 0.304). Therefore these data were log-transformed and the transformation fixed the problem (skewness = .358, SE = .304). The continuous adequacy of payment measure, even after windsorizing, was also positively skewed (skewness = 1.293, SE= 0.306), therefore these data were log-transformed. The transformation fixed the problem (skewness = -.276, SE =.306). In both cases these log-transformed data were used in the analysis. However, for the ease of interpretation, the original values are reported.

Main Analysis Results

Self-control “replenishment” and consumption of unsavory drinks

First, an independent t-test was performed to examine whether the gargling manipulation influenced the amount of consumption of the unsavory drinks. The number of cups and the ounces consumed were the two separate dependent variables; the type of rinsing solution (sugar vs. Equal) was the independent variable.

According to previous findings (i.e. Molden, 2012), following exertion of self-control rinsing one’s mouth with sugar leads to better performance on the second self-control task compared to rinsing one’s mouth with artificial sweetener. Thus I predicted that these individuals will drink more from the unsavory drinks. The results revealed that, indeed, those who rinsed with sugar consumed significantly more cups of the unsavory drinks than those who rinsed with Equal ($M= 8.06, SD = 8.18$ vs. $M= 4.00, SD = 7.02$), $t(61) = 2.711, p = .039, r = .33, d = .69$.

Measured with the number of ounces consumed, the same effect was found: Those who rinsed with sugar consumed significantly more ounces of unsavory drink than those who rinsed with Equal ($M= 11.26, SD= 5.62$ vs. $M=7.38, SD= 5.74$), $t(61) = 3.045, p = .034, r = .36, d = .78$.

Self-control “replenishment” and taste rating

Second, an independent t-test was performed to examine whether the gargling manipulation influenced the actual perception/experience of the drinks. According to previous findings (i.e. Vohs, 2011), following exertion of self-control people rated positive images more positively and negative images more negatively. If such affect intensification happens in case of these unsavory drinks too, it is possible that the sugar-

rinse restores these perceptions, by de-intensifying them. Thus, I predicted that those who rinse with sugar (compared to those who rinse with Equal) will rate the drinks as more pleasant.

To test this hypothesis, the average pleasantness rating of the drinks was the dependent variable and the type of rinsing solution was the independent variable. Although participants in the sugar-rinse condition rated the drinks slightly more pleasant compared to participants in the Equal-rinse condition on the five point scale ranging from 1 (awful) to 5 (awesome), this difference was not significant and the effect was small ($M= 1.88, SD= .624$ vs. $M=1.74, SD= .619$), $t(61) = .867, p =.389, r = .11, d =.22$.

Self-control “replenishment” and motivation to drink (payment adequacy and health goals)

Third, I also hypothesized that in this situation self-control exertion might lead to decreased value placed on the two potential focal goals in this self-control dilemma: 1) the adequacy of payment (5 cents for a fully-consumed 1 ounce cup) and slightly less likely (given its very subtle manipulation) 2) the healthy eating and drinking (consumption) goal that participants might have had.

The external motivation (adequacy of payment) was measured through two questions. First, participants were asked if the reimbursement was adequate on a 4 point scale, ranging from 1 (very bad) to 4 (very good). Participants in both conditions rated the reimbursement as rather low, but the sugar-rinse condition participants rated the reimbursement as slightly more adequate than participants in the Equal-rinse condition; however, this difference was not significant and the effect was small ($M= 2.09, SD= .78$ vs. $M=2.36, SD= 1.02$), $t(63) = 1.193, p =.237, r = .15, d = .30$.

Nevertheless, as a second measure of payment adequacy, participants were also asked the open ended question to estimate the amount of money paid per cup that would make them drink more cups than they consumed. Specifically, participants who rinsed with sugar on average estimated that if the payment was 60 cents per cup more they would have consumed all 20 cups, while participants who rinsed with Equal estimated that they would have needed a payment of about 1 dollar and 25 cents per cup more to consume all the 20 cups ($M= 62.73, SD= 47.21$ vs. $M = 121.87, SD= 123.06$), $t(38.886) = 2.49, p = .017, r = .37, d = .80$.

This payment difference was specific for the task at hand, the drinks. No difference was found between the two rinse conditions for an imaginary scenario which asked about the minimal acceptable payment for listening to an aversive lecture. Moreover, the results in this scenario were in the opposite direction, as those who rinsed with Equal asked for a smaller reimbursement ($M= 18.55, SD = 21.73$ vs. $M= 13.96, SD = 19.75$), $t(51) = .802, p = .426, r = .22, d = .11$.

No difference was found between the reported healthy eating/drinking goals of participants who rinsed with sugar compared to participants who rinsed with Equal, ($M= 4.32, SD= .98$ vs. $M=4.42, SD= .67$), $t(60) = .454, p = .652, r = .06, d = .12$.

The Mediation Analysis

The general liking scores did not yield significant results, only the payment adequacy scores did; therefore, this variable was entered as a mediator to the mediation model in the SPSS PROCESS tool (Hayes, 2013). The 95% confidence interval of the indirect effect was calculated using 1000 bootstrapping resamples (Hayes, 2013).

The mediation analysis revealed that the indirect effect of self-control exertion on procrastination through “payment adequacy” was significant, $b = 1.25$, BCa CI (.38, 2.94). The total effect of self-control replenishment (sugar vs. Equal) on the number of drinks consumed slightly missed significance ($p = .055$). The direct effect of mouth-rinse on procrastination when accounting for the participants’ perception of the adequacy of the payment for their work, compared to the total effect, became smaller and non-significant ($p = .20$). See *Figure 2.*, below, for details.

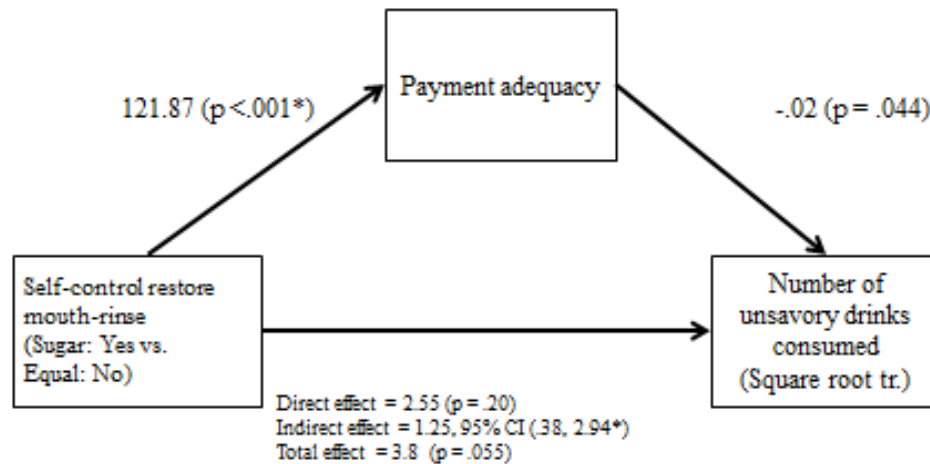


Figure 2. Indirect effect of Self-control replenishment on Number of Drinks consumed through affect/desire intensification (Payment adequacy).

Discussion

My central prediction was that following exertion of self-control, individuals will perceive the world differently (among others, the taste of the unsavory drinks), and this will drive the effect of lower performance on the second task of self-control (the

consumption of unsavory beverages). My predictions were just partially supported. Participants did not evaluate the drinks differently. Nevertheless, they consumed fewer cups and reported a need for higher reimbursement for consuming more drinks in the non-sugar rinse condition.

In light of what we know about self-control exertion and its sugar-rinse “replenishment”, the results suggest that that following exertion of self-control participants desire more rewards for the performance of the same task and a small amount of sugar diminishes this desire. Nevertheless, given the fact that in the current study there was no control group, only one certain conclusion can be made: Following exertion of self-control AND a mouth-rinse with a sugar-based drink (compared to exertion of the same amount of self-control and a mouth-rinse with an equally sweet but non-sugar based drink), individuals need less reward to perform the same task. Payment gauges are often used as measures of motivation (Toure-Tilery & Fishbach, in press). Nevertheless, in this case the measure might actually be considered also a measure of taste evaluation, given that the measure of liking did not capture the differences as the ratings clustered between 1 and 2 on the 5 point scale.

The mediation-analysis further suggested that the effect of self-control “replenishment” on subsequent self-control performance, at least in this unsavory drink task, is not independent of the described intensification of affect measure (which, however could also be conceptualized as a motivation effect). Based on the current results, it appears that (de-)intensification of the value of one’s work does play an important role in self-control exertion and replenishment, at least in situations where the second self-control task is about overwriting something unpleasant.

Experiment 2B: Sugar for Diet

Participants

Sixty-nine undergraduates (35 women, 1 unidentified, 18 to 23 year old, median age 19), recruited through the subject pool of a large Southwestern University, participated in the study. Participants received partial course credit in exchange for participation. All participants were treated and all data were handled following the guidelines of Oklahoma State University IRB.

Participants were randomly assigned to rinsing their mouth with a sugar-based drink (35 participants, 16 women, 1 unidentified, 18-21 years old, median age 19) or a non-sugar based drink (34 participants, 19 women, 18-23 years old, median age 19). No participants were excluded.

Results

Data Screening

Missing values. Missing values were found only on one key variable: the rating of the “overall deliciousness of cookies”. Ten participants misunderstood this part of the rating and provided only a rank order of the five types of cookies or skipped the question altogether; these ten individuals were deleted for this question only.

Outliers. The variable asking for an estimation of how much the participant would pay for a full box of the most delicious cookie had two extreme values (10 and 7.99 dollars) which were more than 3 standard deviations away from the mean, thus outliers. These two values were windsorized to be slightly above the next highest value,

which, although still unrealistically high compared to the other ratings, was not an outlier (6 dollars). Thus for the two extreme values 6.5 dollars were entered as new values.

Normality. The windsorized open-ended measure of the value of the cookies (“pay per full box of most delicious cookie”) was positively skewed (skew = .985, SE = .289), as the absolute value of skewness was above 3, and values above 2 already qualify as skewed (Pelham, 2013, Field, 2013). Therefore these data were log-transformed and the transformation fixed the problem (skew = -.300, SE = .289), so these log-transformed data were used in the analysis.

The “number of cookies consumed” measure was slightly skewed, as the absolute value was above 2 (skew = .655, SE = .291). Therefore, these data were log-transformed and this fixed the problem (skew = -.063, SE = .291). The log-transformed data were used in the analysis. However, for the ease of interpretation, the original mean and standard deviation values are reported in all cases.

Main Analysis Results

First, based on earlier findings (e.g. Molden et al, 2012), I predicted that a sugar-rinse (compared to Equal-rinse) will enhance self-control following self-control exertion. Specifically, in this study, I expected that participants who previously exerted self-control and afterward rinsed their mouth with an Equal sweetened “mouthwash” will sample more pieces of cookies compared to participants who previously exerted self-control and rinsed their mouth with a sugar sweetened “mouthwash”.

Second, based on findings of Vohs and colleagues (2011) I hypothesized that if affect-intensification indeed happens following self-control exertion, participants who exerted self-control should rate the cookies as being more delicious. Consequently, I

hypothesized that if sugar-rinse restores self-control performance, it might do so through eliminating the affect- intensification effect. Thus, specifically, I predicted that following self-control exertion, those individuals who gargle an Equal-rinse will rate the cookies as more delicious than those participants who gargle a sugar-rinse.

Finally, I hypothesized that self-control “replenishment,” just like self-control “depletion,” will happen via this desire (de)intensification affect. Specifically, I predicted that the pleasantness rating of the cookies will mediate the effect of the mouth-rinse on the number of cookies consumed.

Self-control “replenishment” and consumption of cookies

An independent t-test was performed to examine whether the gargling manipulation influenced the amount of consumption of the cookies. The number of cookies was the dependent variable (the measure of self-control exertion/replenishment); the type of rinsing solution (sugar vs. Equal) was the independent variable.

The results revealed no significant differences. In other words, those participants who gargled a sugar-rinse compared to those who gargled an Equal-rinse following self-control exertion and prior to rating the cookies, consumed about the same number of cookies and surprisingly, the results were even in the opposite direction as expected ($M= 11.07, SD = 4.86$ vs. $M= 10.44, SD = 4.69$), $t(66) = .464, p = .644, r = .06, d = .11$.

Self-control “replenishment” and rating of cookies

The average rating of the cookies was the second key dependent variable: the rating of affect/liking. This hypothesis was not supported either. No differences were found on any of the averaged ratings of the five cookies. Participants who gargled with sugar compared to Equal did not rate the cookies differently on appearance ($M= 2.91, SD$

= .33 vs. $M = 2.80$, $SD = .33$; $t(66) = 1.279$; $p = .205$, $r = .16$, $d = .31$), deliciousness based on first bite ($M = 2.91$, $SD = .51$ vs. $M = 2.81$, $SD = .33$; $t(66) = .996$; $p = .323$, $r = .12$, $d = .25$), or overall quality/deliciousness ($M = 3.01$, $SD = .54$ vs. $M = 2.81$, $SD = .39$; $t(57) = 1.597$; $p = .116$, $r = .21$, $d = .42$). Briefly, all comparisons were non-significant.

Self-control “replenishment” and buying price for cookies

Finally, I also predicted that following self-control exertion not only the liking of cookies, but also the wanting of cookies will intensify. Consequently, I predicted that those individuals who gargle a sugar-rinse (compared to those who gargle Equal-rinse) will report/estimate smaller prices, on average, as the highest price they are willing to pay for a full box of their favorite cookie.

The assumption of equal variances was broken: the Levene’s test was significant ($F = 8.61$, $p = .005$), nevertheless even with the adjustment, significant differences emerged and the effect was of medium size. However, contrary to expected, participants who rinsed with sugar (i.e. low self-control exertion) estimated that they would pay on average a dollar more for a box of cookies compared to participants who rinsed with Equal ($M = 2.88$, $SD = 2.17$ vs. $M = 1.85$, $SD = 1.23$), $t(54.015) = 2.439$, $p = .018$, $r = .31$, $d = .66$.

Splitting the data by dieting-goals, restrained eating and temptation conditions

Hofmann (2012) advised that one way to make better conclusions about the nature and mechanisms of self-control is to use better designs when conducting self-control studies. Specifically, he suggested “preselecting participants on the basis of their long term goals” (done post hoc in my Study 3), “providing them with personal temptations” (my Study 1: participants left alone with their cellphones, backpacks, etc.) or “controlling

for the degree to which participants indicate that they are actually tempted by a certain stimulus” (Study 1), Hofman & van Dillen, 2012, p. 318.

In this study, I did measure participants eating and dieting goals and habits and thus I was in a position to follow this advice for the analysis of data. Indeed, when accounting for dieting goals and reported restrained eating habits the results revealed some curious effects of sugar on self-control.

Participants were asked to rate their monitoring of the quality- and quantity of their food intake and the frequency of such tendencies. The responses showed a highly significant correlation between all three items (.58 on average). I wanted to identify those individuals who were the most avid/passionate food-intake monitors, so I combined these three 5-point scores into an average Food Control Score. Individuals who scored above 4 on this averaged combined item were coded as High Controllers (12 participants), while individuals who scored 2 or less were coded as Low Controllers (15 individuals). The middle participants, the “Average Controllers” (about whom no hypotheses could have been generated yet), were coded with zero and were filtered out from further analysis. The scores “below 2” and “above 4” on a 5 point scale were chosen, because I wanted to specifically look at individuals at the two extreme ends of the scale: those who care little and those who care a lot about controlling their food-intake.

Hypothesizing based on the previously discussed models and theories, I expected that only High Controllers will be experiencing conflict in this situation and thus they will break their careful monitoring of their food-intake. Thus, I predicted that they will most likely overeat following self-control exertion and are not ‘replenished’ by the sugar rinse. However, I left open the opportunity that they might possibly under-eat compared

to the Equal-rinsing high-monitors. Briefly, based on the Limited Resource Model, I expected that those individuals who do have dieting/food-monitoring goals will experience a self-control conflict and if gargling with Equal (and thus still lacking self-control) they will break their monitoring and fall back to their automatic tendency.

Low Controllers (those scoring 2 points or less) were included in the analysis as a control group. I expected that as they by definition do not experience any conflict (they are not “tempted” by the cookies), they will show no difference in the two rinse conditions, as they will indulge all the time. So, basically, I expected an interaction effect (however, I did not predict any exact pattern). As in the case of medium Controllers no predictions could be made, for clarity (and power purposes) they were filtered out from further analysis.

After the Average Controllers were coded zero and filtered out, a 2 (rinse: Splenda vs. sugar) x 2 (Control: high vs. low) was conducted with the number of cookies consumed as the dependent variable. No main effect was found on either variable, but, somewhat unexpectedly, a significant interaction emerged, $F(1, 27) = 5.312, p = .031 \eta_p^2 = .188$. The interaction is displayed on the *Figure 3*, below.

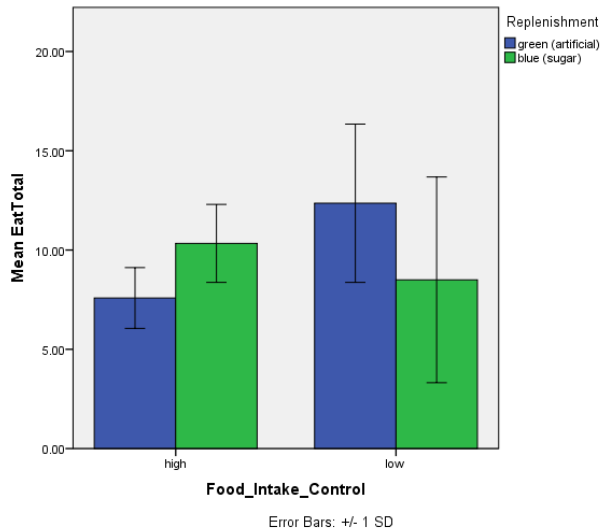


Figure 3. Number of cookies consumed, as a function of mouth-rinse and food-consumption control

To follow up the interaction, two simple effect analyses were conducted, which confirmed the somewhat unexpected results. In the case of High Controllers there was an effect of rinse condition on the number of consumed cookies, however, in the opposite direction as expected based on the classic Limited Resource Model. Specifically, High Food Control participants who rinsed with sugar, which theoretically “restores” self-control resources, consumed significantly *more* cookies (almost 3 pieces more) than High Food Control participants who rinsed with Equal, which theoretically leaves self-control-resources “depleted” ($M = 10.33, SD = 1.97$ vs. $M = 7.58, SD = 1.53$), $t(10) = 2.627, p = .025, r = .64, d = 1.66$).

In the case of Low Controllers there was only a marginally significant effect of rinse condition, in the predicted direction: participants who rinsed their mouth with sugar, consumed fewer cookies compared to those who rinsed with Equal ($M = 8.5, SD = 5.18$ vs. $M = 12.35, SD = 3.99$), $t(13) = 1.596, p = .134, r = .40, d = .88$).

Even more interestingly, when looking at the rating of the cookies based on their evaluation of looks and deliciousness, the previous Affect Intensification findings of Vohs and colleagues (2011) were supported. In the case of the appeal of cookies based on looks both a main effect of “mouth-rinse” (sugar vs. Equal) and an interaction effect (mouth-rinse x control: low vs. high) emerged. Specifically, when combined, High Control and Low Control individuals rated the cookies on average less positively in the sugar rinse (high self-control) compared to the Equal-rinse (low self-control) condition, but high-controllers showed a stronger intensification of their experience of cookies than low-controllers did, $F(1, 27) = 5.312, p = .031, \eta_p^2 = .188$. This interaction is displayed below, on *Figure 4a*.

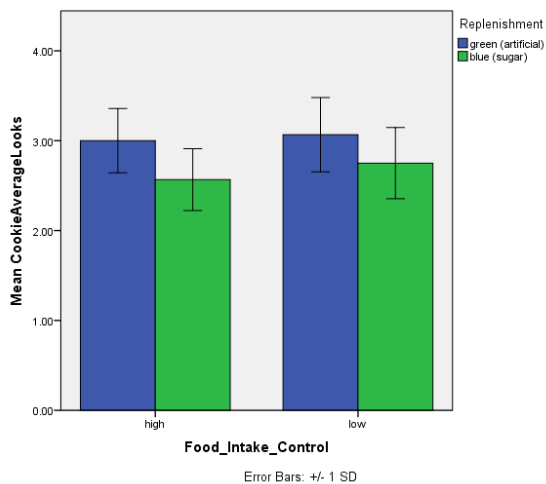


Figure 4a. Rating of the visual appeal of cookies as a function of mouth-rinse and food-consumption control

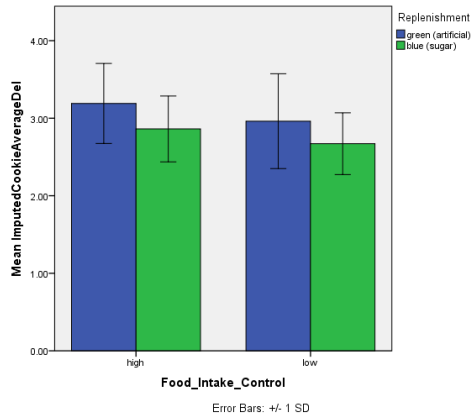


Figure 4b. Rating of the overall deliciousness of cookies as a function of mouth-rinse and food-consumption control

A similar ANOVA was conducted using the cookies' overall taste as the dependent variable. As discussed earlier, some individuals did not provide these overall ratings or provided them incorrectly. Thus the sample was smaller than the sample used in the previous two analyses, so the results should be looked at with caution.

When excluding the individuals with missing values on the overall deliciousness rating, and looking at the remaining 23 (instead of 29 participants), only a significant main effect of the mouth-rinse emerged. Both groups evaluated the taste of the cookies as more delicious when in the Equal (low self-control) condition compared to the sugar (regular/high self-control) condition, $F(1, 21) = 4.452, p = .050, \eta_p^2 = .208$. Although, high-controllers again tended to show an even higher intensification effect (in the Equal/low self-control condition) compared to non-controllers, this interaction effect was not found to be statistically significant, $F(1, 21) = .569, p = .461, \eta_p^2 = .208$. These results are displayed on *Figure 4b*, above.

Discussion

I hypothesized that participants low on self-control (compared to those high on self-control) will experience the cookies in front of them as more delicious and this changed evaluation will drive their tendency (observed in previous studies) to overeat from the cookies. In summary, looking at the entire sample as a unitary group, my hypothesis was not supported. Furthermore, the previous findings that individuals will eat more cookies following self-control exertion, were not replicated either. Nevertheless, Hofmann (2012) recently stated that temptations, the essence of self-control dilemmas, *“often appears to be overlooked in laboratory experiments [on self-control] in which people are confronted with what the researchers believe is tempting for everyone”* (Hofmann & van Dillen, 2012, p. 318).

Based on the dieting literature, a reasonable assumption is that snacking from the cookies is (primarily) a conflict for individuals who have: a) a dieting goal and b) a general tendency to monitor their food-intake (quality or quantity) and also c) do this monitoring on a regular basis. In the case of these dieting individuals, who highly monitor their food-intake, we can assume that their default tendency is to not overeat from the cookies. In the case of these same individuals we can also assume that they will experience temptation when facing the cookies (given that they like them in the first place). Finally, given what we know about self-control exertion, we can probably make an assumption for high food-intake monitors that in case they lack self-control resources, they will break their usual control over food-intake. This can mean two very different outcomes. They will either overeat compared to their usual amount of food-intake (which is probably still lower than the amount individuals without such tendencies have), or they

will under-eat when “depleted”. The latter is a reasonable prediction if we realize that high-controlling dieters probably rarely if ever eat several pieces of cookies in one sitting, under normal circumstances. So, in the laboratory they might force themselves to snack only to please the experimenter by doing a more precise rating job. However, if they lack self-regulatory “resources”, then they will fall back to their automatic tendency to eat less. This latter prediction was supported: High food-control participants ate fewer cookies under the condition which is considered low self-control, supporting the idea that control might not mean the same to everyone in self-control situations. Consequently, and ironically, glucose, which was considered as a most likely candidate for the “resource” of self-control (Gailliot et al, 2007), might actually hurt those individuals who most need self-control in certain situations. Nevertheless, given the small sample-size, as a result of trimming the middle half of the sample, the reported findings should be treated with caution.

CHAPTER V

GENERAL DISCUSSION

When people engage in self-control in one task, their performance becomes worse in a subsequent task that also requires self-control (Baumeister, Vohs & Tice, 2007). Interestingly, the performance decrease is eliminated when people experience a variety of seemingly unrelated events following self-control exertion (see for example Muraven & Slessareva, 2003; Tice et al, 2007), most notably, rinsing their mouth with a sugar-based beverage (Molden et al, 2012; Hagger et al, 2012; Sanders & Martin, 2012). This is a puzzle and regardless of almost two decades of research and hundreds of publications on the topic, little was said about the mechanism of these two phenomena, except of the line of studies started by Gailliot and colleagues (2007) testing that glucose is a potential mediator. In other words, the mediator between self-control at Task 1 and self-control at Task 2 (both with and without a mouth rinse) is still unknown and largely unexplored.

I hypothesized that following exertion of self-control, the phenomenal experience of the world changes (or at least that part which is related to the person's self-regulatory goals). At the proximate level, this different perception of internal and external stimuli is what results in subsequent choices that *look like* self-control failures. Specifically, I predicted that self-control exertion will lead to perceptual changes described below and the sugar-rinse will "replenish" self-control through restoring these perceptions to their original form. Specifically, I predicted the following:

- 1) When the second self-control task is to persist in something unpleasant, people will *choose* to give up on it because they will experience a) the task as irresistibly unpleasant and/or b) the focal goal as not worth working towards.
- 2) When the second self-control task is to resist something pleasant, people will *choose* to indulge in it because they will experience a) the object as virtually irresistible and/or b) the focal goal as not worth working towards.
- 3) When the second self-control task is to persist in something unpleasant while facing the choice of something pleasant, people will experience at least one of the two experiences, but more likely both experiences more intensively. Consequently, the experienced temptations (due to the change in the perception of the stimuli) will increase to the degree that the person will *choose* the more pleasant/tempting outcome.

The proposal was not born in vacuum. Schmeichel and colleagues (2010) found evidence that following self-control exertion approach motivations intensify. Vohs and colleagues (2011) found experimental support to the idea that following self-control exertion, all feelings and desires are intensified. Nevertheless, no one, so far, tested these mechanisms as possible mediators of the self-control exertion findings.

In Experiment 1 (main dependent variable: the length of procrastination) I did not find support for the intensification effect. Nevertheless, participants in the high self-control exertion condition expressed a lower motivation to practice the tasks. This might have been linked to a decrease in the evaluation of some unmeasured aspects of the tasks. Conversely, it might have also been linked to an unmeasured increase in the evaluation of some competing tempting stimuli (such as, for example, the most popular procrastination

target: the participants smartphone and the Facebook news-feeds they were checking on them).

In Experiment 2a (main dependent variable: the amount of unsavory beverage consumed) I found tentative support for the intensification effect. Participants in the non-sugar-rinse condition (i.e., high self-control exertion) rated the value of the reimbursement as significantly lower. Although they did not rate the drinks more negatively, the fact that they reported a need for higher reimbursement to consume more from the bad tasting drink, indirectly tells that they probably experienced the drink more negatively.

In Experiment 2b (main dependent variable: the number of savory cookies consumed) I also found tentative support for the intensification effect. Participants in the non-sugar-rinse condition (i.e. high self-control exertion) rated the cookies as more delicious, based on looks as well as based on overall taste and quality. These results should be qualified, however, as they were true only for half of the sample (the individuals who were categorized as very high and very low on the experienced temptations). Furthermore, for these two groups it led to opposite effects in terms of the number of cookies consumed. Specifically, high food-intake controllers consumed fewer, while low food-intake controllers consumed more cookies.

Together, the results from the three experiments provide tentative evidence that following self-control exertion people might indeed perceive the world differently, finding pleasant stimuli even more pleasant and unpleasant stimuli even more unpleasant (which can be also viewed as the strengthening of impulses/momentary desires). More

importantly, the results also found tentative evidence that these changed perceptions (intensified impulses/desires) indeed mediate the classic effect of self-control exertion on subsequent self-control impairment. These findings have a crucial impact on the so far domineering resource depletion theory of Baumeister and colleagues (e.g. 1996, 2007), from both theoretical and practical points of view. From a theoretical point of view the results suggest that the observed findings that following self-control exertion at Time 1, self-control is impaired at Time 2, which was used as a support for the resource-depletion view, might not be (solely) the result of weakened self-control strength, but also strengthened desire strength. The most recent theoretical view voiced by Wagner and Heatherton (2014) also suggests that there are not one but three major threats of self-regulatory failure: self-regulatory capacity, impulse strength and self-awareness. Wagner and Heatherton (2014) argue that these three threats are not static, but subject to modulation by each other and other factors (such as negative affect, attention, drugs, brain damage etc.). Finally, the findings of the current dissertation impact the work on the development of prevention- and intervention strategies aimed at improving self-control: Instead (or besides) of searching for the cure for the diminished resource, it might be also possible to improve self-control by developing training programs that focus on perception, affect and motivation – one such intervention, mindfulness meditation, already showing promise (Teper, Segal & Inzlicht, 2013).

Explanation of the Results and Limitations

The fact that I did not replicate all previous findings in the self-control literature qualifies the fact that not all of my predictions were supported either. These null and partial findings might have resulted from several issues

The “too incredible” effect of self-control?

The most extreme criticism of the self-control exertion findings came from Carter & McCullough (2013) who re-analyzed earlier meta-analytical data by Hagger and colleagues (2010) and concluded that the results from the two-task ego-depletion studies “could be a small effect – less than half the size estimated by Hagger et al; but it could also be a non-existent effect for which belief has been kept alive through the neglect of null findings” (p. 684). Although this extreme state of affairs is unlikely, Carter and McCullough’s claim highlights the growing agreement on the issue that more precise designs should be implemented in the future.

This is the idea advocated by Hofmann, Kotabe and Luhmann (2013) who asserted that, most likely, not all individuals experience self-control situations the same way. Specifically, situations that researchers assume to be a self-control conflict and stimuli that are assumed to be tempting, might not be experienced as such by everyone at every time (and maybe not even by the majority of individuals and/or most of the time). Consequently, temptation should be measured or manipulated and used as a variable; alternatively, participants should be pre-selected based on if they are or if they are not tempted by the target stimuli.

In light of this, the fact that I did not replicate the general findings of previous cookie-snacking studies (when looking at the full sample) probably should not be seen simply as a replication failure. Instead, it provides support to Hofmann’s suggestion that careful attention should be devoted to how self-control is viewed and how studies testing self-control are designed in the future.

Floor and ceiling effects.

In case of both Study 2 and Study 3 floor and ceiling effects might have interfered with finding differences in the rating of the drinks and cookies. Specifically, in Study 2a the average ratings for the unsavory drinks were in both groups slightly below 2 on a 5 point scale. Thus, possibly, these drinks could not have been rated more negatively. Consequently, the fact that participants expressed a need for higher reimbursement to drink more, might be considered also as an implicit rating of the taste of the drink (aside from being a measure of motivation).

In Study 2b, the opposite might have happened. Two out of the five cookies were of high quality and three were relatively cheap sugar cookies. Thus, finding an effect in the number of consumed cookies might become harder, because, everyone indulged in them, however only to a certain point.

Extraneous variables: Experimenter and laboratory effects.

The Laboratory. Study 2b was not conducted in a classic psychology laboratory, but instead in study rooms reserved at the University Library. Although every effort was made to reserve the same rooms each time, on several occasions it was not possible. The experiment was therefore conducted in rooms with somewhat varying design, lighting, heat and other conditions. Nevertheless, the rooms were randomly distributed across the two conditions.

The Experimenters. In case of all three studies multiple pairs of experimenters (research assistants) were used. Muraven and colleagues (2008) found that if the study was conducted by a warm and friendly experimenter (compared to a cold and distant

experimenter), participants showed less deterioration in performance. The suspicion that some experimenter effects might be present in my studies is strengthened by the pattern of the observed results across experimenters.

In Experiment 1 (Procrastination), as the *Figure 5a* shows, Experimenter Pair coded as AAP (17 participants) had a markedly different pattern of results compared to all other experimenter pairs (50 participants). Here, no coding error could have happened because the sessions were videotaped. Thus, most likely, some personal characteristic of the experimenter conducting self-control 2 might have had somehow primed procrastination in the case of all participants, or some personal characteristic of the experimenter conducting self-control 1 “depleted” all participants. Participants of the same experimenter pair also showed the exact mirror image of the participants of the other experimenters on the measure of desires (see *Figure 5b*).

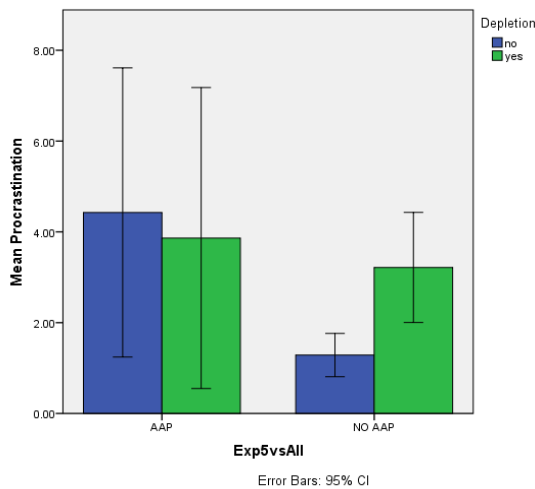


Figure 5a. Amount of procrastination, as a function of self-control exertion (“depletion”: yes vs. no) and experimenter pair (AAP vs. 4 other experimenter pairs)

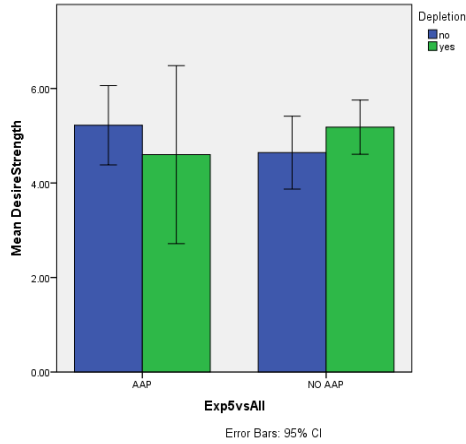


Figure 5b. Rating of the strength of spontaneous desires, as a function of self-control exertion (“depletion”: yes vs. no) and experimenter pair (AAP vs. 4 other experimenter pairs)

In Experiment 2a, the same Experimenter Pair, PA, completely reversed the effect, compared to the other experimenters *and* previous research on self-control, suggesting, possibly, that they, somehow, used the wrong mouth-rinse bottle each time (see Figure 6). Thus, these two individuals (out of the 10 experimenters in the studies) might be solely responsible for all unusual results (as well as for several null-findings).

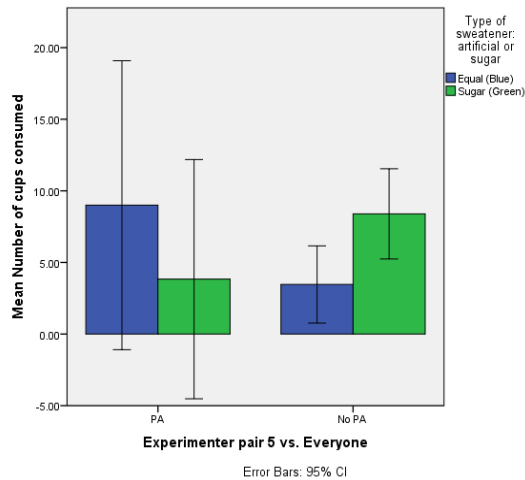


Figure 6. Number of cups consumed, as a function of mouth-rinse and experimenter pair (PA vs. everyone)

Given these large differences between different experimenters on the main dependent variable, a possibility exists that the results from some of these experimenters cannot be trusted at all. However, I decided to keep their participants in the sample, as removing them would be unjustified without concrete evidence that they committed a fraud or administered the protocol in a wrong way (such as, for example, used the wrong bottle mouth rinse most of the time, confusing blue with green).

In summary, the experimenter effects in the current studies are calling for caution when selecting and training research assistants for the role of administering the studies. As research on self-control especially needs detailed behavioral measures and finite manipulations with deception, future studies in the area must take different aspects of experimenter effects into consideration.

Experimental Design and Measurement problems

To investigate the intensification of affects and desires I created my own measures. Clearly, they were not perfect and most likely better measures can be created. Most importantly, I am planning to use different forms of implicit measures in the future (see for example Toure-Tillery & Fishbach, in press); explicit measures might have led to several potential biases in the current studies. For example, participants might have been overly polite when rating the cookies and the drinks or they might not have wanted to display extreme interest in certain magazines (for example due to gender expectations).

Furthermore, the studies could be improved by including measures of personality. I included some measures of the degree to which the specific target stimuli are tempting to the participants by measuring their perception as well as the participants' goals (for

example, dieting). Nevertheless, further measures of personality or at least some specific personality traits (for example grit or action/state-orientation) could be used to examine how these personality factors relate to the dependent and independent variables used in these studies.

It has been known for a long time that personality influences people's perceptions, emotions and motivations (e.g. Leary & Hoyle, 2009). It is possible that some of the proposed aftereffects of self-control exertion happen or are more pronounced in certain individuals. The study of individual differences in self-control has a rich history. A long line of research demonstrated that trait self-control influences a wide range of behaviors (de Ridder et al, 2012).

A somewhat newer line of research also found strong evidence that the related, but distinct measure of individual differences in the more task specific, called grit, is also an important determinant of resisting momentary desires and sticking with longer-term goals (Duckworth & Gross, in press). More recently researchers also found evidence for the role of approach motivation (Schmeichel, Harmon-Jones & Harmon-Jones, 2010) and action-state orientation (Grope, Baumeister & Beckman, in press). Consequently, measuring certain personality variables might be necessary to gain a full picture on the detailed mechanism of self-control.

Finally, the use of a within-subject design, rather a between-subject design (especially for Experiment 1 where the level of self-control exertion was manipulated) might have proven to be more powerful. Indeed, my hypothesis was that following self-control exertion at Time 1 self-control becomes worse at Time 2 because people's

momentary desires intensify. I tested this idea in a between-subject design because this is how studies in the field were conducted in the past. Nevertheless, it would be worthwhile to conduct experiments in the future using a within-subject design.

Connections to other theories and research, implications and future directions

My basic proposed idea that following self-control exertion, phenomenal experience undergoes a change, which in turn leads to different self-control performance, is promising. The idea resonates or can be connected to several recently emerged lines of research or theories, as well as also has a long past in the history of psychology, not discussed in the introduction. Bruner and Goodman (1947) were among the first to shed light on the fact that even in the case of the physical world no “objective reality” exists: People perceive the world depending on their desires, goals and motivations. In a classic study Bruner and Goodman asked schoolchildren to judge the size of coins and cardboard discs and found that the size of coins (and especially those with higher value) was always over-estimated. Furthermore, children from low SES (compared to high SES) made such errors more often. Bruner argued that as poor children needed the money more, a top-down, motivational influence changed their basic perceptual experience.

This idea of “motivated perception” was reborn during the past 10 years within the embodiment literature. For example, researchers found that people estimate the slope of the hill as steeper if they are wearing a heavy backpack or if they are worried about something, but this effect is de-intensified if they are with a supportive other or if they consumed a sugar-sweetened beverage (Profitt, 2006; Schall, Zadra & Profitt, 2010). In a similar vein, desired objects are perceived to be closer (Balcetis & Dunning, 2010).

Even more interesting for the current work is a recent line of findings by Cole (2014) suggesting that under normal conditions, individuals who are tempted by desirable targets tend to devalue the attractiveness of the target of their temptation. Specifically, heterosexuals who were in a relationship (compared to those who were single) devalued the attractiveness of an opposite sex other if the target is labeled as “single” *and* “interested in pursuing a relationship”, the exact individuals who were the highest potential threat to the current relationship of the participant (Cole, 2014, experiment 1 & 2). In a completely different domain similar results emerged: Female (but not male) restrained eaters estimated the distance of a snack cart with highly desirable items to be further than a snack cart with less desirable items. Non-restrained eaters showed the opposite pattern, estimating a snack cart with highly desirable items to be closer compared to a snack cart with less desirable items (Cole, 2014, Experiment 3)

Although these studies did not investigate the role of previous engagement in self-control, they show that participants’ self-regulatory goals indeed appear to be changing the way how they see the world. Specifically, it appears that under normal circumstances people somehow, automatically devalue momentary temptations, presumably to achieve their longer term goals. If this is true, it is possible that self-control exertion eliminates this temptation-devaluation effect, somehow, returning perception to “normal”. In light of these findings, the “depletion” findings might be the result of a perceptual change: The perception of the world might be distorted in order for us to achieve our goals; however unrewarded self-control exertion eliminates this tendency and consequently, we fail in our goals and indulge in the temptation.

A further support for my new hypothesis that “depletion” might actually intensify desires by eliminating the described temptation-devaluation effects comes from the *Selfish Goal Theory* by Huang and Bargh (2014). The Selfish Goal Theory proposes that the person’s goals influence the basic information processing of the individual in such a way that the person acts in accordance to them, regardless of whether it is beneficial to the individual or not. Specifically, the *reconfiguration principle* of the *selfish goal model* states that whichever goal (from the person’s multiple goals) becomes primed at a given moment, it makes the individual “see the world through goal colored glasses” (p.129), perhaps, automatically changing the experienced value of stimuli depending on whether they are serving the focal goal or not. It is possible, again, that this tendency is eliminated following non-rewarded self-control exertion. An interesting further application of the Selfish Goal Model to the area of the role of desires in self-control would be to investigate closely the battle of goals and desires from the perspective of Kenrick’s new hierarchy of needs (Kenrick et al, 2010; Becker & Kenrick, 2014): When will, for example, the social affiliation motives of the participant (e.g. pleasing the experimenter) win over her self-protection motives (e.g. avoiding what tastes harmful)?

A further line of research providing support to the above described idea is Martin’s *I-D (immediate-return – delayed-return) Compensation Theory* (Martin, 1999, Martin & Shirk, 2013). According to this theory human nature is different from that which the society people live in requires. Specifically, humans have “*immediate-return needs*”, meaning that similar to the world of our ancestors we prefer no strict standards of behavior and we need frequent feedback in forms of rewards to inform us about our goal progress. However, the functioning of the society requires a nature of “*delayed-return*

needs”, meaning that strict standards of behavior exist and feedback on goal-progress is scarce or at least greatly delayed. Therefore, to survive in our society, humans have to constantly *compensate* by overwriting their real nature with an, in some sense, inauthentic nature in order to gain the acceptance of peers and avoid ostracism.

In my Experiment 2B I found that following self-control exertion and a non-sugar based mouth-rinse (i.e. “high self-control exertion” without reward), participants who were low in their tendency of monitoring their food intake showed a tendency to *increase* their cookie consumption. Conversely, participants who were high in their tendency of monitoring their food intake showed a tendency to *decrease* their cookie consumption. Based on these results, possibly, what happens following self-control exertion is not a self-control decrease or failure. Instead, following self-control exertion, people might be expressing their “true self”, “whose worth is” NOT “contingent on the evaluation of others” (Martin, 1999, p. 206); and possibly, they start seeing the world “quite simply, the way things are” (Martin, Sanders et al, in press, p. 32). And by seeing the world in this authentic way, they simply start acting authentically, and choose the options that they *really* want (instead what they think they should want – based on others’ approval).

Specifically, instead of controlling themselves to follow standards, in the state of “depletion” people might start choosing their own “true” standards: eat more if they do not truly care about dieting (disregarding the societal standards of restraint and preference for thinness) and eat less if they do care about dieting (disregarding the social pressure coming from the experimenter’s direction to eat as much as needed to arrive to a good rating). This is what, according to Martin (1999), our ancestors, the members of immediate return societies, would have done. Such individuals needed frequent

feedback, but were not required to adhere to specific standards. Martin suggested that to become like hunter-gatherers were, one should experience either a very “close brush with death” (Martin et al, 2005) or practice mindfulness (Martin et al, in press). Perhaps, exerting self-control, without receiving immediate rewards, what we all do from time-to-time, somehow, does the same? An especially interesting line of work might be combining traditional self-control manipulations, I-D manipulations and mindfulness manipulations (along with the evolutionarily meaningful reward of sugar), as all of them appear to influence people’s judgments and perceptions; furthermore, Teper and colleagues (Teper, Segal & Inzlicht, 2013) already found promising effects of mindfulness manipulations on self-control exertion.

It is important to emphasize that, in general, emotion and motivation are highly related, difficult to tease apart and interact to produce behavior. In my studies I did not truly differentiate between “liking” and “wanting” either. Essentially, if something is liked, it is also wanted most of the time. However, the reverse is not true. People can “want” things, but do not necessary “like” them (Berridge, 2009). Consequently, a promising, although difficult, avenue of research is to start teasing apart these two components, trying to measure and/or manipulate them separately and concurrently to see what specific role they play in the mechanism of self-control.

Finally, in order to test a mediation model, of utmost importance is to start manipulating the mediator experimentally (Inzlicht & Schmeichel, 2012). Thus, instead of simply measuring how much participants like or want certain targets, experimenters should start manipulating their likeability. I did make such an attempt in Experiment 2A when presenting two slightly different unsavory drinks to participants, however many of

them did not reach the second half of the drinks, so this comparison was not calculated. Nevertheless, manipulating the attractiveness or aversiveness level of the target object of the study both between subject and within subject is a promising way of testing if the affect intensification is the driving force of the self-control exertion effects.

Closing

The results of the hundreds of studies conducted in the dual task paradigm did not so far demonstrate the existence of the limited resource. All they say is basically that performance on Task 2 is *different* than what would be expected from a “well-behaved”, “normal” member of the society. People who previously exerted self-control are more likely to play than work when we suggest them to work, they drink less from a bad tasting beverage if we ask them to drink as much as they can (and give them a ridiculously small reimbursement) and they snack more from the cookies than “normal” people do if the cookies are in front of them. These and similar findings were taken as an evidence of the “depletion” of a mysterious “limited resource” of self-control. Nevertheless, the findings can be equally well explained by other mechanisms, most notably, assuming the intensification of desires that we try to control.

Van Lange (2013) recently proposed a framework for evaluating the goodness of theories in Psychology using four criteria/”ideals”: Truth, Abstraction, Progress and Applicability. The Limited Resource model succeeds in two criteria (Abstraction and Applicability), but falls short in the other two (Truth and Progress). The Desire Intensification model meets all four criteria.

The Limited Resource model definitively succeeds in the criterion of *Applicability*: “it speaks to many events and issues in everyday life” (van Lange, 2013, p. 45). The model and the research it generated was quintessential in turning the attention of scientists and practitioners towards the central importance of self-control problems in daily life. The Limited Resource model fairs also well based on the criterion of *Abstraction*: “it describes particulars (e.g. phenomena, events) in terms of the general (concepts, assumptions, principles)” (van Lange, 2013, p. 43) . Nevertheless, the Limited Resource model falls somewhat short in terms of the other two ”ideals” of a good theory. First, the ideal of *Truth* states that a good theory should “separate fact from fiction; it should establish what’s real and what’s imaginary” (van Lange, 2013, p. 41). Van Lange (2013) suggests that this should be done by the theory permitting “formulations of specific hypothesis that can be tested in carefully designed studies” (van Lange, 2013, p. 41). The Limited Resource model does not allow this crucial criterion, as its main explanation, the resource is only implied and never measured. Second, the related “ideal” of *Progress* states that a good theory should be “subject to refinement through a process of sharpening and empirical testing” (van Lange, 2013, p. 44). The Limited Resource model did lead to clear progress during its first decade of existence, as evidenced by the more than 200 published papers using its ideas. However, given the Limited Resource model’s current inability to specify the resource, its argumentation became circular and the progress that it originally started was stalled. In its current form it cannot be subject for refinement, for the exact reason that it is impossible to disconfirm it.

In contrast, the Desire Intensification model allows for specific hypotheses and tests; it allows falsification, refinement and thus considerable progress. Also, the Desire

Intensification model speaks about the same events and at the same level of abstraction as the Limited Resource Model does. Moreover, if the Desire Strength model ultimately becomes falsified (what is unlikely based on current evidence) it would lend support to the Limited Resource Model, helping it to start generating further progress.

Bringing desires to the focus of self-control research, and paying close attention to how people phenomenally experience the world (related to momentary desires and longer-term goals), is a promising avenue for future research. Besides of more refined theoretical knowledge, this way of thinking could lay the foundations for the development of truly effective interventions and preventions for individuals facing self-control dilemmas and struggling with self-control problems.

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APPENDICES

Appendix A

Task Rating

(only Task 1 is displayed, all ratings were identical)

Please, first, rate each task on the 4 dimensions listed below.

Then, estimate the the number of practice questions you would likely solve for each task type before taking the actual test.

Task # 1

Dislike very much	1	2	3	4	5	Like very much
Very dull	1	2	3	4	5	Very interesting
Not exciting at all	1	2	3	4	5	Very exciting
Not challenging at all	1	2	3	4	5	Very challenging

If preparing for the actual test, how many practice questions would you solve from each task type?

Not practice it at all questions	1-5 questions	5-10 questions	More than 10 questions	All 30
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Appendix B: Magazine rating

(only Magazine 1 is displayed, all ratings were identical)

Please, first, rate each magazine on the 4 dimensions listed below.

Then, estimate the highest price you would likely buy the magazine if offered at the Student Union.

Magazine # 1

Dislike very much	1	2	3	4	5	Like very much
Very dull	1	2	3	4	5	Very interesting
Not exciting at all	1	2	3	4	5	Very exciting
Very poorly designed	1	2	3	4	5	Very well designed

If offered at the Student Union, what would be the highest price you would pay for it?

I'd never buy it 80% discount 50% discount 25% discount 10% discount I'd buy it even for full price

Appendix C: Additional questions for Experiment 1 (Procrastination study)

1) What do you think was the purpose of this research?

2) Were the separate studies related to each other?

Yes

No

If yes, how?

What are your hobbies?

What is your

a. Age

b. Gender

c. Major

***** ONCE FINISHED, CONTINUE ON THE OPPOSITE SIDE OF THE PAGE *****

Please, answer the following questions as honestly as possible. Your answers are confidential.

1) How strong was your desire to pick up and look through some of the magazines on the table?

No desire at all 1 2 3 4 5 6 Irresistible

2) How strong was your desire to pick up and play with the Gameboy on the table?

No desire at all 1 2 3 4 5 6 Irresistible

3) How strong was your determination to practice for the upcoming test?

No determination at all 1 2 3 4 5 6 Extremely strong

4) To what degree these desires for the magazines and the Gameboy conflicted with your goal of learning more about yourself and practicing for the test?

Not at all 1 2 4 5 Very much

5) Have you experienced within the last 30 minutes any other *desire*, meaning any **subjective experience that had a sense of wanting or longing to do or consume a certain thing**? This may include but is not limited to doing nothing, sleeping, eating, drinking, tobacco or other substance use, sexual desire, doing any kinds of a sport, hygiene, social contact or media use)?

Yes No

6) What specifically?

7) For each desire you list, also indicate its strength ranging from 1 (very weak) to 7(irresistible)

8) How do you feel at the moment?

Very bad 1 2 3 4 5 6 7 Very good

Appendix D

The Unsavory Drink Ratings

Please, first, rate how *delicious* each sport drink tastes, using the following scale:

1 (awful); 2 (bad); 3 (neutral); 4 (good); 5 (awesome)

Then, rate each drink on how *sweet, sour, bitter and salty* it is, using the following scale:

1 (not at all); 2 (slightly); 3 (just right); 4 (very); 5 (extremely/way too)

Drink # 1

Awful	1	2	3	4	5	Awesome
Not sweet	1	2	3	4	5	Extremely sweet
Not sour	1	2	3	4	5	Extremely sour
Not salty	1	2	3	4	5	Extremely salty
Not bitter	1	2	3	4	5	Extremely bitter

Appendix E

Additional questions for Study 2A (unsavory drinks)

1) What do you think was the purpose of this research?

2) Was Study 1 (the attention task) related to Study 2 (the drink-tasting task)?

Yes

No

If yes, how?

***** ONCE FINISHED, CONTINUE ON THE OPPOSITE SIDE OF THE PAGE *****

3) What do you think was the main ingredient of the mouth-rinse?

a. Sugar b. artificial sweetener (sugar-substitute) c. lemon d. lime e. other

4) What were the ingredients of the drinks you tasted? (circle as many as you want)

Water Orange Lemon Salt Vinegar Sugar Sugar-substitute Mint Grape Apple Raspberry

5) The amount paid per cup (5 cents, 1 dollar for all 20) was

- A) very good
- B) adequate
- C) rather little
- D) very bad

6) What is the *minimal amount* of money that would make you drink MORE?

_____ per cup

ALL 20?

_____ per cup

7) If you were required to listen closely to an aversive lecture, what would be the minimal acceptable compensation (in US Dollars) for a 30 minute lecture?

8) How much do you care about controlling the type of food and drinks you consume?

- Not at all - 1 2 3 4 5 - Very much -

9) What is your:

a. Age

b. Gender

c. Current height

d. Current weight

Appendix F: The rating of the cookies

For all the ratings (except question 4), use the following scale:

1 (totally not), 2 (not); 3 (yes); 4 (totally yes)

1. Please, rate how **delicious** each cookie *looks* (before trying them):

Cookie # 1 : _____

Cookie # 2 : _____

Cookie # 3 : _____

Cookie # 4 : _____

Cookie # 5 : _____

2. Please, rate how **delicious** each cookie *tastes* (based on first bite). Do not change these ratings based on your later ratings!

Cookie # 1 : _____

Cookie # 2 : _____

Cookie # 3 : _____

Cookie # 4 : _____

Cookie # 5 : _____

3. Please, rate each cookie on the following characteristics:

Cookie #1 Cookie #2 Cookie #3 Cookie #4 Cookie #5

Creamy

Moist

Crunchy

Sweet

Salty

Delicious

4. Please provide the ranking of the cookies based on how likely you would buy them if they are offered at the Student Union: 1st – most likely to 4th – least likely

Cookie # 1 : _____ Cookie # 2 : _____ Cookie # 3 : _____

Cookie # 4 : _____ Cookie # 5 : _____

5. How much would you be willing to pay for a full box of your highest ranked cookie if it is offered at the Student Union?

Appendix G: Additional questions Experiment 2B (cookies)

What do you think was the purpose of this research?

Was Study 1 (the attention task) related to Study 2 (the cookie-tasting task)? Yes No

If yes, how?

***** ONCE FINISHED, CONTINUE ON THE OPPOSITE SIDE OF THE PAGE *****

Eating Habits

1. How often do you try to control your eating? By “control” we mean changing any aspect of your eating related behavior, either for the purpose of losing weight or being healthier?

Never Rarely Sometimes Often Always

2. How much do you care about controlling the *type* of food you eat?

1 – Not at all 2 3 4 5 – Very much

3. How much do you care about controlling the *amount* of food you eat?

1 – Not at all 2 3 4 5 – Very much

4. What are you currently trying to do regarding your weight?

Lose a lot Lose some Maintain it Gain some Gain a lot

5. What is your: a. Age b. Gender c. Current height d. Current weight

Oklahoma State University Institutional Review Board

Date: Thursday, June 06, 2013 Protocol Expires: 2/27/2014
IRB Application No: AS131
Proposal Title: Personality and Perceptions

Reviewed and Expedited
Processed as: **Modification**

Status Recommended by Reviewer(s) **Approved**
Principal Investigator(s):

Csongor Daniel Hornyik 140 N. Duck Stillwater, OK 74075	David Thomas 116 N. Murray Stillwater, OK 74078
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The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office **MUST** be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

✕ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

The modification to change advisors to Dr. David Thomas is approved.

Signature :



Shelia Kennison, Chair, Institutional Review Board

Thursday, June 06, 2013
Date

**ADULT CONSENT FORM
OKLAHOMA STATE UNIVERSITY**

PROJECT TITLE: Attention and Success in Life

INVESTIGATOR: C. Daniel Hornyik, M.S., David Thomas, Phd; Oklahoma State University

PURPOSE: This study will examine your perceptions and ratings of various stimuli.

PROCEDURES: To receive credit, you will participate in two brief studies. One study will ask you to complete a measure of attention, while the second study will ask you to complete a measure of intelligence. You will stay no longer than 55 minutes in the lab and you will receive one (1) SONA credit as a reimbursement.

RISKS OF PARTICIPATION: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life..

BENEFITS OF PARTICIPATION:

Participants in this study are not expected to benefit personally. Society may one day benefit if the results increase our understanding of the factors influencing human behavior.

CONFIDENTIALITY: The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. Your data will also be stored anonymously; your name will not be linked to your responses at any point in the study.

COMPENSATION: You will receive one unit of course credit for your participation, which is expected to last 55 minutes or less. Other alternatives for course credit are available -please check with your instructor for details.

CONTACTS : Should you desire to discuss your participation in the study and/or request information about the results of the study, you may contact: Daniel Hornyik, M.S., North Murray Hall, Dept. of Psychology, Oklahoma State University, Stillwater, OK 74078. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS: I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION: I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and I also understand the following statements:

I affirm that I am 18 years of age or older.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

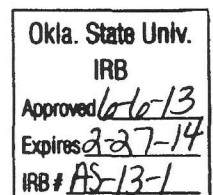
Signature of Participant

Date

I certify that I have personally explained this document before requesting that the participant sign it.

Signature of Researcher

Date



Video Recording/Usage Consent Form

I understand that I was videotaped during the second phase of this study in order to monitor how much time I spent on each activity (reading magazines, solving tasks or resting).

Signature: _____ Date: _____

Only research assistants and the investigators will have access to the videos and they will use them solely for the purposes of recording the amount of time I spent on each activity.

Initials: _____

3 data will be extracted from the videos: 1) the amount of time spent viewing the magazines (in seconds), 2) the amount of time spent working on the practice tasks (in seconds) and 3) the amount of time spent on a different activity, such as taking a nap or sitting silently (in seconds). No other information will be extracted from the videos. Initials: _____

The videos will be kept together with other materials in the locked cabinet of Dr Shelia Kennison's laboratory, for five years. Initials: _____

**I agree for the videotape to be used by the researchers
of this study ONLY**

YES / NO

Signature: _____ Date: _____

Okla. State Univ.
IRB
Approved 2-27-13
Expires 2-27-14
IRB # AS-13-1

ADULT CONSENT FORM
OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: Attention and Drink Taste

INVESTIGATOR: C. Daniel Hornyik, M.S., David Thomas, PhD; Oklahoma State University

PURPOSE: This study will examine your perceptions and ratings of various stimuli.

PROCEDURES: To receive credit, you will participate in two brief studies. One study will ask you to complete a measure of attention, while the second study will ask you to rate different drink items.

You will stay no longer than 55 minutes in the lab and you will receive one (1) SONA credit as a reimbursement.

RISKS OF PARTICIPATION: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

BENEFITS OF PARTICIPATION:

Participants in this study are not expected to benefit personally. Society may one day benefit if the results increase our understanding of the factors influencing human behavior.

CONFIDENTIALITY: The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. Your data will also be stored anonymously; your name will not be linked to your responses at any point in the study.

COMPENSATION: You will receive one unit of course credit for your participation, which is expected to last 55 minutes or less. Other alternatives for course credit are available -please check with your instructor for details.

CONTACTS : Should you desire to discuss your participation in the study and/or request information about the results of the study, you may contact: Daniel Hornyik, M.S., North Murray Hall, Dept. of Psychology, Oklahoma State University, Stillwater, OK 74078. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS: I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION: I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and I also understand the following statements:

I affirm that I am 18 years of age or older.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

Signature of Participant

Date

I certify that I have personally explained this document before requesting that the participant sign it.

Signature of Researcher

Date

Okla. State Univ.
IRB
Approved <u>6/6/13</u>
Expires <u>2-27-14</u>
IRB # <u>AS-13-1</u>

ADULT CONSENT FORM
OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: Attention and Food Taste

INVESTIGATOR: C. Daniel Hornyik, M.S., David Thomas, PhD; Oklahoma State University

PURPOSE: This study will examine your perceptions and ratings of various stimuli.

PROCEDURES: To receive credit, you will participate in two brief studies. One study will ask you to complete a measure of attention, while the second study will ask you to rate different food items.

IF YOU ARE UNABLE TO EAT NUTS, CHOCOLATE, DAIRY, SUGAR AND FLOUR OR IF YOU ARE ALLERGIC TO NUTS, CHOCOLATE, DAIRY OR FLOUR, HAVE HIGH CHOLESTEROL, OR CANNOT EAT SUGAR, YOU SHOULD NOT PARTICIPATE.

You will stay no longer than 55 minutes in the lab and you will receive one (1) SONA credit as a reimbursement.

RISKS OF PARTICIPATION: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life. Allergic reactions are possible from any product and although uncommon, cannot be predicted. You should stop eating the food if any rashes, difficulty breathing or other adverse/allergic symptoms occur and seek medical advice.

BENEFITS OF PARTICIPATION:

Participants in this study are not expected to benefit personally. Society may one day benefit if the results increase our understanding of the factors influencing human behavior.

CONFIDENTIALITY: The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. Your data will also be stored anonymously; your name will not be linked to your responses at any point in the study.

COMPENSATION: You will receive one unit of course credit for your participation, which is expected to last 55 minutes or less. Other alternatives for course credit are available -please check with your instructor for details.

CONTACTS : Should you desire to discuss your participation in the study and/or request information about the results of the study, you may contact: Daniel Hornyik, M.S., North Murray Hall, Dept. of Psychology, Oklahoma State University, Stillwater, OK 74078. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS: I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION: I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and I also understand the following statements:

I affirm that I am 18 years of age or older.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

Signature of Participant

Date

Okla. State Univ.
IRB
Approved <u>6-6-13</u>
Expires <u>2-27-14</u>
IRB # <u>AS13-1</u>

I certify that I have personally explained this document before requesting that the participant sign it.

Signature of Researcher

Date

Okla. State Univ.
IRB
Approved 6-6-13
Expires 2-27-14
IRB # AS-13-1

VITA

Csongor Daniel Hornyik

Candidate for the Degree of Psychology

Doctor of Philosophy

Dissertation: TOWARDS A DESIRE-CENTERED VIEW OF SELF-CONTROL

Major Field: Psychology

Education:

Completed the requirements for the Doctor of Philosophy in Psychology at Oklahoma State University, Stillwater, Oklahoma in December, 2014.

Completed the requirements for the Master of Science Psychology at Oklahoma State University, Stillwater, Oklahoma in 2010.

Completed the requirements for the Master of Science Social Psychology at VU (Vrije Universiteit), Amsterdam, The Netherlands in 2007.

Completed the requirements for the Bachelor of Arts in Psychology at University of Kentucky, Lexington, KY in 2004.

Experience:

Research within the areas of social psychology, specifically emotion and motivation. Primary research areas include self-regulation, goals, motivation and emotion.

Professional Memberships:

Society of Personality and Social Psychology
Southwestern Psychological Association