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Exploring the Interplay of Trait Self-Control and Ego Depletion: Empirical Evidence for Ironic Effects

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Abstract

Trait self-control (TSC) has been conceptualized as a general and abstract ability to exert self-regulation across multiple domains that has mostly beneficial effects. However, its relationship to situational depletion of self-regulatory resources has received little attention. We systematically explore the interplay of trait and situational self-control in two studies (total $N = 264$). In contrast with a positive view of TSC, the results show greater ego depletion effects for high (vs. low) self-control abilities across such diverse domains as candy consumption (Study 1), risk-taking behavior (Study 2), and achievement motivation (Study 2). It is proposed that these ironic effects are attributable to high-TSC individuals' less frequent active inhibiton of impulses in everday life and their resulting lack of experience in resisting acute temptations. A third study ($N = 358$) corroborated this general reasoning by showing that TSC is indeed associated with less frequent impulse inhibition in daily routines. Our data point to a downside of dispositional self-control in ego depletion paradigms. Other explanations and potential future avenues for resolving inconsistent findings across the literature are discussed.

176 words

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People exert self-control on a daily base. Short-term temptations (e.g., high-calorie food, risky sexual behavior, or avoidance of taxing activities like studying or physical exercise) have to be overcome for the sake of long-term goals (e.g., good health, academic achievement). A large body of literature has focused on individual differences in how good people are in deferring short-term temptation for their long-term goals. In addition, a more recent approach to self-control has pointed to the finiteness of self-regulatory resources. Immediately after engaging in effortful self-control, individuals experience ego depletion and are less likely to effectively exert self-control. The present paper seeks to bring together these two previously disparate research traditions on self-control: a dispositional trait perspective with more recent research on situational depletion of self-regulatory resources. We report unexpected findings in support of an ironic effect of greater situational depletion for participants who describe themselves as high in trait self-control (TSC).

Trait Self-Control

Most working definitions of self-control encompass regulating thoughts, emotions, impulses, and performance as operationalizations of self-control behavior (e.g., Baumeister, Heatherton, & Tice, 1994). In general, the ability to control oneself is regarded as a relatively stable individual difference variable that plays a pivotal role for a wide range of positive outcomes in people's lives, like high level of achievement and performance, impulse control, healthy adjustment, and satisfactory interpersonal relationships (Tangney, Baumeister, & Boone, 2004). In summary, TSC is commonly understood as the ability to exert habitual inhibition of undesired habits or impulses (e.g., procrastination, impulsive eating or drinking, socially inappropriate or risky behaviors) and direct one's own behavior towards the achievement of desired (mostly long-term) goals (e.g., academic achievement, interpersonal adjustment, personal health).

Ego Depletion

In addition to the trait perspective on self-control, it has been emphasized that the ability to control oneself is a limited resource, resulting in depletion after exerting self-control. Baumeister, Bratslavsky, Muraven, and Tice (1998) coined the term *ego depletion* (ED) for the effect of showing less self-control on a subsequent task when an earlier task demanded self-control (i.e., *dual-task paradigm*). ED effects have been found in such diverse domains as physical endurance, persistence, emotion regulation, performance in logical decision tasks, sexual impulses, aggression after being provoked, and several interpersonal processes (for an overview see Baumeister, Vohs, & Tice, 2007). A recent meta-analysis has provided an extensive overview of ED effects with the finding that average effects range from medium to large (average d = .62; Hagger, Wood, Stiff, & Chatzisarantis, 2010).

The interplay of TSC and ED

At present it remains both theoretically and empirically unclear how trait and state conceptions of self-control should interact. Some authors suggested that participants high in TSC should be less vulnerable to ED, potentially because they have more resources at hand before reaching a point of depletion (e.g., Dvorak & Simons, 2009). Other authors suggested that TSC and ED should function largely independently (e.g., Muraven, Pogarsky, & Shmueli, 2006). Empirically speaking, the protective account would suggest that TSC moderates ED effects. In fact, a (relatively small) number of studies find such a protective effect of ED (DeWall, Baumeister, Stillman, & Gailliot, 2007; Dvorak & Simons, 2009; Gailliot, Schmeichel, & Baumeister, 2006; Gailliot, Schmeichel, & Maner, 2007). However, all of these studies have some limitations in the way TSC is measured, in the operationalization of the dependent variable, or the way resource depletion is induced. We will briefly discuss these problems to allow a more differentiated weighing of the available evidence in favor of a protective account of TSC against ED.

For instance, Dvorak and Simons (2009) a priori differentiated two styles of self-control, which they labeled as good and bad self-control, and found only good self-control buffered the effect of ED on task persistence. Good self-control here was defined as high scores on subscales that tapped into *future time perspective*, *problem-solving,* and *cognitive effort* – all constructs that seem to be more closely related to the dependent variable *task persistence* than to be primary indicators of TSC. In another study, TSC was measured in a more straight-forward way (Self-control Scale; Tangney et al., 2004) but the dependent variable was rather weak. Instead of looking at actual aggressive behavior, the study solely relied on participants' self-estimated intentions to aggress as the dependent variable (DeWall et al., 2007; Exp. 4).

So far, the most robust evidence for buffering effects of TSC comes from work on Terror Management Theory. Results showed that only low-TSC individuals showed increased support for US president Bush (Gailliot et al., 2006; Study 5) and general worldview defense (Gailliot et al., 2007; Study 2) after thinking about their own death. In a similar vein, a previous task to regulate emotions led to an increase in death-related words included in participants' narratives only for low-TSC individuals (Gailliot et al., 2007; Study 1). Although these results are interesting, consistent, and telling, it is open to debate whether the underlying processes could be easily mapped onto the ED model of situational self-control depletion. For one, having thoughts of death or supporting president Bush do not seem to be prime examples of impulsive behavior (i.e., self-control failure). Second, building an analogy to the protective account of TSC cited above one would need to assume that TSC helps individuals to resist exhaustion of their self-regulatory resources and remain self-controlled. However, the theoretical rationale of why TSC buffers mortality salience effects is not based on less exhaustion due to an equally strong depletion manipulation but rests on the reasoning that TSC helps minimize the (depleting) manipulation by facilitating the "suppression of death

thoughts" (Gailliot et al., 2007; p. 895). This reasoning deviates from an account based on general resistance against resource depletion and the effect may thus be specific to the domain of suppressing mortality salience.

Other works either explicitly do not find the mentioned interaction effect (Gailliot & Baumeister, 2007; Stillman, Tice, Fincham, & Lambert, 2009; Study 2) or fail to report a corresponding interaction analysis (Freeman & Muraven, 2010; Muraven et al., 2006). In summary, the evidence regarding the interplay of TSC and ED has to be regarded as inconclusive, leading the authors of a recent meta-analysis to suggest that "future research should provide further tests of the interaction between ego depletion and trait self-control on task performance using the dual-task paradigm" (Hagger et al., 2010, p. 520).

The present research

In the present research, we systematically explored the role of TSC in the dual-task paradigm with frequently used ED manipulations (as opposed to the potential special case of mortality salience) and behavioral dependent variables (as opposed to self-reported behavioral intentions), more specifically eating behavior (Study 1), and risky decisions (Study 2). As an additional (weaker) dependent variable we included self-reported achievement motivation (Study 2). These domains were chosen because they are distinct domains for which general positive effects of TSC have been found (impulse inhibition and achievement; see Tangney et al., 2004) and thus allowed testing for the boundary conditions of the presumed effects. For each of these dependent variables we predicted a main effect of ED with more candy consumption, more risky choices, and less achievement motivation for high- vs. low-ED participants. With regard to the moderating role of TSC, we tested whether we could establish the buffering effect occasionally found or whether no such effect could be detected. Inconsistent with any of our a priori hypotheses, we found an ironic effect on all three dependent variables: Particularly those high in TSC were vulnerable to the debilitating effect

of the ED manipulation. Seeking to find an explanation for this thought-provoking finding, we explored the nature of TSC in everyday temptations in Study 3. The results showed that TSC was associated with temptation avoidance — not inhibition — leading us to conclude that the central skill to resist temptations seems to be least trained in high-TSC individuals.

Study 1

The consumption of unhealthy, high-calorie food (e.g., candy) often serves as a prime example of impulsive behavior – and a failure of the self to prevent such sweet surrender (e.g., Hofmann, Rauch, & Gawronski, 2007). The conventional wisdom that we are particularly likely to grab snacks when our self-regulation is either depleted (e.g., after a long day) or distracted (e.g., while watching TV) is corroborated by a plethora of scientific findings (e.g., Friese, Hofmann, & Wänke, 2008; Hofmann et al., 2007, Shmueli & Prochaska, 2009; Vohs & Heatherton, 2000; Zyphur, Warren, Landis, & Thoresen, 2007). In the first study, we sought to replicate previous findings of increased candy consumption after ED with two important additions. First, we sought to explore the interplay of TSC and ED in this domain. Second, we tested whether a possible moderation by TSC would be incremental to the moderating role of an overly controlled style of eating (restrained eating). Previous studies have demonstrated that restrained eating exposes individuals to greater danger of food consumption, especially after ED (Hofmann et al., 2007; Kahan, Polivy, & Herman, 2003).

Method

Participants. University students (N = 137; 28 men, 109 women, mean age = 22.6 years, SD = 4.7) participated for monetary compensation. Allocation of participants to the experimental conditions was independent of age, $t(135) = 1.23$, $p = .22$, and sex, $\chi^2 = 1.73$, $p = .19$.

Ego depletion manipulation. To manipulate the level of ED, we used a modified Stroop task. All participants had to select a colored key to indicate the color of the text in

which color names were presented. In the low-ED condition, the color names were presented in lettering of the corresponding color (e.g., "red" appeared in red lettering). In the high-ED condition, the meaning of the word never matched the text color, and so the automatic response to process the key corresponding to the meaning of the word had to be inhibited. In addition, participants were asked to press the key corresponding to the meaning of the word if the word was presented in blue lettering (25% of the trials), thus preventing them from strategically ignoring the meaning of the words. After completing 12 practice trials, participants received feedback regarding their accuracy. If participants answered more than 25% of the items incorrectly, they had to repeat the practice phase. Participants completed 180 test trials in both conditions.

Measured moderators.

Trait Self-Control (TSC). TSC was assessed with the self-control subscale from the German Self-Regulatory Skills Questionnaire (SRSQ; Schmidt & Imhoff, 2011). Higher scores on this measure indicate higher TSC. The SRSQ self-control scale is comprised of 10 items from several well-established measures of self-control including the Self-Control Scale (SCS; Tangney et al., 2004). The items were extracted factor-analytically from a large pool of items tapping into self-control-related constructs of conscientiousness, impulse control, and procrastination that are all also reflected in the SCS. Speaking to the conceptual overlap with existing standard TSC scales, three items were taken from the SCS (e.g., "People would say that I have iron self-discipline"), four items were taken from the UPPS Impulsive Behavior Scale (UPPS; Whiteside & Lynam, 2001; e.g., "I usually think carefully before doing anything"), and three items were taken from the short form of the German Volitional Components Inventory (VCI-S3; Kuhl & Fuhrmann, 1998; e.g., "If a task needs to be completed, I like to tackle it immediately"). The complete wording can be found in the appendix. The SRSQ was chosen because at the time of the studies the recently published

German language version (Bertrams & Dickhäuser, 2009) of the well-established SCS (Tangney et al., 2004) was not available.

Restrained Eating (RE). A scale for assessing RE was derived from the German translation of the five-item *Restraint Eating* subscale from the Eating Disorders Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994; German version: Hilbert & Tuschen-Caffier, 2006) to assess habitual RE practices over a long period of time. On a seven-point scale (1 = "never", 7 = "all the time"), participants indicated how often within the last five years they had tried to reduce their caloric intake, eaten nothing for a long time, banned certain products from their diet, made diet rules, and tried to keep an empty stomach in order to modify their weight or figure.

Dependent variable. In an ostensible product test, a bowl containing the contents of a 125g peanut m&m®'s package was placed in front of each participant. Five minutes were given to taste the product and to rate it on a variety of dimensions such as naturalness, sweetness, and package design. After time had expired, the candy was taken away. Candy consumption was later determined by weighing the amount left and subtracting it from preconsumption weight.

Procedure. Participants arrived either alone or in groups of up to five, were greeted by an experimenter, and were seated in separate cubicles. Participants first filled in the TSC and RE measures. Then, participants completed the Stroop task that included the ED manipulation and, after a short filler task, engaged in the product test. At the end of the experiment, participants were asked their height and weight, and how hungry they felt before they entered the experiment to control for pre-existing differences between the two ED conditions. At the end, participants were fully debriefed and thanked.

Results

Preliminary analyses. The two experimental conditions did not differ with regard to their reported feelings of hunger before the experiment, nor on the two moderator variables, $F < 1$. Importantly, feelings of hunger before the experiment were unrelated to TSC and RE, $|r| < .06$, $p > .55$. Height and weight information was used to calculate the body mass index for each participant, which also did not differ between conditions, $p = .28$, and was unrelated to RE and TSC, $|r| < .03$, $p > .80$. All continuous variables were screened for univariate outliers ($|SD| > 3$). One participant's candy consumption in the high-ED condition was more than three *SD* above the overall mean. All analyses reported below were conducted both with and without this participant. However, because results did not differ, the analyses reported below are based on the full sample.

Main analyses. As predicted, participants in the high-ED condition consumed more candy, $M = 21.63$ grams, $SD = 3.42$, than participants in the low-ED condition, $M = 19.49$ grams, $SD = 2.68$, $t(126.81) = 4.07$, $p < .001$, $d = 0.72$. RE and TSC were moderately correlated across the whole sample and both TSC and RE were positively related to greater candy consumption (Table 1).

We conducted multiple regression analyses to test the moderation of the ED effect. To test the predicted moderation by RE, we conducted a hierarchical multiple regression analysis (Cohen, Cohen, West, & Aiken, 2003). Regressing the amount of consumed candy on the effect-coded ED manipulation (-1 for low ED, +1 for high ED) and the standardized RE scale resulted in a significant outcome, $R^2 = .15$, $F(2, 133) = 12.09$, $p < .001$. Adding the cross-product of these two predictors significantly increased the amount of variance explained, $\Delta R^2 = .06$, $p < 001$. Results showed that, in addition to the main effects of the experimental manipulation, $\beta = .34$, $p < .001$, and RE, $\beta = .19$, $p < .01$, the interaction term also reached significance, $\beta = .25$, $p < .001$. Thus, RE moderated the ED effect on candy consumption in a positive direction. That is, for participants with a higher score on RE (+1 *SD*), the ED effect

simple slope was large and significant, $b = 1.92$, $SE = 0.35$, $p < .001$. The slope for participants low in RE (-1 *SD*) did not significantly differ from zero, $b = 0.26$, $SE = 0.35$, $p = .45$. Hence, only participants who reported habitual restrained eating practices over the last five years consumed more chocolate after completing a highly ego depleting task (vs. low-ED).

The same procedure was then employed with TSC (instead of RE) as a moderator. Paralleling the results for RE, ED and TSC conjointly predicted a significant amount of variance in the criterion, $R^2 = .30$, $F(2, 134) = 29.49$, $p < .001$. Again, adding the interaction term significantly increased the explained variance, $\Delta R^2 = .07$, $p < .001$. Thus, the main effects of ED, $\beta = .32$, $p < .001$, and TSC, $\beta = .44$, $p < .001$, were qualified by a significant interaction, $\beta = .26$, $p < .001$. Contrary to the assumption of a protective effect of TSC, a general disposition to control one's impulses led to greater vulnerability to the effect of an ED manipulation on the consumption of tempting food, $b = 1.87$, $SE = 0.31$, $p < .001$ (simple slope test at +1 *SD*). In contrast, participants low in TSC (-1 *SD*) showed virtually no ED effect, $b = 0.18$, $SE = 0.31$, $p = .57$. Participants who self-reported highly self-controlled behavior were observed to consume more candy following an ego depleting manipulation (vs. low-ED).

RE and TSC were moderately correlated, and so the parallel results could have been due to the shared variance of the two moderators. To estimate each moderator's unique effect, we entered the experimental manipulation, TSC, RE, and all their cross products including the three-way interaction simultaneously into a multiple regression to predict candy consumption. Whereas the main effects of the experimental condition, $\beta = .31$, $p < .001$, and TSC, $\beta = .40$, $p < .001$, remained stable, RE no longer had a main effect, $\beta = .07$, $p > .30$. More importantly, both two-way interactions remained significant, not qualified by the three-way interaction, $\beta = .05$, $p > .52$. The ED effect was thus independently moderated by TSC, $\beta = .19$, $p = .01$, and

RE, β = .18, p = .01. Figures 1 and 2 show the plotted means for both two-way interactions (at ± 1 *SD*) based on the regression coefficients in this last regression equation.

Discussion

Candy is a high-calorie food that is generally desired, but that is avoided (for health and weight concerns) through successful self-regulation efforts. In this study, we replicated the effect that ED leads to increased candy consumption. We also replicated the finding that – ironically – those individuals who try hardest to inhibit the impulse to eat high-calorie foods (restrained eaters) are most vulnerable to the ED effect. Controlling for body mass index and pre-experimental feelings of hunger did not alter the results. Adding to this, the same was true for dispositional TSC. Participants who described themselves as highly self-controlled showed an increase in chocolate consumption after the high-ED task. We also looked at the relationship between the two moderators (RE and TSC). Some might argue that TSC could be the more distal personality variable of the more proximal RE and thus basically tap into the same variance. However, our data suggest otherwise: The moderation effects were independent from each other, thus having unique and incremental validity. Another noteworthy result is the positive zero-order correlation of TSC and candy consumption that might raise doubt about the validity of the TSC measurement. It is thus important to realize that the reported correlations are calculated across both ED conditions and will thus be largely driven by the positive ironic effect under high-ED. Control analyses revealed that there is no significant correlation between TSC and candy consumption under low ED.

This ironic effect of TSC is at odds with the view of TSC as a protective factor that would ultimately lead to more self-controlled behavior. However, it may be that candy consumption is a special case in this regard. There exists the view that the physiological base of ED is glucose consumption (Gailliot & Baumeister, 2007; but see Kurzban, 2010). It has been claimed that self-control depletes relatively large amounts of blood glucose (Gailliot &

Baumeister, 2007) and that one single act of self-control is sufficient for glucose to drop below optimal levels (Gailliot, Baumeister, et al., 2007). It might thus be argued that glucose intake after ED is highly functional to optimize self-regulation in one's everyday life after the lab session. In that sense, the enhanced sugar intake after ED could be interpreted as a rational strategy intended to optimize blood glucose levels rather than as a failure of self-control. We thus sought to expand the findings to other dependent variables to de-confound self-control failure from functional recovery of self-regulatory resources.

Study 2

We conducted a second study with a different ED manipulation and, more importantly, with two conceptually different dependent variables: risky behavior and achievement motivation. Recent research suggests that ego depleted individuals are willing to take more risk than non-depleted individuals. After typical ED manipulations, participants bought more lottery tickets (Bruyneel, Dewitte, Franses, & Dekimpe, 2009), opted for more risky options in hypothetical situations (Freeman & Muraven, 2010), and risked more "pumps" in the Balloon Analogue Risk Task (BART; Freeman & Muraven, 2010; for the BART, see Lejuez et al., 2002). If self-control resources are depleted, people will make riskier but ultimately more costly decisions. We tested whether TSC moderated this effect – and if so, in which direction.

As a second dependent variable, we used a measure of achievement motivation. Achievement and performance constitute a classical domain of self-controlled behavior (Tangney et al., 2004). In fact, typical items tapping into self-control include behavioral descriptions like working effectively and being self-disciplined or procrastinating (for reverse-coded items). Several studies have demonstrated that ED manipulations lead to a decrease in task persistence (e.g., Price & Yates, 2010; Vohs et al., 2008; Zyphur et al., 2007) as well as reduced performance on several cognitive tasks (for an overview see Hagger et al.,

2010). Importantly, both of these variables share a common motivational antecedent. Task persistence is closely related to individuals' motivation to excel, commonly labelled *achievement motivation* (e.g., Brunstein & Maier, 2005; Cooper, 1983). Similarly, achievement motivation has also been shown to directly predict success or task performance (e.g., Cooper, 1983; Karabenick & Youssef, 1968). We theorized that achievement motivation, task persistence, and task performance represent sequential stages of performance-related behavior (cf., the *Rubicon model of action phases*; Achtziger & Gollwitzer, 2008; Heckhausen, 1991). Thus, following from the robust effect of ED on both task persistence and performance, self-regulation failure might already become visible at an earlier stage of performance-related behavior: the motivation to excel. This notion is corroborated by a recent finding that ego depleted students self-selected easier tasks than non-depleted students, thus exhibiting a lower achievement motivation (Price & Yates, 2010). We expected achievement motivation to be lower after ED, and explored whether this effect was contingent on TSC.

Method

Participants. One hundred twenty-seven students (92 women, 35 men) participated in this study in exchange for monetary compensation. Their average age was 21.8 years (SD = 2.6). Allocation of participants to the experimental conditions was independent of age, $t(125) = 1.313$, $p = .19$, and sex, $\chi^2 < 1$.

Ego depletion manipulation. We used a working memory capacity task (e.g., Park, Glaser, & Knowles, 2008; Schmeichel, 2007, Study 3; Wright et al., 2007, Studies 1 and 2) to induce ED. Recent research has suggested that working memory capacity plays a role in self-control tasks like the inhibition of prepotent automatic behavioral tendencies and the shielding of explicitly endorsed attitudes (Hofmann, Gschwender, Friese, Wiers, & Schmitt, 2008) as well as emotion suppression (Schmeichel, Volokhov, & Demaree, 2008). We built on the idea

that working memory is more than just a passive memory container and is, rather, an active, self-control behavior in which attention is used to maintain or suppress information (Engle, 2002). To induce low vs. high ED, we manipulated whether participants had to exert less or more self-control, that is hold a small or large amount of information in their working memory. To this end we adapted a computation span task (Oberauer, Süß, Schulze, Wilhelm, & Wittmann, 2000) to create low- and high-ED versions. All participants had to judge whether the result of an equation was true or false. Furthermore, the correct results of each equation had to be remembered and entered in the correct order on the keyboard. The two conditions differed in the number of equations that had to be completed before the results could be entered. Whereas participants in the low-ED condition had to remember the results of two equations, participants in the high-ED condition had to remember four to eight equations. Participants completed 180 trials in both conditions.

Measured moderator. The measure of TSC was identical to the one used in Study 1.

Dependent variables.

Game of dice task (GDT). The GDT (Brand et al., 2005) is a computerized decision task that provides explicit information about the gains and losses associated with given choices. Participants were instructed to maximize their fictitious starting capital of 1,000 € within 10 rounds of throwing a single die. Before each round, they had to bet either on a single number or a combination of two, three, or four numbers. If the die showed a number they had chosen (either as a single number or within a combination), they won an amount of money (a single number: 1,000 € gain/loss; combination of two numbers: 500 € gain/loss; combination of three numbers: 200 € gain/loss; combination of four numbers: 100 € gain/loss). If not, they lost the same amount. Thus, betting high amounts of money (500 € or 1,000 € on a single number) was a riskier option. As each of these choices has a different winning probability ranging from 16.6% to 66.6%, it follows that risky decisions are also

more disadvantageous. Participants had to make a total of 10 decisions within the game. After each throw, the gain or loss was indicated on the screen. The computer also displayed the participants' current money total, as well as the number of remaining rounds. In the GDT, two out of the four possible choices are defined as "advantageous" or "not risky" because they have a winning probability of 50% or higher. The other two options are referred to as "disadvantageous" or "risky" because they have a winning probability of less than 50% and result in high losses. The GDT score "risky decisions" is defined as the number of risky decisions accrued after 10 rounds. Higher GDT risk scores indicate more risky decisions. Reliability was estimated by the Spearman-Brown-corrected correlation between GDT test halves (α = .71).

Achievement motivation. Achievement motivation was measured using a German version of the Achievement Motives Scale (AMS; Gjesme & Nygard, 1970; German version: Lang & Fries, 2007). The AMS contains five items (e.g., "I like situations in which I can find out how capable I am"), and higher achievement motivation is indicated by higher scores (scale ranging from 1 to 6).

Procedure. The study was conducted in the laboratory in group sessions of up to five individuals. Upon arrival, participants were seated at individual computer stations where they completed the TSC measure followed by the ED task, the AMS, and the GDT. After that, participants were debriefed and thanked.

Results

Preliminary analyses. All continuous variables were screened for univariate outliers ($|SD| > 3$), but none were found. The two dependent variables were unrelated, but across the whole sample higher TSC was related to less achievement motivation and more risky decisions (Table 2). To test whether these bivariate relationships were moderated by ED, we conducted moderated regression analyses for each dependent variable independently.

Risky behavior. A high degree of ED led to more risky decisions, $M = 4.62$, $SD = 1.64$, than low ED, $M = 3.97$, $SD = 1.09$, $t(100.72) = 2.59$, $p < .01$, $d = .52$. The number of risky decisions in the dice task was regressed on the experimental manipulation of ED and the standardized TSC scale, resulting in a significant amount of explained variance, $R^2 = .15$, $F(2, 124) = 10.50$, $p < .001$. Importantly, adding the cross-product significantly increased the explained variance, $\Delta R^2 = .12$, $p < 001$, and the main effects of ED, $\beta = .22$, $p < .01$, and TSC, $\beta = .26$, $p < .001$, were qualified by their interaction, $\beta = .35$, $p < .001$. Simple slope analyses revealed that the ED manipulation did not lead to an increase in risky decisions for participants low in TSC, $b = -0.18$, $SE = 0.15$, $p = .26$ (Figure 3). However, participants high in TSC were prone to making significantly more risky decisions after high (vs. low) ED induction, $b = 0.80$, $SE = 0.15$, $p < .001$. Thus, a positive relationship between TSC and risky behavior was found only under high ED.

Achievement motivation. As expected, ED led to a decrease in achievement motivation. Participants in the high-ED condition had lower AMS scores, $M = 4.34$, $SD = 0.80$, than participants in the low-ED condition, $M = 4.69$, $SD = 0.66$, $t(114.46) = 2.71$, $p < .01$, $d = 0.51$. Regressing achievement motivation on the effect-coded ED manipulation (-1 for low ED, +1 for high ED) and the standardized TSC scale revealed a significant outcome, $R^2 = .10$, $F(2, 124) = 7.21$, $p < .001$. Adding the cross-product of these two predictors significantly increased the amount of variance explained, $\Delta R^2 = .08$, $p < 001$. Results showed that the main effects of the experimental manipulation, $\beta = -.23$, $p < .01$, and TSC, $\beta = -.19$, $p < .05$, were qualified by a significant interaction, $\beta = -.29$, $p = .001$ (Figure 4). Thus, TSC moderated the ED effect on achievement motivation in a negative direction. That is, for high-TSC participants the ED effect was large and significant, $b = -0.38$, $SE = 0.09$, $p < .001$, whereas for low-TSC participants the ED manipulation showed no effect, $b = 0.04$, $SE = 0.09$,

p =.61. Thus, TSC was negatively related to achievement motivation only if participants were previously depleted.

Discussion

The findings consistently replicated the findings of Study 1 in showing an ironic effect of TSC. ED led to an increase in risky decisions but a decrease in achievement motivation. However, these effects were more pronounced for high-TSC participants. The replication of the ED effect on risk-taking behavior was thus complemented by a previously unexplored – and seemingly paradoxical – moderation of this effect. Participants who reported high levels of TSC were more risk-prone after ED than low-TSC participants. Furthermore, we have demonstrated an effect of ED on (self-reported) achievement motivation. Complementing the literature on ED effects on task persistence and task performance, this shows that ED also has an effect at an earlier stage of a performance-related behavioral sequence. Importantly, this effect was also moderated by TSC such that high-TSC participants showed the lowest achievement motivation after ED. The moderation analyses also showed that the unexpected zero-order correlations between TSC and the number of risky decisions and achievement motivation were entirely driven by the high-ED condition. In the low-ED condition, the opposite was apparent (but not different from zero): High TSC was associated with fewer risky decisions and more achievement motivation.

Taken together, the first two studies report an ironic effect of TSC after ED on three dependent variables. These findings are difficult to reconcile with the positive view of TSC pervasive in the literature. Why did participants who describe themselves as highly self-controlled in their daily life show more self-control failure in our experimental settings? One straight-forward explanation could be based on the suspicion that self-reported levels of TSC are simply inaccurate. It may be tempting to accept the low validity of TSC self-reports as an explanation of our findings. However, such an argument does not explain why high-TSC

participants are indeed better adjusted in everyday life, as can be derived from the association of TSC with non self-reported variables like academic achievements (Tangney et al., 2004), rule violation (Muraven et al., 2006), or perpetration of partner violence (Finkel, DeWall, Slotter, Oaten, & Foshee, 2009).

As a second explanation, it may be that experimental ED tasks put high-TSC individuals in positions that are unknown to them. It has become increasingly accepted in self-control research that successful self-control in real life may rely on inherently different strategies than the active inhibition of impulsive behavior (Fujita, 2011). Indeed, high-TSC persons seem to more frequently use strategies that avoid any encounter with tempting situations. They therefore engage less frequently in the effortful inhibition of impulses than low-TSC persons (Hofmann, Baumeister, Förster, & Vohs, 2012). Avoiding temptation, a naïve variant of the effective behavioral therapeutic technique of stimulus control, is highly effective in everyday life as it does not entail the risk of depleting one's resources while actively inhibiting.

However, engaging in effortful inhibition of impulses has been shown to be a capacity that can be trained. Within the strength model of self-control (Muraven & Baumeister, 2000) actively suppressing one's desires will train the self-control muscle and make it more likely that temptation can be actively resisted in the future (Baumeister et al., 1998; Gailliot, Baumeister et al., 2007; Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006a, 2006b, 2007). Ironically, the fact that high-TSC individuals avoid tempting situations means that they also hardly engage in active inhibition, potentially resulting in a weaker ability to resist temptation once they are forcibly confronted with it. Therefore, we conducted a third study to clarify the relationships among TSC, impulse strength, impulse inhibition, and self-regulatory success in routine self-regulation behavior.

Study 3

We conducted a cross-sectional study to explore the relationship between TSC and the average frequency of impulse inhibition across 16 different domains of routine self-controlled behavior. Based on the reasoning outlined above, we expected TSC to be associated with less frequent impulse inhibition attempts. To gain a more fine-grained understanding of TSC in everyday self-regulation situations, we also assessed perceived desire strengths as well as perceived self-regulation success across these domains.

Method

Participants. A total of 358 individuals (310 women, 45 men; mean age = 25.16, *SD* = 6.91) participated in an online study on daily temptations and how well people could overcome their weaker self. Participation was completely voluntary and no compensation was offered.

Everyday self-regulatory behavior. A list of 16 self-control relevant behaviors was created and included either short-term temptations that required inhibition (e.g., eating candy, drinking alcohol, procrastinating, playing video games) or short-term efforts (e.g., studying, being on time, exercise) that needed to be initiated to reach long-term goals like better health, academic achievement, and fulfilling social relationships. For each of these domains we assessed the strength of temptation by asking, "How difficult is it for you to resist the following temptations?" or respectively, "How difficult is it for you to pull yourself together to engage in the following activities?" on a continuous slider scale from zero (*weak temptation/not difficult*) to 100 (*strong temptation/very difficult*). This was followed by our main variable of interest: the frequency of self-control efforts. For each of the 16 domains, participants indicated on a scale from zero (*never*) to six (*several times a day*) how often they inhibited an urge to give in to temptation or actively had to overcome their weaker self to engage in short-term efforts. Lastly, self-control success was assessed by asking, "How often

do you actually succeed in resisting these temptations/carrying out these activities?" on a scale from one (*never*) to seven (*always*).

Self-control scales. After reporting these aspects of routine self-regulatory behavior, participants completed the same TSC scale as in the previous two studies. In addition, the German version (Bertrams & Dickhäuser, 2009) of the well-established SCS (Tangney et al., 2004) was included to test whether the presumed relation was specific to our TSC scale.

Results

All three aspects of everyday self-regulatory behavior proved sufficiently consistent across the 16 domains (Table 3). We therefore aggregated across these domains to reach one indicator of average temptation strength, average frequency of self-control efforts, and average self-control success, respectively. Intercorrelations of these scales revealed that stronger temptation required more self-control efforts and that both were negative predictors of self-control success (Table 3). More importantly, TSC was related to a lower frequency of actually engaging in self-control efforts.[1] Instead, individual differences in TSC corresponded with individual differences in perceived temptation strength. This pattern was identical for the TSC scale employed in Studies 1 and 2, as well as the German version of the standard SCS (Bertrams & Dickhäuser, 2009). Speaking to the convergent validity of these two scales, they were highly intercorrelated.

Discussion

As hypothesized, participants who described themselves as highly self-controlled effectively engaged in fewer self-control consuming efforts in their everyday life. In fact, individual differences in self-reported TSC did not tap into individual differences in the ability to inhibit one's impulses but rather into individual differences in the strength of these

[1] Post-hoc control analyses revealed that this was particularly the case for the frequency of resisting short-term temptation and not significantly so for the frequency of investing short-term effort. Full analyses can be obtained from the authors.

impulses. Whether these desire strengths can actually be accurately introspected or whether they are inferred from the fact that few problems arise in these domains is open to debate. Importantly, the findings align well with the recent proposal that TSC may operate more by way of establishing effective habits and routines than by resisting single temptations (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2011). Empirically, a large ambulatory experience sampling study also showed that TSC was related to lower desire strengths and less active resistance against temptation (Hofmann et al., 2012). Thus, people high in TSC seem to avoid temptations in the first place, which also leads them to experience less self-control conflict situations in which impulses have to be actively inhibited.

How does this conceptualization of TSC offer an explanation for our ironic findings? Crucially, participants in our Studies 1 and 2were forced to encounter temptations independent of whether they avoided such encounters in real life. In that sense, the experimental situations might have been less common and more artificial for high-TSC participants. Highly self-controlled participants who are used to avoiding exposure to tempting sweets in real life were seated in front of a bowl of chocolate after completing a depleting task. Actively inhibiting the impulse to eat candy is something they may have been less used to do in their routine activities and they may have lacked the everyday training to successfully inhibit it. This process assumption could be supported in future work by demonstrating that high-TSC individuals experience themselves as less able to cope with tempting situations. An alternative view could be based on the reasoning that resisting one's impulses is more central to the self-concept of high-TSC individuals. Thus, ED manipulations tax them in a twofold sense: The manipulations deplete cognitive resources (as they do for everybody), but additionally evoke fear about self-control failure and thus potentially further deplete resources needed to resist temptations. This reasoning could receive support from

future data showing greater feelings of fatigue and exhaustion in high-TSC individuals after ED.[2]

General Discussion

In two studies, we have provided empirical support for our argument that dispositional TSC exposes individuals to the danger of self-regulation failures after situational ED. We found this effect utilizing two different ED manipulations (i.e., modified Stroop task, working memory capacity task) for three different dependent variables, including such self-regulation relevant domains as appetitive/impulsive behavior (i.e., candy consumption, risky behavior) and performance-related behavior (i.e., achievement motivation). This ironic effect of TSC after ED has not been explored previously. In fact, little attention has been paid to the interplay of trait and state self-control, and the existing empirical evidence is mixed (Hagger et al., 2010). In trying to understand this puzzling effect we explored the relationship between TSC and relevant everyday self-regulation behavior. In line with more recent conceptualizations of TSC, our results corroborate that the view of high TSC as the frequent active inhibition of acute strong impulses needs to be corrected to reflect that high-TSC individuals rather seem to actively avoid tempting situations. Our lab-based exposure to tempting cues might thus have been more unusual for them, as they were confronted with self-control conflicts they had less experience resisting.

It should be noted that our findings are at odds with previously published studies that showed a buffering effect of TSC on ED. Trying to make sense of these inconsistencies, it should be noted that our studies bear some advantages over previous studies. First, we have shown an effect on different *behavioral* variables, candy consumption and risk-taking behavior. Second, both our ED manipulations were content-free tasks that could not be resisted by merely suppressing the evoked content (as opposed to mortality salience

[2] We are grateful to an anonymous reviewer for providing a helpful comment regarding future studies.

manipulations). Also, modified Stroop tasks are a well-established ED manipulation (average meta-analytic effect size d = .40; Hagger et al., 2010). Finally, although our scale cannot be called a standard scale, its operationalization relied on common definitions of self-control and it showed high convergence with the standard SCS scale (Bertrams & Dickhäuser, 2009) as it was empirically derived from standard scales assessing self-control related traits (Schmidt & Imhoff, 2011).

Despite an apparently provocative contradiction against the positive view on TSC implied in the strength model of self-control, our results are in principle reconcilable with it under specific assumptions. As an example, a prominent conceptualization of TSC has emphasized that individuals who are good at self-control know how to use their scarce self-regulatory resources in highly efficient ways, as captured in the descriptive term *conservation hypothesis* (Muraven, Shmueli, & Burkley, 2006). If this reasoning is adopted, then it would be inferred that high-TSC individuals appeared more vulnerable to ED manipulations because they did not waste much effort towards self-control in these conditions, wanting instead to save their scarce self-control resources for later. The fact that in Study 2 greater vulnerability of high-TSC individuals was found not only in the first (i.e., achievement motivation) but also in a second dependent variable (i.e., risky behavior) may be taken as a preliminary indication against this explanation. To defend the conservation hypothesis one would need to hypothesize that participants were saving their resorurces for tasks outside of the laboratory situation. Although this may be a legitimate argument, it clearly points to epistemological pitfalls of such auxiliary assumptions. Accepting this possibility makes it impossible to falsify the protective account of TSC: If high TSC individuals do better after ED, they are protected by TSC. If they do worse, they are just saving their scarce resources for more relevant situations. Thus, allowing to make these additional assumptions about conservation would make the whole model immune to empirical contradictions.

Ironically, the strength model also allows for a diametrically opposed explanation in dual-task paradigms. Individuals high in TSC could have spent more effort in the initial ED tasks, thus wasting their scarce self-control resources on the irrelevant task (*anti-conservation hypothesis*). We conducted control analyses to test for this alternative explanation. However, average response latency and error rates in the Stroop (Study 1) or working memory capacity task (Study 2) were not related to TSC or the dependent variables in either the low-ED, $|r| < .18$, $p > .14$, or the high-ED condition, $|r| < .16$, $p > .22$. Thus, exhaustion of high-TSC individuals in the ED-inducing first task can be ruled out as an explanation for the effects.

On a more conceptual level, future research should elucidate under which conditions TSC has protective vs. detrimental effects on self-control in dual-task paradigms. We reasoned that the greater vulnerability of high-TSC participants was attributable to the fact that their routine regulation strategies (e.g., stimulus control) became futile when they were confronted with situations they otherwise would have avoided and consequently had little experience with. However, tempting situations cannot only be avoided physically, but also psychologically. If individuals decide beforehand that they will not become engaged with the tempting stimulus, their likelihood of resisting should increase. An example of such psychological stimulus control could be seen in implementation intentions (Gollwitzer & Brandstaetter, 1997). Implementation intentions describe a self-regulatory strategy linking a rather abstract intended goal ("I want to achieve goal x") to very concrete, goal-directed behaviors ("I intend to (not) do y when situation z is encountered in order to achieve goal x"). Empirically, implementation intentions served as a protective factor against ED effects (Webb & Sheeran, 2003). As it is highly plausible that high-TSC individuals more frequently rely on implementation intentions, the effect of TSC on ED effects might be moderated by whether they have a chance to develop such intentions a priori or not. Future research could

manipulate whether participants are offered the opportunity or even actively encouraged to form such intentions (a priori information about the temptation to follow) or not.

Another aspect future research might elucidate is the different role of TSC in either resisting temptations to reach long-term goals or initiating (unpleasant) short-term effort to reach long-term goals (recently labeled *stop* and *start control*; de Boer, van Hooft, & Bakker, 2011). All our dependent measures were instances of *stop control*, requiring the necessity to overcome temptations. Thus, the backfiring effect of TSC might only be existent for such instances but not if an initiation of effort is required (e.g., an anagram task). In relation to our proposed explanation it might very well be that people high in TSC have less routine in *stop control* (as they avoid tempting situations) but more experience in *start control* (e.g., initiating such planful avoidance). In line with such an interpretation, both TSC scales were negatively related to the frequency of resisting short-term temptation but not investing short-term effort in Study 3. Future research might directly address this differentiation.

That said, we caution against the premature characterization of TSC as increasing the vulnerability for self-control failure in dual-task paradigms per se. As argued above, the ironic effect we found might be due to the fact that the highly efficient stimulus-control strategy of high-TSC individuals to avoid tempting situations in the first place is blocked in experimental ED studies. Thus, our findings clearly do not invalidate the plethora of general findings providing support for positive effects of TSC (Baumeister & Alquist, 2009; Tangney et al., 2004). However, it may be that the highly efficient avoidance of tempting situations that characterizes successful self-control attempts does not come without costs. When encountering commonly avoided temptations, high-TSC individuals may ironically be particularly bad at resisting these temptations and thus more vulnerable to situation-specific self-control failure.

References

Achtziger, A., & Gollwitzer, P. M. (2008). Motivation and volition in the course of action. In J. Heckhausen & H. Heckhausen (Eds.). *Motivation and Action* (pp. 272-295). New York, NY: Springer.

Baumeister, R. F., & Alquist, J. L. (2009). Is there a downside to good self-control? *Self & Identity, 8,* 115-130. doi:10.1080/15298860802501474

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 74,* 1252-1263. doi:10.1037/0022-3514.74.5.1252

Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.

Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. *Current Directions in Psychological Science, 16,* 351-355. doi:10.1111/j.1467-8721.2007.00534.x

Bertrams, A. & Dickhäuser, O. (2009). Messung dispositioneller Selbstkontroll-Kapazität. Eine deutsche Adaptation der Kurzform der Self-Control Scale (SCS-K-D). *Diagnostica, 55,* 2-10. doi:10.1026/0012-1924.55.1.2

Brand, M., Fujiwara, E., Borsutzky, S., Kalbe, E., Kessler, J. & Markowitsch, H. J. (2005). Decision-making deficits of Korsakoff patients in a new gambling task with explicit rules – associations with executive functions. *Neuropsychology, 19*, 267-277. doi:10.1037/0894-4105.19.3.267

Brunstein, J. C. & Maier, G. W. (2005). Implicit and self-attributed motives to achieve: Two separate but interacting needs. *Journal of Personality and Social Psychology, 89*, 205-222. doi:10.1037/0022-3514.89.2.205

Bruyneel, S. D., Dewitte, S., Franses, P. H., & Dekimpe, M. G. (2009). I felt low and my purse feels light: Depleting mood regulation attempts affect risk decision making. *Journal of Behavioral Decision Making, 22*, 153–170. doi:10.1002/bdm.619

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/ correlation analysis for the behavioral sciences* (3rd edition). Mahwah: Lawrence Erlbaum.

Cooper, W. H. (1983). An achievement motivation nomological network. *Journal of Personality and Social Psychology, 44*, 841-861. doi:10.1037/0022-3514.44.4.841

de Boer, B. J., van Hooft, E. A. J., & Bakker, A. B. (2011). Stop and start control: A distinction within self-control. *European Journal of Personality, 25*, 349-362. doi:10.1002/per.796

de Ridder, D., Lensvelt-Mulders, G., Finkenauer, C. F., Stok, M., & Baumeister, R. F. (2011). Taking stock of self-control: A meta-analysis of how trait self-control relates to a wide range of behaviors. *Personality and Social Psychology Review*. doi:10.1177/1088868311418749

DeWall, C. N, Baumeister, R. F., Stillman, T. F., & Gailliot, M. T. (2007). Violence restrained: Effects of self-regulation and its depletion on aggression. *Journal of Experimental Social Psychology, 43,* 62-76. doi:10.1016/j.jesp.2005.12.005

Dvorak, R. D, & Simons, J. S. (2009). Moderation of resource depletion in the self-control strength model: Differing effects of two modes of self-control. *Personality and Social Psychology Bulletin, 35,* 572-583. doi:10.1177/0146167208330855

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11,* 19–23. doi:10.1111/1467-8721.00160

Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders: Interview or self-report questionnaire? *International Journal of Eating Disorders, 16,* 363-370.

Finkel, E. J., DeWall, C. N., Slotter, E. B., Oaten, M., & Foshee, V. A. (2009). Self-regulatory failure and intimate partner violence perpetration. *Journal of Personality and Social Psychology, 97*, 483-499. doi:10.1037/a0015433

Freeman, N., & Muraven, M. (2010). Self-control depletion leads to increased risk taking. *Social Psychological and Personality Science, 1*, 175–181. 10.1177/1948550609360421

Friese, M., Hofmann, W., & Wänke, M. (2008). When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology, 47*, 397–419. doi:10.1348/014466607X241540

Fujita, K. (2011). On conceptualizing self-control as more than the effortful inhibition of impulses. *Personality and Social Psychology Review, 15*, 352-366. doi:10.1177/1088868311411165

Gailliot, M. T., & Baumeister, R. F. (2007). The physiology of willpower: Linking blood glucose to self-control. *Personality and Social Psychology Review, 11,* 303–327. doi:10.1177/1088868307303030

Gailliot, M. T., Baumeister, R. F., DeWall, C. N., Maner, J. K., Plant, E. A., Tice, D. M., et al. (2007). Self-control relies on glucose as a limited energy source: Willpower is more than a metaphor. *Journal of Personality and Social Psychology, 92,* 325-336. doi:10.1037/0022-3514.92.2.325

Gailliot, M. T., Schmeichel, B. J., & Baumeister, R. F. (2006). Self-regulatory processes defend against the threat of death: Effects of self-control depletion and trait self-control on thoughts and fears of dying. *Journal of Personality and Social Psychology, 91*, 49-62. doi:10.1037/0022-3514.91.1.49

Gailliot, M. T., Schmeichel, B. J., & Maner, J. K. (2007). Differentiating the effects of self-control and self-esteem on reactions to mortality salience. *Journal of Experimental Social Psychology, 43,* 894-901. doi:10.1016/j.jesp.2006.10.011

Gjesme, T., & Nygard, R. (1970). *Achievement-related motives: Theoretical considerations and construction of a measuring instrument*. Unpublished report, University of Oslo.

Gollwitzer, P., & Brandstaetter, V. (1997). Implementation intention and effective goal pursuit. *Journal of Personality and Social Psychology, 73,* 186-199.

Hagger, M. S., Wood, C., Stiff, C. & Chatzisarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin, 136,* 495-525. doi:10.1037/a0019486

Heckhausen, H. (1991). *Motivation and Action*. New York, NY: Springer.

Hilbert, A., & Tuschen-Caffier, B. (2006). *Eating Disorder Examination 2 – Questionnaire. Deutschsprachige Übersetzung* [German translation]. Münster: Verlag für Psychotherapie.

Hofmann, W., Baumeister, R. F., Förster, G., & Vohs, K. (2012). Everyday Temptations: An Experience Sampling Study of Desire, Conflict, and Self-Control. *Journal of Personality and Social Psychology*. doi:10.1037/a0026545

Hofmann, W., Gschwender, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008) Working memory capactiy and self-regulatory behavior: Toward an individual difference perspective on behavior determination by automatic versus controlled processes. *Journal of Personality and Social Psychology, 95*, 962-977. doi:10.1037/a0012705

Hofmann, W., Rauch, W., & Gawronski, B. (2007). And deplete us not into temptation: Automatic attitudes, dietary restraint, and self-regulatory resources as determinants of eating behavior. *Journal of Experimental Social Psychology, 43,* 497-504. doi:10.1016/j.jesp.2006.05.004

Kahan, D., Polivy, J., & Herman, P. C. (2003). Conformity and dietary disinhibition: A test of the ego-strength model of self-regulation. *International Journal of Eating Disorders, 33,* 165-171. doi:10.1002/eat.10132

Karabenick, S. A., & Youssef, I. Y. (1968). Performance as a function of achievement motive level and perceived difficulty. *Journal of Personality and Social Psychology, 10*, 414-419. doi:10.1037/h0026735

Kuhl, J. & Fuhrmann, A. (1998). Decomposing self-regulation and self-control: The volitional components checklist. In J. Heckhausen & C. Dweck (Eds.), *Life span perspectives on motivation and control* (pp. 15-49). Mahwah, NJ: Lawrence Erlbaum.

Kurzban, R. (2010). Does the Brain Consume Additional Glucose During Self-Control Tasks? *Evolutionary Psychology, 8*, 244-259.

Lang, J. W. B., & Fries, S. (2007). A revised 10-Item Version of the Achievement Motives Scale. *European Journal of Psychological Assessment, 22*, 216-224. doi:10.1027/1015-5759.22.3.216

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., et al. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied, 8*, 75-84. doi:10.1037/1076-898X.8.2.75

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126,* 247–259. doi:10.1037/0033-2909.126.2.247

Muraven, M. R., Baumeister, R. F., & Tice, D. M. (1999). Longitudinal improvement of self-regulation through practice: Building self-control strength through repeated exercise. *Journal of Social Psychology, 139,* 446-457. doi:10.1080/00224549909598404

Muraven, M. R., Pogarsky, G., & Shmueli, D. (2006). Self-control depletion and the general theory of crime. *Journal of Quantitative Criminology, 22*, 263–277. doi:10.1007/s10940-006-9011-1

Muraven, M. R., Shmueli, D., & Burkley, E. (2006). Conserving self-control strength. *Journal of Personality and Social Psychology, 54,* 687-696. doi:10.1037/0022-3514.91.3.524

Oaten, M., & Cheng, K. (2006a). Improved self-control: The benefits of a regular program of academic study. *Basic and Applied Social Psychology, 28,* 1–16. doi:10.1207/s15324834basp2801_1

Oaten, M., & Cheng, K. (2006b). Longitudinal gains in self-regulation from regular physical exercise. *British Journal of Health Psychology, 11,* 717–733. doi:10.1348/135910706X96481

Oaten, M., & Cheng, K. (2007). Improvements in self-control from financial monitoring. *Journal of Economic Psychology, 28,* 487–501. doi:10.1016/j.joep.2006.11.003

Oberauer, K., Süß, H.-M., Schulze, R., Wilhelm, O., & Wittmann, W. W. (2000). Working memory capacity: Facets of a cognitive ability construct. *Personality and Individual Differences, 29,* 75-79. doi:10.1016/S0191-8869(99)00251-2

Park, S. H., Glaser, J., & Knowles, E. D. (2008). Implicit motivation to control prejudice moderates the effect of cognitive depletion on unintended discrimination. *Social Cognition, 26,* 401–419. doi:10.1521/soco.2008.26.4.401

Price, D. A., & Yates, G. C. R. (2010). Ego depletion effects on mathematics performance in primary school students: Why take the hard road? *Educational Psychology, 30,* 269-281. doi:10.1080/01443410903563330

Schmeichel, B. J. (2007). Attention control, memory updating, and emotion regulation temporarily reduce the capacity for executive control. *Journal of Experimental Psychology: General, 136,* 241–255. doi:10.1037/0096-3445.136.2.241

Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology, 95,* 1526-1540. doi:10.1037/a0013345

Schmidt, A. F., & Imhoff, R. (2011). *Fundamental dimensions of self-regulation – Development and validation of the Self-regulatory Skills Questionnaire.* Manuscript submitted for publication. University of Bonn.

Shmueli, D., & Prochaska, J. J. (2009). Resisting tempting foods and smoking behavior: Implications from a self-control theory perspective. *Health Psychology, 28*, 300–306. doi:10.1037/a0013826

Stillman, T. F., Tice, D. M., Fincham, F. D., & Lambert, N. M. (2009). The psychological presence of family improves self-control. *Journal of Social and Clinical Psychology, 28,* 498-529. doi:10.1521/jscp.2009.28.4.498

Tangney, J. P., Baumeister, R. F. & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72,* 271-322. doi:10.1111/j.0022-3506.2004.00263.x

Vohs, K. D., & Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. *Psychological Science, 11*, 249–254. doi:10.1111/1467-9280.00250

Vohs, K. D., Baumeister, R. F., Schmeichel, B. J., Twenge, J. M., Nelson, N. M., & Tice, D. M. (2008). Making choices impairs subsequent self-control: A limited-resource account of decision making, selfregulation, and active initiative. *Journal of Personality and Social Psychology, 94,* 883–898. doi:10.1037/0022-3514.94.5.883

Webb, T. L., & Sheeran, P. (2003). Can implementation intentions help to overcome ego-depletion? *Journal of Experimental Social Psychology, 39*, 279-286. doi:10.1016/S0022-1031(02)00527-9

Whiteside, S. P. & Lynam, D. R. (2001). The five-factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669-689. doi:10.1016/S0191-8869(00)00064-7

Wright, R. A., Junious, T. R., Neal, C., Avello, A., Graham, C., Herrmann, L., et al. (2007). Mental fatigue influence on effort-related cardiovascular response: Difficulty effects and extension across cognitive performance domains. *Motivation and Emotion, 31,* 219–231. doi:10.1007/s11031-007-9066-9

Zyphur, M. J., Warren, C. R., Landis, R. S., & Thoresen, C. J. (2007). Self-regulation and performance in high-fidelity simulations: An extension of ego-depletion research. *Human Performance, 20*, 103–118. doi:10.1080/08959280701332034

Table 1

Descriptive statistics, internal consistency, and zero-order correlations of all continuous variables in Study 1.

Variable	α	*M*	*SD*	1.	2.
1. Candy Consumption	-	20.55	3.24		
2. Trait Self-Control (TSC)	.85	3.20	0.74	.45**	
3. Restrained Eating (RE)	.88	3.40	1.54	.20*	.29**

Note. $N = 137$. Candy consumption in grams, TSC on a scale from 1 to 5, and RE on a scale from 1 to 7.

** $p < .01$, * $p < .05$

Table 2

Descriptive statistics, internal consistency, and zero-order correlations of all continuous variables in Study 2.

Variable	α	*M*	*SD*	1.	2.
1. Achievement Motivation	.88	4.53	0.75		
2. Risky Decisions	.71	4.28	1.41	-.14	
3. Trait Self-Control (TSC)	.84	3.17	0.69	-.23*	.31**

Note. $N = 127$. Achievement motivation on a scale from 1 to 6, risky decisions between 0 and 10, and TSC on a scale from 1 to 5.

** $p < .01$, * $p < .05$

Table 3

Descriptive statistics, internal consistency, and zero-order correlations of all continuous variables in Study 3.

Variable	α	*M*	*SD*	1.	2.	3.	4.
1. Average Strength of Temptation	.63	45.93	11.21				
2. Average Frequency of Self-Control Efforts	.71	2.56	0.57	.32**			
3. Average Self-Control Success	.73	4.82	0.76	-.60**	-.19**		
4. Trait Self-Control (TSC)	.86	3.18	0.79	-.57**	-.19**	.50**	
5. Self-Control Scale (SCS)	.86	2.79	0.71	-.67**	-.33**	.49**	.72**

Note. $N = 358$. Average temptation strength from 0 to 100, average frequency of self-control efforts from 0 to 6, average self-control success from 0 to 7, and TSC and SCS on a scale from 1 to 5.

** $p < .01$, * $p < .05$

Figure captions

Figure 1. Candy consumption (in grams) as a function of ego depletion and habitual restrained eating in Study 1.

Figure 2. Candy consumption (in grams) as a function of ego depletion and trait self-control in Study 1.

Figure 3. Number of risky decisions in a game of dice task as a function of ego depletion and trait self-control in Study 2.

Figure 4. Achievement motivation (hope for success) as a function of ego depletion and trait self-control in Study 2.

Figure 1

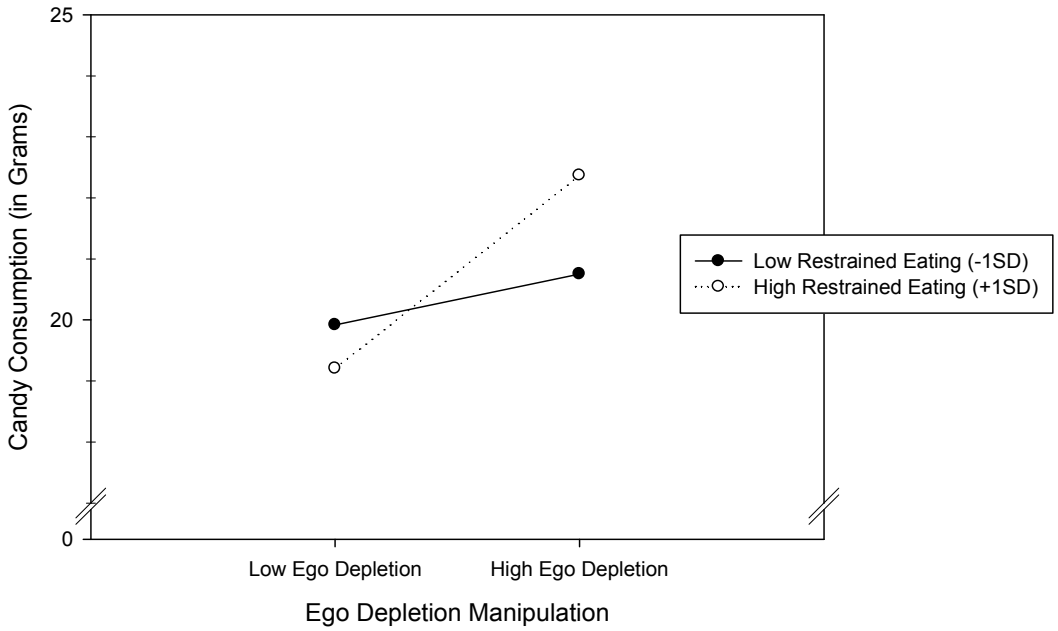


Figure 2

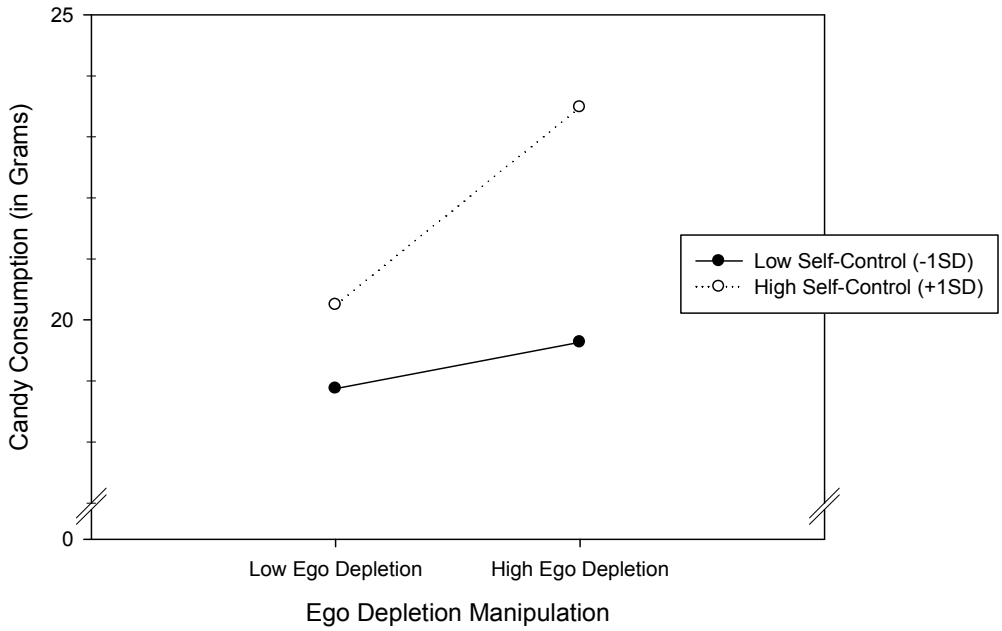


Figure 3

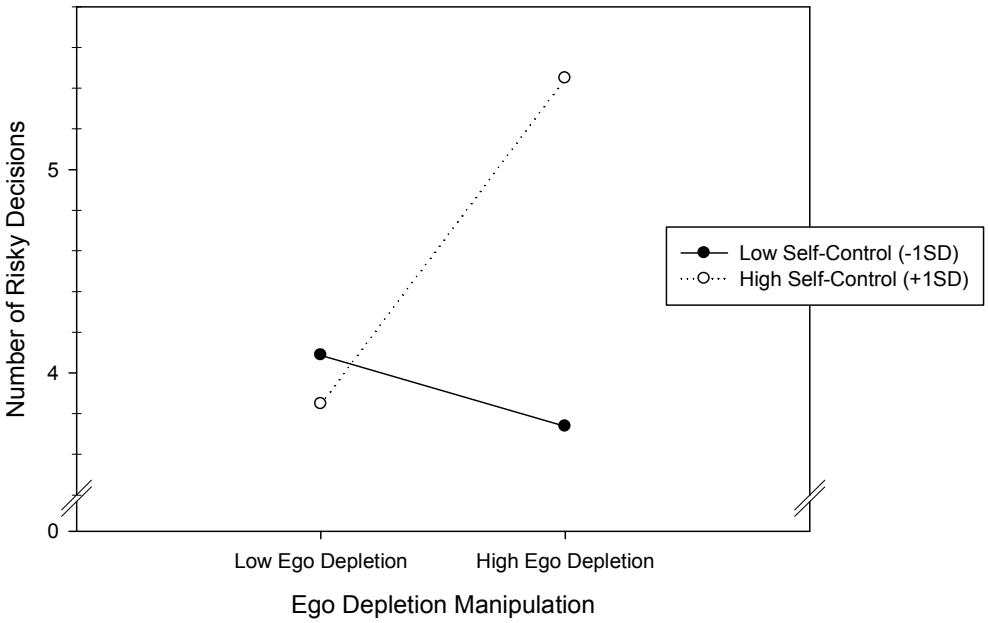
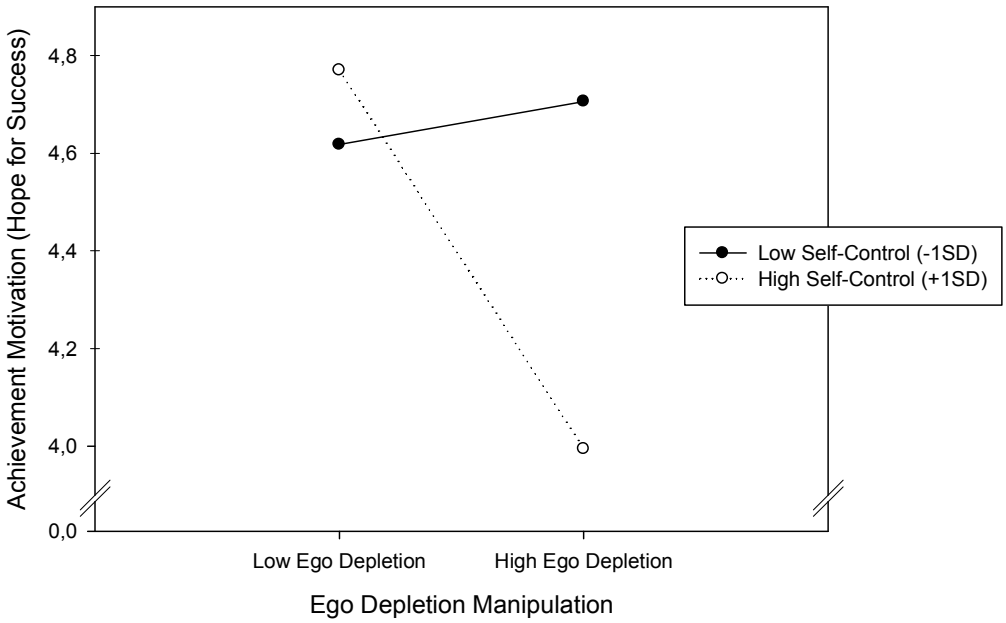


Figure 4



Appendix

SRSQ self-control scale

Item #	Item wording	Source
1.	I finish what I start.	UPPS
2.	I usually think carefully before doing anything.	UPPS
3.	I'm pretty good about pacing myself so as to get things done on time.	UPPS
4.	Before I start to tackle a new task, I usually make a plan.	VCI-S3
5.	People would say that I have iron self-discipline.	SCS
6.	If a task needs to be completed, I prefer to tackle it immediately.	VCI-S3
7.	People can count on me to keep on schedule.	SCS
8.	I am a productive person who always gets the job done.	UPPS
9.	I keep everything neat.	SCS
10.	When something needs to be done, I prefer to begin at once.	VCI-S3

Note. Source indicates original item source. Items from SCS and UPPS were translated into German.

SCS = Self-Control Scale (Tangney, Baumeister, & Boone, 2004)

UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001)

VCI-S3 = Volitional Components Inventory (Kuhl & Fuhrmann, 1998)