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Self-Control and Crime Revisited: Disentangling the Effect of Self-Control on Risk Taking and Antisocial Behavior

Tim Friehe[1] Hannah Schildberg-Hörisch[2]

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Abstract

Low self-control is considered a fundamental cause of crime. The aim of our study is to provide causal evidence on the link between self-control and criminal behavior. We test whether individuals with lower self-control behave in a more antisocial manner and are less risk-averse and thus are, according to both the *General Theory of Crime* and the economic literature on criminal behavior, more likely to engage in criminal activities. In order to exogenously vary the level of self-control in a laboratory experiment, we use a well-established experimental manipulation, a so-called depletion task. We find that subjects with low self-control take more risk. The effect of self-control on antisocial behavior is small and not significant. In sum, our findings are consistent with the proposition that low self-control is a facilitator of crime to the extent that individuals with lower levels of self-control are less effectively deterred by probabilistic sanctions.

JEL-Codes: C91, D03, K42

Keywords: self-control, risk taking, antisocial behavior, criminal behavior, ego-depletion, experiment

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1. Motivation

Crime is a social phenomenon of great importance, adversely affecting society as a whole and the countless individuals who are victimized each day (see, e.g., Anderson 1999). One of the most influential theories regarding its causes is the *General Theory of Crime*. It argues that low self-control "is the primary individual characteristic causing criminal behavior" (Gottfredson and Hirschi 1990: 111). According to Gottfredson and Hirschi (1990), self-control is learned, usually early in life, and a rather stable character trait afterwards. In Gottfredson and Hirschi's definition of trait self-control, individuals with low self-control are risk-takers, self-centered, impulsive, have a preference for simple rather than complex tasks and for physical rather than cognitive activities, and, lastly, respond to conflict through physical rather than verbal means. Possessing any of these characteristics makes individuals – all else held equal - more likely to engage in criminal activities. Empirical research has tested this proposition and has generally found that individuals with low self-control as a character trait are indeed more likely involved in various criminal behaviors (see the meta-analyses by Engel 2012 and Pratt and Cullen 2000). Yet, as Engel's (2012) meta-analysis concludes, "proof of causation would (…) require exogenous variation [of self-control]". Our study aims at providing a first piece of evidence on the *causal* link between self-control and criminal behavior. In particular, we use a so-called ego-depletion task in order to exogenously manipulate an individual's self-control in a laboratory experiment. We test whether individuals with lower situational self-control are indeed less risk-averse and more self-centered and thus, according to both the *General Theory of Crime* and the economic literature on criminal behavior[3], more likely to engage in criminal activities. Thus, in contrast to the preceding literature, we provide an indirect, but causal test of the *General Theory of Crime* as we explore whether an exogenous reduction in situational self-control indeed induces conditions that favor criminal conduct.

Our research design builds on the fact that self-control does not only vary across individuals as all character traits do but also across situations for a given individual, as has been argued

[3] The seminal paper by Becker (1968) was the first to analyze criminal behavior using an economic approach. While he focuses on the role of incentives in deterring criminal behavior, a central implication of his model is that more risk-averse individuals are, ceteris paribus, less likely to commit a crime. Becker (1968: 179) writes "Whether 'crime pays' is then an implication of the attitudes offenders have toward risk". Mungan and Klick (2014) provide a recent contribution in which risk preferences take center stage. With regard to self-centeredness Posner and Rasmusen (1999), for example, elaborate on the possibility of guilt acting as a deterrent.

by both criminologists (Wikström and Treiber 2007) and psychologists (Muraven et al. 2006). In social psychology, ego-depletion tasks are a standard tool to exogenously manipulate an individual's current level of self-control. They are based on the intuition that self-control can be likened to a muscle that is fatigued by prior use (e.g., Muraven and Baumeister 2000). The exertion of self-control in one activity is assumed to consume mental self-control resources, thereby diminishing self-control resources in subsequent activities (Muraven forthcoming). Self-control resources are required when situations and tasks involve conflict and a need to suppress natural tendencies, such as resisting a temptation, thought control, control of affect, or persisting on complex cognitive tasks (Kahneman 2011: 42). As Muraven et al. (2006) stress the self-control depletion perspective from social psychology shares several fundamental premises with criminological self-control theory. Both assume that humans are generally motivated to pursue immediate pleasures and both perspectives agree that low self-control can lead to a wide range of undesirable and antisocial behaviors such as drug addiction or criminal behavior (see, e.g., Baumeister 2002). These commonalities suggest that using a self-control depletion task in a laboratory experiment to reduce the current level of self-control may provide a valuable tool to test whether there is causal link between self-control and criminal behavior.

In our laboratory experiment, we aim at exogenously varying the level of situation-specific self-control across treatments and collect information about the level of trait self-control in a post-experimental questionnaire. In the first stage of our 2x2 between-subject design, subjects participate in a so-called ego-depletion task that induces either high or low self-control. In the second stage, we measure subjects' antisocial behavior or risk taking. In order to mimic criminal behavior in the laboratory, we follow the economic literature on "crime in the lab" (Falk and Fischbacher 2002, Harbaugh et al. 2013, Khadjavi 2015, Rizzolli and Stanca 2012, and Schildberg-Hörisch and Strassmair 2012) and use a take game to measure antisocial behavior. For risk taking, we use a standard incentivized task that is applied by many economists (Gneezy and Potters 1997).

As predicted by the *General Theory of Crime*, we find that individuals with low self-control take significantly more risk. This effect is mainly driven by the behavior of male subjects. However, the effect of self-control on antisocial behavior is not significant. In sum, our findings are consistent with the proposition of the *General Theory of Crime* that low self-

control is a facilitator of criminal behavior for individuals with an antisocial predisposition whenever it is uncertain ex ante whether a specific criminal endeavor will be sanctioned.

The existing evidence on the link between ego-depletion and decision making under risk is inconclusive. In a strongly framed investment experiment, Unger and Stahlberg (2011) ask subjects to imagine that they were a manager making a decision on behalf of their firm. Consequently, subjects' decisions do not necessarily reflect only their own risk preferences.[4] They report that depleted subjects with low self-control make more risk-averse decisions. Using hypothetical choices, De Langhe et al. (2008) observe higher risk aversion following ego-depletion. Kostek and Ashrafioun (2014) examine a setup in which the treatment variation is a combination of ego depletion and prior losses. Under those circumstances, they also find a higher degree of risk aversion. In contrast, two further psychological studies (Bruyneel et al. 2009, Freeman and Muraven 2010) find increased "risk taking" under ego depletion. Here, however, either (unincentivized) vignettes or tasks with unknown probabilities were used, such that subjects decided under ambiguity instead of risk (i.e., without knowing the probabilities of the different states of the world). In contrast, we use a well established, widely used, and, incentivized tool for measuring risk preferences (Gneezy and Potters 1997).

There is some previous literature that uses an ego-depletion task to investigate the effect of low self-control on prosocial behavior, while our focus is on its effect on antisocial behavior.[5] Overall, the evidence on the effect of self-control on prosocial behavior is inconclusive. Our study adds evidence on the absence of a significant effect of self-control on antisocial behavior. For instance, Halali et al. (2013) provide evidence that depleted dictator game allocators choose the "prosocial" equal split significantly less often than non-depleted ones. For ultimatum games, Halali et al. (2013) find that depleted proposers choose the equal split option significantly more often than non-depleted proposers, while Achtziger et al. (2012) find that depleted proposers make slightly lower offers than non-depleted proposers. In Achtziger et al. (2012), acceptance rates of depleted and non-depleted responders are not significantly different. It is difficult to compare findings from our take game setting to

[4] For example, Pahlke et al. (2012) provide evidence that individuals behave more risk averse in the gain domain if others are affected by their decision as well.

[5] It seems likely that behavior in in the prosocial domain differs from that in the antisocial domain. Relatedly, Dohmen et al. (2009) emphasize that positive and negative reciprocity are not simply mirror images of each other.

ultimatum game results because we have no similar strategic or interactive game element. Muraven et al. (2006), DeBono et al. (2011), and Gino et al. (2011) study cheating as a form of norm-deviant behavior and find that subjects with low self-control cheat more.[6] In contrast to our take game, cheating in their setup does not impose harm on another participant, a typical characteristic of crime. DeWall et al. (2008) report that depleted subjects are less willing to help.[7]

The remainder of our paper is structured as follows. In Section 2, we describe the experiment design and procedures. Section 3 spells out the hypotheses, before Section 4 presents results. Finally, we discuss implications of our results and conclude.

2. Experiment design, treatments, and procedures

We first describe the experiment design and the four treatments. Next, we provide details on the implementation of the experiment. Appendix B contains a translated example of the instructions that subjects received in the beginning of the experiment.

2.1 Experiment design and treatments

Our central research question is whether subjects with low self-control take more risk and behave in a more antisocial manner than subjects with higher self-control. Since risk taking and antisocial behavior are among the core determinants of criminal behavior at the individual level (e.g., Becker 1968, Falk and Fischbacher 2002, Gottfredson and Hirschi 1990), such an influence of self-control would establish an indirect channel from self-control to criminal behavior. For a sound understanding of the mechanisms underlying the relationship between self-control and criminal behavior in situations with probabilistic law enforcement, a separate analysis of the "indirect" effects of self-control on risk attitudes and antisocial

[6] Only in Gino et al. (2011), the experimental task was incentivized.

[7] Cognitive load is another manipulation which consumes self-control resources. In contrast to ego-depletion which exhausts self-control resources *before* the decision of interest, cognitive load occupies self-control resources *during* the decision of interest. Schulz et al. (2014), Hauge et al. (2009), and Cornelissen et al. (2011) use dictator games to study the effect of cognitive load on prosocial behavior. Hauge et al. (2009) and Cornelissen et al. (2011) do not find a significant treatment effect, while in Schulz et al. (2014) subjects with higher cognitive load behave in a more prosocial manner. In the domain of risky choices, Benjamin et al. (2012) report results of an experiment in which higher cognitive load induces more risk-averse behavior. Other experimental designs vary, for example, the likelihood that the self-control conflict is perceived by the subject (e.g., Martinsson et al. 2012).

behavior is crucial since the two effects could potentially offset each other. For example, if subjects with low self-control behave in a more antisocial and a more risk-averse manner, the first effect will increase and the second effect will decrease the attractiveness of criminal behavior, which may result in unchanged behavior.

We use a 2x2 design. The first treatment dimension distinguishes subjects who participate in the ego-depletion task that induces low self-control (LSC treatment) from subjects who take part in a "placebo" ego-depletion task that results in unchanged and, thus, relatively higher self-control (HSC treatment). The second treatment dimension captures whether a subjects' risk preferences or antisocial behavior are measured first. For each subject, we measure both risk attitudes and antisocial behavior, but the order of decisions differs across treatments. The second decision was announced only after subjects had taken their first decision. Table 1 summarizes the four treatments.

Table 1: Treatments

	Ego-depletion task	*First decision*	*Second decision*	*N*
Treatment 1	high self-control	risk preferences	antisocial behavior	43
Treatment 2	high self-control	antisocial behavior	risk preferences	43
Treatment 3	low self-control	risk preferences	antisocial behavior	47
Treatment 4	low self-control	antisocial behavior	risk preferences	47

We describe the different stages of our experiment in more detail below.

Ego-depletion task:

We use the depletion task in order to exogenously induce variations in situation-specific self-control across treatments. Being such an essential part of the experiment, we required it to be both well-established in the literature and as effective as possible in inducing low self-control. The task of our choice, the crossing-out-letters task that was introduced by Baumeister et al. (1998), meets both criteria and is also easily implementable in the lab. It has been used successfully in several studies (e.g., Baumeister et al. 1998, Freeman and Muraven 2010; Achtziger et al. 2012). According to the meta-analysis by Hagger et al. (2010),

it is one of the most frequently used ego-depletion tasks and the one inducing the largest effect sizes.

The version of the crossing-out letters task employed in our experiment is a paper-and-pencil task that had two parts lasting seven minutes each. In both parts, participants received a text with six paragraphs. Each paragraph had six lines of text. The content of the text (about the pros and cons of different kinds of statistics software) was chosen to be relatively boring, and, thus, not distracting from subjects' task.

For the first part of the task, subjects in both the LSC and the HSC treatment were instructed to cross out and count each instance of the letter "e", paragraph after paragraph. This habituated all subjects to crossing out each instance of the letter "e". In the second part of the task, subjects in the LSC treatment received the new instruction to cross out and count each letter "e" unless another vowel immediately followed the letter "e" or unless another vowel was at a distance of exactly two letters from the letter "e" (in either direction). Looking at _ _ e _ _, the letter "e" should not be crossed out when there was a vowel on position 1, 3, or 4. Participants in the HSC treatment got the same text, but were asked to continue crossing out and counting each letter "e" (i.e., maintain the habituated behavior in part 2 of the task). These instructions ensured that only subjects in the LSC treatment had to consume self-control resources to inhibit the habituated urge to cross out each letter "e" in part 2 of the task.

We refrained from incentivizing performance in the ego-depletion task because there is evidence that monetary incentives can mitigate depletion effects (Muraven and Slessareva 2003). Moreover, due to the different rules of the task in the LSC and HSC treatments, subjects' average performance (as measured, for instance, by the number or share of correctly crossed out letters "e") will differ systematically by treatment. In the LSC treatment, all letters "e" are to be crossed out instead of only some. Consequently, using the same performance-based payment scheme across treatments will induce different earnings in the depletion stage of the experiment that may influence behavior in later stages ("income effects"). Using a payment scheme that tries to counter the asymmetry in the performance measure from the depletion task across treatments would require a judgment about the effort required to correctly identify a correct letter "e" in the difficult LSC treatment compared to the effort in the easier HSC treatment. Such a judgment may not be

shared by subjects such that individuals may consider their payment as unfair. In other words, there is no easy way to introduce incentives without introducing the possibility that these drive treatment differences. Our decision not to pay the depletion task thus intends to ensure that potential differences in risk attitudes or antisocial behavior can clearly be attributed to differences in self-control and not to differences in income or perceived fairness of the payment for the depletion task. We repeatedly emphasized the importance of doing the task right and collected the task sheets for later control. Moreover, subjects knew that they would receive private feedback about their performance in the crossing-out-letters task on the computer screen at the end of the experiment. As we discuss in the results section, our data show that the vast majority of subjects worked very conscientiously on the depletion task.

Risk taking:

In order to measure risk taking, we use the basic setup of Gneezy and Potters (1997) and the subsequent literature surveyed in Charness and Gneezy (2012), i.e., a very established tool for measuring risk preferences.[8] Each subject receives 20 points and decides how many points y to invest in a risky option and how many to keep. The invested amount y yields a dividend of 2.5y with probability 1/2 and is lost with probability 1/2, where $y \in \{0,1,2,\ldots,20\}$. The money not invested, 20-y, is kept by the subject. The resulting payoffs are 20-y+2.5y with probability 1/2 and 20-y with probability 1/2. Given our parameters, risk-neutral and risk-seeking individuals invest all 20 points, while different investment levels below 20 reflect different degrees of risk aversion. At the end of the experiment, 4 points were converted into 1 Euro.

Antisocial behavior:

Following numerous other studies in the field (e.g., Falk and Fischbacher 2002, Harbaugh et al. 2013, Khadjavi 2015, Rizzolli and Stanca 2012, and Schildberg-Hörisch and Strassmair 2012), we use a take game to mimic criminal behavior in the laboratory. Each participant

[8] Other established tools for measuring risk preferences in experiments are, for example, series of binary lottery choices or price lists such as the one proposed by Holt and Laury (2002). In our context, an advantage of Gneezy and Potter's task over both a series of choices over binary lotteries and price lists is that it only requires a rather quick, single decision. Since there is no evidence on how long depletion effects last, we prefer a quick measurement. A potential disadvantage of the Gneezy and Potters task is that it does not allow differentiating between risk neutral and various degrees of risk-seeking behavior.

obtains an initial endowment of 20 points. Two subjects are matched randomly and anonymously. One of the two subjects decides how many points x to take from the other passive subject, where $x \in \{0,1,2,\ldots,20\}$.[9] When taking x points from the other subject, the taking subject obtains 20+x/4 and the other subject receives 20-x. This setting clearly suggests that taking points is antisocial since it is characterized by an initially equal distribution of endowments and a drastic inefficiency of taking. In order to disentangle the effect of self-control on antisocial behavior and risk preferences, we do not add a probabilistic sanctioning scheme to the take game. We share these features – inefficiency of taking from others and absence of law enforcement – with Falk and Fischbacher's (2002) setup of "crime" in the lab.

2.2 Experiment procedures

Subjects received written instructions that described the ego-depletion task in detail and their first decision in general terms. In order to prevent that subjects could plan their exact decision before completing the ego-depletion task, we represented the level of endowment, the inefficiency parameter in the take game and the dividend in the winning state of nature of the risky investment as general variables. In view of the evidence that many people struggle with the concept of probabilities, we included the probability of 50% in the written instructions. The second decision was announced after subjects had made their first decision to keep the first decision as clean as possible. In each session, we measured antisocial behavior in the first decision and risk taking in the second decision for half of the subjects. The other half of subjects first made the decision that revealed risk taking followed by the decision that revealed antisocial behavior. In the take game, the active subject was randomly matched with another subject taking the risky investment decision at that time. After participating in the ego-depletion task and making the two decisions, subjects filled out a questionnaire on their trait self-control, age, sex, and subject of studies, among others.

The level of situation-specific self-control is of key interest in our study. In addition, we measure the level of trait self-control as proposed by Grasmick et al. (1993) who construct their scale to directly reflect the six components that Gottfredson and Hirschi (1990) discuss: risk-seeking, self-centeredness, impulsivity, a preference for simple tasks, a preference for

[9] The wording of the instructions was "As participant B, you choose an integer transfer amount that you would like to take from participant A's endowment."

physical rather than cognitive activities, and volatile temper. Each component is measured by four items. The overall measure of trait self-control is the sum of standardized answers to each item.[10]

The experiment was run in August and October 2013 at the experimental laboratory of the University of Bonn, Germany (BonnEconLab). We used the experimental software z-Tree (Fischbacher 2007) and the recruitment software ORSEE (Greiner 2003). In total, 180 students of various fields of study participated. Subjects were randomly assigned to sessions. Sessions were framed neutrally and lasted about 60 minutes. Subjects did not receive a show-up fee and earned 13.04 Euro on average.

3. Hypotheses

We take our hypotheses from the *General Theory of Crime* (Gottfredson and Hirschi 1990), which posits that individuals with low self-control are less risk-averse and more self-centered and antisocial, and, for that reason, more likely to engage in criminal activities.

H1: Lower self-control causes less risk-averse behavior.

H2: Lower self-control causes more antisocial behavior.

Dual-system models offer an alternative source for deriving hypotheses.[11] According to dual-system models, decision-making is governed by the interaction of an instinctive affective system and a controlled deliberative system. Exerting self-control is required for implementing deliberative processes and overriding affective processes. Our low self-control treatment diminishes mental resources left for further self-control and thereby enhances the influence of the affective system on behavior in the second stage. Fudenberg and Levine (2006, 2011) present a dual-system model in which the affective system is assumed to be more risk-averse than the deliberative one, which contrasts with Hypothesis H1. Hypothesis H2 implies that selfish behavior is pushed by the affective system and inhibited by the deliberative system. Hypothesis H2 is supported by Moore and Loewenstein (2004) and

[10] Despite the fact that the Grasmick scale is designed to measure trait self-control as a personality trait that remains stable across situations and time, one might worry that the answers to the Grasmick scale might differ across treatments. Reassuringly, this is not the case: a two-sided t-test yields p=0.69.

[11] For a recent, general discussion of the dual-system approach, see, e.g., Alós-Ferrer and Strack (2014) or Rustichini (2008).

Rachlin (2002), for example, while Haidt (2001) considers moral decisions to be automatic. How a lack of self-control or affect influences social preferences continues to be debated (e.g., Joosten et al. 2015, Schulz et al. 2014).

When testing hypotheses H1 and H2, we focus on the effect of situation-specific self-control on risk attitudes and antisocial behavior since our experiment design allows for an exogenous manipulation of situation-specific self-control. Additionally, we control for the level of trait self-control as measured by the standard Grasmick scale (Grasmick et al. 1993) in the post-experimental questionnaire.

4. Results

We will first discuss results on the manipulation of self-control via the ego-depletion task. We then turn to the causal effect of self-control on risk taking, before we present results on the relationship between self-control and antisocial behavior. We additionally provide gender-specific results on risk preferences and antisocial behavior and the effect of self-control on both to reflect the comprehensive evidence that preferences of men and women differ. Charness and Gneezy (2012) survey results based on the risk preferences elicitation tool that we use, and Croson and Gneezy (2009) provide a general survey on gender differences in risk taking. Gender differences in prosocial behavior are also reported frequently (see, e.g., the survey of Croson and Gneezy 2009).[12]

For the analysis to come, we use the first decision of our subjects (compare Table 1). First decisions are cleanest, since they cannot be affected by previous decision behavior. For example, the second decision could be affected by (expected) earned income in the first decision or consistency considerations. Furthermore, depletion effects will fade out over time and there is no evidence on how quickly self-control resources replenish. Using data from first decisions ensures that differences in self-control across treatments are still

[12] In an especially careful study of a dictator game, Eckel and Grossman (2008) conclude that women behave in a more prosocial manner than men. However, our take game is in the domain of antisocial as opposed to prosocial behavior and additionally characterized by inefficiency of transfers. Varying the price of giving in a dictator game, Andreoni and Vesterlund (2001) show that men care more about efficient outcomes, which, in our experiment, could decrease potential gender differences in antisocial behavior. With respect to antisocial or deviant behavior, Dreber and Johannesson (2008) and Erat and Gneezy (2012) document that women are more averse to lying.

present.[13] Figures 1 and 2 in Appendix A contain histograms of investments in the risky option and the taken amount that are arranged by treatment and gender.

4.1 Ego-depletion task

In general, subjects worked on the crossing-out-letters task in a concentrated and ambitious manner. According to the meta-analysis by Hagger et al. (2010), the crossing-out-letters task is an ego-depletion task that is especially successful in inducing variations in self-control and is the type of ego-depletion task that results in largest effect sizes on various outcomes.

The first part of the crossing-out-letters task was identical in treatments HSC and LSC. Thus, we can compare the average performance of subjects in HSC and LSC in the first part to check for any systematic differences in group composition across treatments (e.g., differences in ability in crossing-out letters, motivation, or initial concentration). Reassuringly, the number of paragraphs worked on with high precision was not significantly different in LSC and HSC (MWU, p=0.47). High precision implies that the number of counted letters "e" is within a range of +/-5 of the true number that varied between 64 and 91 across paragraphs. The mean number of paragraphs worked on with high precision was 2.92 (SD 1.22) in HSC and 3.05 (SD 1.27) in LSC. Turning to the number of completed paragraphs in the second part of the task that differed across treatments, we find that the maximum (minimum) number of completed paragraphs in HSC was 6 (2), while the maximum (minimum) number of completed paragraphs in LSC was 3 (1). After the experiment, subjects had to indicate on a sliding scale ranging from 'not at all' to 'extremely' to which extent they had to concentrate to perform the two parts of the crossing-out-letters task. We find that the second part required significantly more concentration in LSC than in HSC (MWU, p<.01) and that the difference in the concentration required for part 2 and part 1 was significantly higher for subjects in LSC (MWU, p<.01). As intended, treatment LSC was more demanding than treatment HSC.

[13] In our data, we indeed find that subjects behave significantly different in first and second decisions. Specifically, we find order effects for risk preferences in LSC (Mann-Whitney-U test (MWU), p=.02) and antisocial behavior in HSC (MWU, p=.03). Throughout the paper, we report two-sided p-values.

4.2 Subjects with low self-control take more risk

Table 2 reports the mean investment in the risky option out of a total of 20 points for the full sample and according to gender. Overall, we find that subjects in LSC take more risk. Subjects with low self-control invest 18% (or 1.7 points) more in the risky option than subjects with high self-control. Gender-specific results show that inducing low self-control has a stronger effect on risk taking of male subjects than female subjects. On average, male subjects invest 9.8 out of 20 points in the risky option in HSC, but 13.8 in LSC (MWU, p=.06). For women, the average investment difference in the risky option is only about 0.5 points and not significant (MWU, p=.46).

Table 2: Mean level and standard deviation of investment in the risky option (whole sample and gender-specific)

	All in HSC	*All in LSC*	*Male in HSC*	*Male in LSC*	*Female in HSC*	*Female in LSC*
Mean level (SD) of Investment	8.98 (5.60)	10.64 (5.57)	9.81 (6.01)	13.83 (5.47)	8.18 (5.20)	8.66 (4.72)
N	43	47	21	18	22	29

In Columns (1)-(3), Table 3 displays regression results on the effect of self-control on risk taking based on a tobit model.[14] The treatment effect is captured by the dummy variable *Low self-control*, which is equal to one if a subject participated in LSC and zero otherwise. The gender dummy *Female* is one for women and zero for men. In other words, our reference group is male subjects in the high self-control treatment. Moreover, we include a measure for the level of *Trait self-control* that is based on the Grasmick scale (Grasmick et al. 1993). Column (1) in Table 3 documents the treatment effect for the sample as a whole: subjects in LSC invest more in the risky option (p<.1), i.e., subjects with low self-control take

[14] Since there are substantially more female subjects in treatment LSC (29 female compared to 18 male subjects) and gender differences in risk-taking behavior are well documented, drawing conclusions on treatment comparisons based on non-parametric tests implicitly overweighs female risk-taking behavior in a state of low self-control. In contrast, in a regression analysis, we can easily control for both baseline and potential treatment-specific gender differences. Thus, with the data at hand, regression analysis is a more appropriate method to isolate treatment differences that are due to differences in self-control from gender differences in behavior.

more risk. Column (2) shows that the overall treatment effect is due to a change in the behavior of male subjects: while low self-control induces men to take more risk (p<.05), women's behavior does not change much (p=.88 in an F-test for the joint significance of *Low self-control* and the interaction term *Female*Low self-control*). In Column (3), we add trait self-control as an additional explanatory variable. Trait self-control does not significantly predict risky investments.[15] Finally, Column (4) displays probit estimates for the probability that a subject behaves in a risk-averse as opposed to a risk-neutral or risk-seeking manner. In line with the results above, we find that only male subjects with low self-control are less likely to be risk-averse (p=.06, while p=.31 in an F-test for the joint significance of *Low self-control* and the interaction term *Female*Low self-control*).

Table 3: The effect of self-control on risk taking

	(1)	(2)	(3)	(4)
Low self-control	2.383*	5.274**	5.251**	-0.862*
	[1.366]	[2.422]	[2.420]	[0.465]
Female	-4.060***	-1.532	-1.514	0.323
	[1.444]	[1.993]	[2.020]	[0.518]
Female*Low self-control		-5.031*	-4.993*	1.431**
		[2.907]	[2.916]	[0.725]
Trait self-control			0.006	0.018
			[0.059]	[0.017]
Constant	11.243***	9.931***	9.924***	1.062***
	[1.366]	[1.580]	[1.595]	[0.341]
Observations	90	90	90	90
Pseudo R-squared	0.0196	0.0261	0.0261	0.161

*Notes: Column (1)-(3) report coefficient estimates from tobit regressions. The dependent variable is the level of investment in the risky option and in the range [0, 20]. Column (4) displays probit estimates. The dependent variable is equal to 1 if a subject invests less than 20 points (risk-averse behavior) and 0 otherwise. Female and Low self-control are dummy variables, whereas Trait self-control is continuous. Robust standard errors in brackets. *** p<.01, ** p<.05, * p<.1.*

We summarize:

[15] This is also true if trait self-control is the only explanatory variable in addition to the female dummy variable and if we allow for a gender-specific relation of trait self-control and risky investments (results not displayed). Engel (2012) reports that studies that use the Grasmick scale generally report a lower sensitivity of deviant behavior to changes in self-control than studies relying on other measures of self-control.

Result 1: Low situational self-control causes less risk-averse behavior.

Next, we turn to Hypothesis H2 that addresses the effect of self-control on antisocial behavior.

4.3 No significant effect of self-control on antisocial behavior

Our measure of antisocial behavior is the number of points subjects take from the endowment of another subject who initially possesses 20 points. Table 4 reports the average amount taken for the full sample and according to gender. In contrast to Hypothesis H2, we find that on average subjects take 12% (1.6 points) less in treatment LSC than in treatment HSC, i.e., subjects with low self-control tend to behave in a less antisocial manner. Similar to the case of risk preferences, there is some (somewhat weaker) evidence for gender differences in antisocial behavior in our data. The overall difference in antisocial behavior arises due to the effect of self-control on antisocial behavior of female subjects. On average, women in LSC take 2 points less than in HSC (MWU, p=.19). The average taken amount of men is nearly unchanged across treatments (MWU, p=.96).

Table 4: Mean level and standard deviation of taken amount

(whole sample and gender-specific)

	All in HSC	*All in LSC*	*Male in HSC*	*Male in LSC*	*Female in HSC*	*Female in LSC*
Mean level (SD) of taken amount	13.91 (7.02)	12.28 (7.12)	14.95 (7.3)	14.65 (7.8)	12.91 (6.75)	10.93 (6.45)
N	43	47	21	17	22	30

Table 5: The effect of self-control on antisocial behavior

	(1)	(2)	(3)	(4)
Low self-control	-2.687	-0.534	-0.454	0.021
	[2.827]	[5.209]	[5.164]	[0.415]
Female	-5.527*	-3.725	-3.586	-0.406
	[2.964]	[4.254]	[4.317]	[0.391]
Female*Low self-control		-3.546	-3.555	-0.785
		[6.107]	[6.077]	[0.573]
Trait self-control			0.104	0.009
			[0.166]	[0.015]
Constant	19.999***	19.022***	18.819***	0.048
	[2.796]	[3.328]	[3.379]	[0.279]
Observations	90	90	90	90
Pseudo R-squared	0.0122	0.0131	0.0142	0.107

*Notes: Column (1)-(3) report coefficient estimates from tobit regressions. The dependent variable is the number of points taken from another participant and in the range [0, 20]. Column (4) displays probit estimates. The dependent variable is equal to 1 if a subject behaves in a completely selfish manner (i.e., takes all 20 points) and 0 otherwise. Female and Low self-control are dummy variables, whereas Trait self-control is continuous. Robust standard errors in brackets. *** p<.01, ** p<.05, * p<.1.*

We next turn to tobit regression results presented in Table 5. Neither situation-specific self-control (Column (1)-(3)) nor trait self-control (Column (3)) is a significant predictor of the amount taken from the other participant.[16] Despite the 2 points difference in the taken amount across treatments, the female-specific treatment effect is not significant either: a joint F-test on the coefficients of *Low self-control* and *Female*Low self-control* in Column (2) yields p=.21. Both in treatment HSC and LSC, women take less than men. The overall gender difference in the taken amount is marginally significant (p<.1), see Column (1). Analyzing the most extreme form of antisocial behavior (i.e., the probability that a subject takes all points from the other participant) in Column (4), we still find that neither measure of self-control significantly predicts the behavior of male subjects. However, women with higher self-

[16] Also when allowing for a gender-specific effect of trait self-control on antisocial behavior, trait self-control does not have predictive power.

control are significantly more likely to show extreme antisocial behavior than women with lower levels of self-control (a joint F-test on the coefficients of *Low self-control* and *Female*Low self-control* in Column (4) yields p=.05). The histograms in the Appendix illustrate that close to 40% of women take the maximum amount of 20 points in HSC, while less than 15% do so in LSC.

We summarize the findings of this section:

Result 2: Low situational self-control does not have a significant impact on antisocial behavior on average. However, women with low self-control are significantly less likely than women with high self-control to display extreme forms of antisocial behavior.

4.4 Alternative hypothesis: Does low self-control strengthen an individual's natural predisposition?

Gottfredson and Hirschi (1990) hypothesize that low self-control is associated with risk-seeking and antisocial behavior. However, an alternative hypothesis is that a state of low self-control or impulsiveness reinforces and strengthens an individual's natural predisposition[17]: an individual with a general antisocial predisposition is predicted to become even more antisocial in a state of low self-control, while a prosocial individual is predicted to become even more prosocial. Similarly, an individual who is of risk-seeking nature would become even more risk-seeking when his self-control resources are depleted, while a risk-averse individual would become even more risk-averse. Low self-control acting as an amplifier of an individual's natural predisposition could potentially explain why we do not find an average effect of ego-depletion on antisocial behavior. Moreover, it could be consistent with the seemingly contradictory findings in the literature that we discuss in the introduction: Depleting self-control would have a different effect in a primarily pro-socially than in a primarily anti-socially orientated sample; likewise, in a risk-averse sample, ego-depletion would affect risk attitudes differently than in a risk-seeking sample.

Our data allow testing this alternative hypothesis since we have information on individuals' general predisposition concerning impulsivity (that we use as a proxy for self-control), risk-

[17] We thank an anonymous referee for suggesting this alternative hypothesis.

seeking, and self-centeredness / antisocial behavior from the Grasmick et al. (1993) scale.[18] Each of the trait measures of impulsivity, risk-seeking, and self-centeredness is constructed as the sum of the four corresponding standardized items that is standardized again.[19] We consider the impulsivity component to be a good proxy for self-control since its items are: I often act on the spur of the moment without stopping to think; I don't devote much thought and effort to preparing for the future; I often do whatever brings me pleasure here and now, even at the cost of some distant goal; I am more concerned with what happens to me in the short run than in the long run. Moreover, impulsivity is the component of the Grasmick scale that is most closely related to standard notions of self-control that are less comprehensive than the notion that Gottfredson and Hirschi (1990) use. For example, self-control failure and impulsivity are seen as closely related by Baumeister (2002) and Kalenscher et al. (2006). Since the measures of impulsivity, risk-seeking, and self-centeredness are designed to reflect an individual's respective trait that is supposed to be stable over time, it is reassuring that there are no significant differences in these three traits between treatment LSC and treatment HSC ($p=0.49$ for impulsivity, $p=0.25$ for risk-seeking, and $p=0.61$ for self-centeredness, t-tests).

Moreover, we can use the three trait measures as well as our incentivized measures of risk attitudes and antisocial behavior in the baseline treatment HSC to directly test the prediction of the *General Theory of Crime* that individuals with low trait self-control tend to be more risk-seeking and more antisocial. All four comparisons of means in risk-seeking or antisocial behavior of individuals with low and high trait self-control in Table 6 are in line with this prediction (although not all differences in means are significant).

[18] In the Grasmick scale, impulsivity, risk-seeking, and self-centeredness reflect three of the six components of the very broad concept of low trait self-control of criminals that Gottfredson and Hirschi (1990) discuss.

[19] For risk-seeking, the items are: I like to test myself every now and then by doing something a little risky. Sometimes I will take a risk just for the fun of it. I sometimes find it exciting to do things for which I might get in trouble. Excitement and adventure are more important to me than security. For self-centeredness: I try to look out for myself first, even if it means making things difficult for other people. I'm not very sympathetic to other people when they are having problems. If things I do upset people, it's their problem not mine. I will try to get the things I want even when I know it's causing problems for other people.

Table 6: Individuals with low trait self-control have a more risk-seeking and more antisocial predisposition

	High trait self-control (above or equal to median impulsivity)	Low trait self-control (below median impulsivity)	p-value
Trait risk-seeking (mean 0, std. dev. 1)	-0.28	0.26	p<0.001 (t-test, N=180)
Risk taking (investment in risky option, 0 to 20)	8.05	9.71	p=0.30 (MWU test, N=43)
Trait self-centered (mean 0, std. dev. 1)	-0.11	0.10	p=0.15 (t-test, N=180)
Antisocial behavior (taken amount, 0 to 20)	12.11	15.20	p=0.13 (MWU test, N=43)

In a next step, we test the alternative hypothesis that low self-control acts as an amplifier of an individual's natural predisposition. Overall, results in Table 7 do not provide support for this hypothesis. The upper half of Table 7 displays results that are based on a median split of our sample according to the trait measure of risk-seekingness. As one would expect, in both treatments individuals with a risk-seeking predisposition invest more in the risky option than those who score below median in risk-seeking ("not risk-seeking"). However, both types of individuals react to a reduction in the situational level of self-control by adjusting their behavior in the *same* direction: they invest more in the risky option (for both types, differences are not significant, however). Thus, it is not the case that the not risk-seeking subjects take even less risk in treatment LSC.

We observe a similar pattern in the lower half of Table 7 that contains results based on a median split of our sample according to the trait measure of self-centeredness. In both treatments individuals with an antisocial (i.e., above median self-centered) predisposition take a larger amount than the prosocial individuals (i.e., those who score below or equal to median in self-centered predisposition). Again, both antisocial and prosocial types of individuals react to a reduction in the situational level of self-control in the *same* manner: they take a lower amount (for both types, differences are not significant, however). Thus, our data do not support the alternative hypothesis that a state of low self-control strengthens an individual's natural predisposition.

Table 7: Low self-control does not act as an amplifier of an individual's natural predisposition

	Treatment HSC (high self-control)		Treatment LSC (low self-control)		MWU test
Predisposition	Investment in risky option	Δ	Investment in risky option	Δ	
Risk-seeking	9.38	0.79	12.18	2.90	Δ=2.80 (p=0.14, MWU test, N=43)
Not risk-seeking	8.59		9.28		Δ=0.69 (p=0.46, MWU test, N=47)
	Taken amount	Δ	Taken amount	Δ	
Antisocial	15.01	2.24	13.21	2.43	Δ=-1.80 (p=0.24, MWU test, N=50)
Prosocial	12.77		10.78		Δ=-1.99 (p=0.25, MWU test, N=40)

5. Discussion

The influential *General Theory of Crime* proposes that low self-control is the most important cause of crime. It argues that individuals with low self-control behave in a less risk-averse and more antisocial manner and, therefore, are more likely to engage in criminal activities. Our study exogenously manipulates the level of situation-specific self-control in a laboratory

experiment to explore the causal effect of self-control on risk taking and antisocial behavior. Overall, we do not find a significant effect of self-control on antisocial behavior. However, subjects with low self-control resources take more risk. Altogether, our results are compatible with the argument that low self-control promotes criminal behavior to the extent that antisocial individuals with lower levels of self-control are less effectively deterred by probabilistic sanctions.

When we consider median splits of our sample according to proxies for trait risk-seekingness or antisocial predisposition, we find that the manipulation of situational self-control influences all types of subjects in the same way: that is, it tends to make them less risk-averse and less antisocial. This observation suggests that the concentration of antisocial behavior among people with low trait self-control may be related to another trait shared by these individuals. One possibility might be that a lack of empathy is more frequent among individuals with low self-control. In any case, our results once again indicate the complexities of factors driving criminal behavior. Against this background, it is worthwhile to stress that our findings regarding the *General Theory of Crime* are somewhat ambiguous: while low trait self-control is positively correlated with antisocial behavior, a reduction in the current level of self-control causes a slight, however not significant decrease in antisocial behavior..

Our results may inform law enforcement authorities. The fact that low self-control tends to lower risk aversion suggests that, for many criminals, the risk premium implied by the detection probability and the level of the sanction may act as a less important deterrent than is typically assumed. When law enforcers face a population with a low level of self-control, it may be advisable to shift attention to prevention instead of relying on the deterrent effect of investigations ex post. Moreover, subjecting inmates to a training of self-control may be promising to lower the risk of recidivism.

Taking a wider perspective, our paper points at a potential mechanism underlying empirical findings on crime and factors which, surprisingly, have predictive power for crime. Examples are the relationship between crime and hot weather (Jacob et al. 2007) or the relationship between family or hooligan violence and the unexpectedly bad performance of sports teams (Card and Dahl 2011, Priks 2010). If hot weather or an unexpected loss of the own team consume self-control resources, lower self-control in subsequent situations might increase an individual's inclination to engage in criminal behavior.

Moreover, our research contributes to the ongoing discussion about the role of rational choice in theories about crime. For example, De Haan and Vos (2003) argue for the case of street robbery that the rational-choice perspective misses essential aspects such as impulsiveness. There is a related discussion on the effectiveness of deterrence with regard to juvenile crime (e.g., DiIulio 1996, Mocan and Rees 2005). In our paper, we investigate how subjects with low self-control, i.e., subjects acting more impulsively, decide and compare their choices to the behavior of subjects with higher levels of self-control. Our results suggest that antisocial individuals with lower self-control are indeed less likely to be deterred by probabilistic sanctioning.

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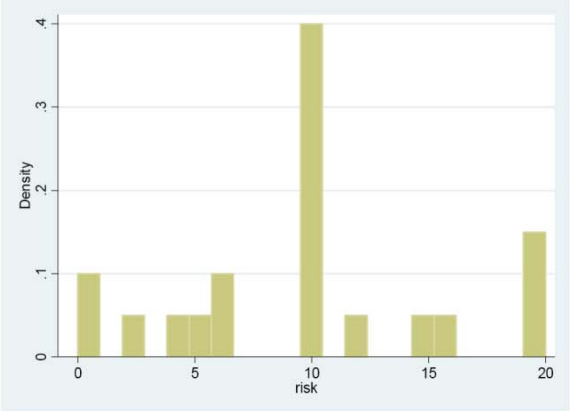
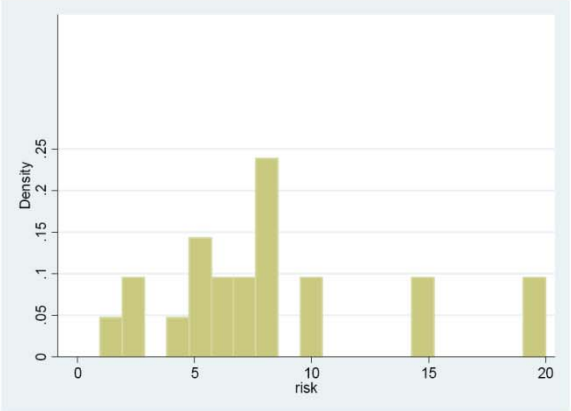
Appendix A: Histograms

In order to further document the gender-specific treatment effect, Figure 1 depicts the histograms for investments in the risky option in HSC and LSC for male and female subjects. It shows that the share of men who invest the maximum amount in the risky option (i.e., who behave in a risk-neutral or risk-seeking manner) increases substantially from about 15% in HSC to more than 40% in LSC. Figure 1 also illustrates the absence of a treatment effect regarding the behavior of female subjects.

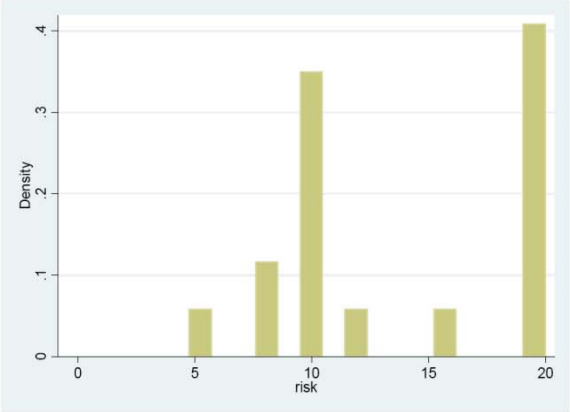
Figure 1: Histograms of investment in risky option arranged by self-control and gender



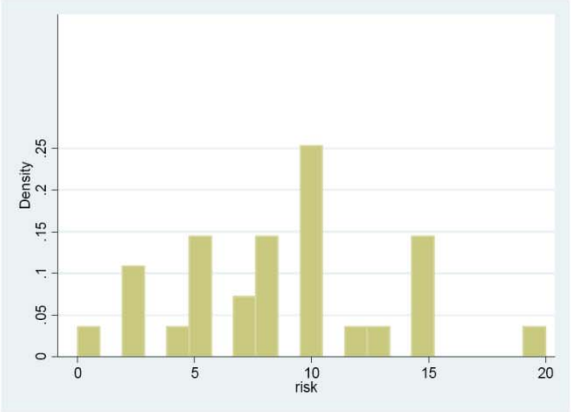
(a1) Male subjects in HSC (N=21)



(b1) Female subjects in HSC (N=22)



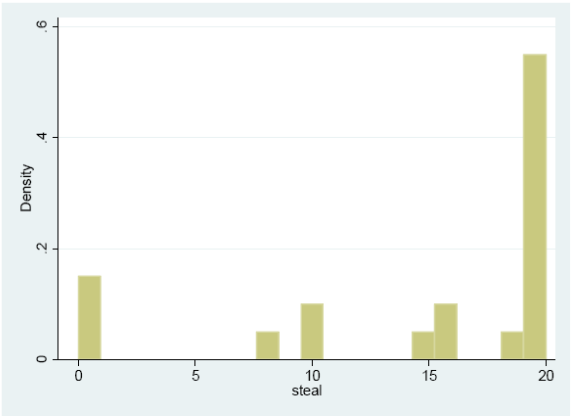
(a2) Male subjects in LSC (N=18)



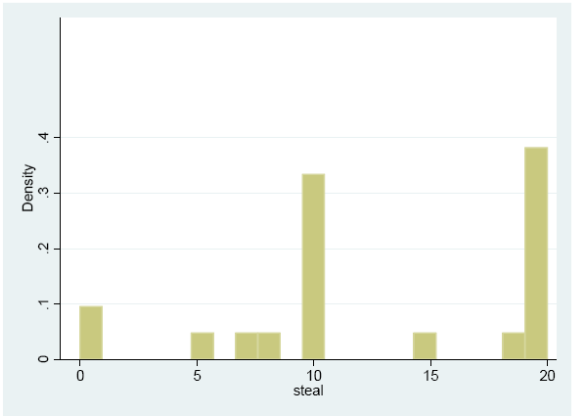
(b2) Female subjects in LSC (N=29)

Figure 2 presents gender-specific histograms of the taken amount in treatments HSC and LSC. They illustrate that antisocial behavior of men is not affected by self-control, while women with high self-control tend to behave in a more antisocial manner. For example, close to 40% of women take the maximum amount of 20 points in HSC, while less than 15% do in LSC.

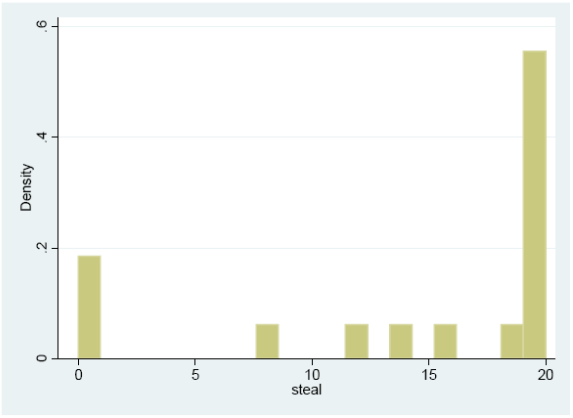
Figure 2: Histograms of taken amount arranged by self-control and gender



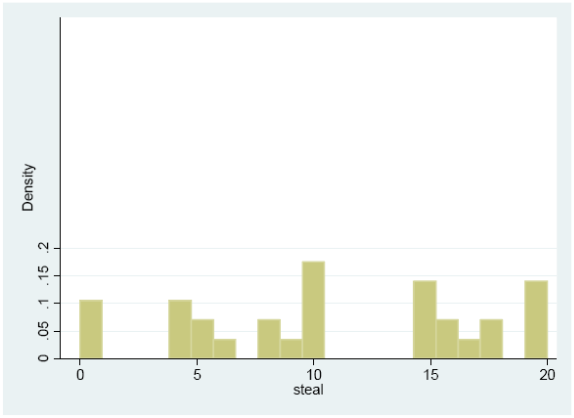
(a1) Male subjects in HSC (N=21)



(b1) Female subjects in HSC (N=22)



(a2) Male subjects in LSC (N=17)



(b2) Female subjects in LSC (N=30)

Appendix B: Translated version of the instructions for the LSC [HSC] treatment for risky investment first

General explanations

Welcome to this economic experiment.

In the following, we explain how you can earn money from your decisions in this experiment. Please read the instructions carefully. If you have any questions, please raise your hand and we will come to your seat.

During the whole experiment it is not allowed to talk to the other participants, to use cell phones, or to launch any programs on the computer. Disregarding any of these rules will lead to your exclusion from the experiment and from all payments.

During the experiment, your gains and losses are counted in points instead of in Euro. Your total income will be calculated in points first. At the end of the experiment, your total points will be converted into Euro: 1 point=25 Cents. At the end of the experiment, you will receive the income that results from your decision in cash.

In the following paragraphs we will describe the exact experimental procedure.

The experiment

First, we will describe your decision situation in general terms, using the variables X and Y that are explained below. We will assign numerical values to the variables X and Y during the course of the experiment and show them to you on the screen.

In this experiment, you will make a decision which influences only your payoff. You receive an endowment of X points and decide how many of these X points to invest in a risky asset. Your income in this experiment is determined by your investment level as follows:

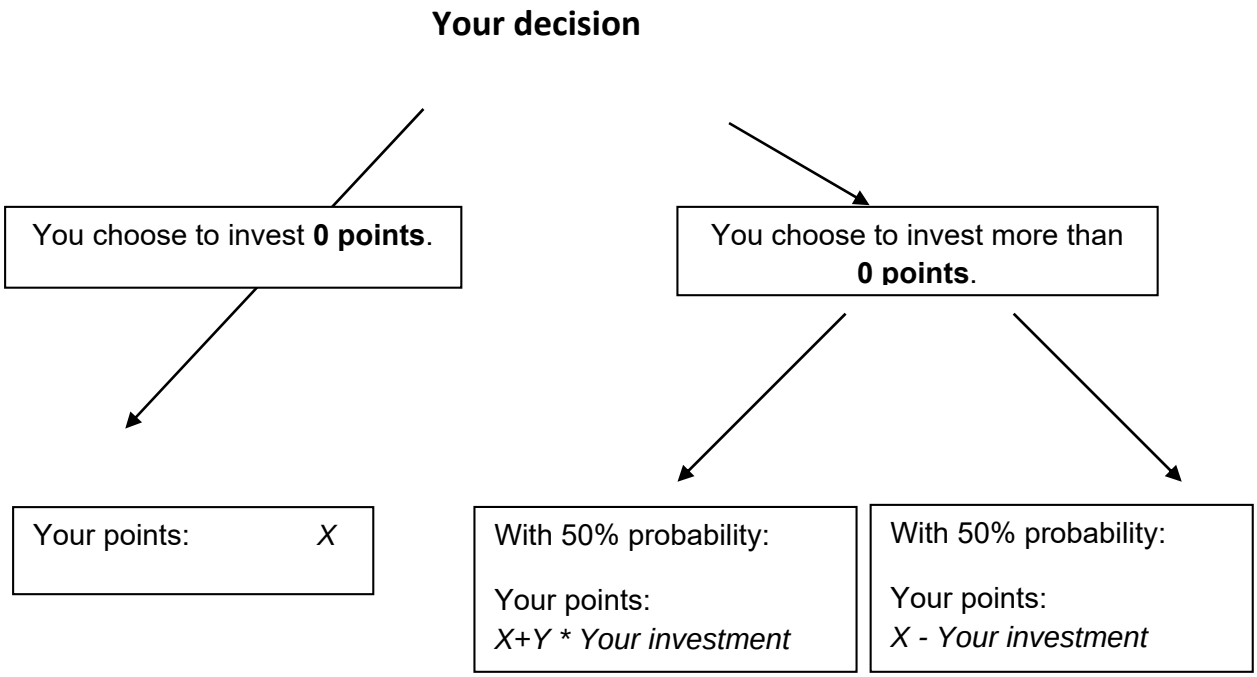
If you invest 0 points, you will receive your endowment amounting to X points as income.

If you invest more than 0 points, you will receive:

- with 50% probability, your endowment plus Y times your investment level, that is, your income is *X+Y * Your investment*. Y is greater than 1.

- with 50% probability, your endowment minus your investment level, that is, your payoff is *X-Your investment*.

Your income as a function of your investment level is represented in the following figure:



In order to determine how many points you would like to invest in the risky asset, specify the number of points in the according cell on screen and then press the OK-button. You will make this choice once. At the end of the experiment, you will be paid your income resulting from the investment decision in cash.

Before you make your decision, there are two tasks to be completed. It is very important for the experiment that you make an effort to complete the tasks diligently and correctly. For each task, you will be handed out a sheet of paper that you should work on. We will collect both sheets of paper at the end of the experiment. Moreover, you will receive private feedback onscreen about your performance in the two tasks at the end of the experiment.

<u>First task:</u>

We will hand out the first sheet of paper with text after all questions concerning the decision have been answered by the experimenters. **Please cross out each instance of the letter "e" in the text.** Start the task with working on the first paragraph and continue paragraph by paragraph. After you have finished a paragraph, specify the number of "e" you crossed out

in the paragraph in the field below the paragraph. We will check later on whether you crossed out the number of “e” indicated.

You have 7 minutes to work on the task. Rather spend more time on few paragraphs and do them right instead of trying to do many paragraphs. The time remaining for the task is shown in the upper right corner of your screen. A new display will appear after the 7 minutes have passed. Please insert the number of counted “e” for each completed paragraph on the screen. Enter a zero for each paragraph not worked on or not completed.

Second task:

After you have finished the first task, we will hand out a second sheet of paper with text. You now have to cross out the letter “e” according to the following set of rules:

Generally you cross out the letter “e”; however, there are the following exceptions:

(a) there is a vowel in the text after the letter “e” or

(b) there is a vowel in the text two letters after the letter “e”, or

(c) there is a vowel in the text two letters before the letter “e”.

In counting letters, disregard full stops, commas, or spaces. You are asked to cross out the “e” if there is a vowel directly before the “e” (as, for instance, in the example “were engaged” (in German “etwa elf”)). Vowels comprise: A, Ä, E, I, O, Ö, U, Ü.

The following representation summarizes the rules:

_ _ e _ _
1 2 3 4
Cross out all “e” in principle. Exceptions: Do not cross out the “e” if there is a vowel on position 1, 3, or 4.

[HSC Treatment: After you have finished the first task, we will hand out a second sheet of paper with text. **Please again cross out each instance of the letter “e” in the text.** This is the same instruction as used for the first task.]

Please start again with the first paragraph and continue paragraph by paragraph. Specify the number of “e” you crossed out in the paragraph in the field below it. We will check later on whether you crossed out the number of “e” indicated.

Again, you have 7 minutes to work on the task. Spend rather more time on few paragraphs and do them right instead of trying to do many paragraphs. The time remaining is shown in the upper right corner of the screen. A new display will appear after the 7 minutes have passed. Please insert the number of counted “e” for each completed paragraph on the screen. Enter a zero for each paragraph not worked on or not completed.

Subsequent to the two tasks, you will make your previously described decision concerning the level of investment. At the end of the experiment, all participants will receive their income resulting from the investment decision **in cash**.

Please raise your hand in case you have any questions. One of the experimenters will come to you to answer it.

Another experiment

Next, you will make one further decision. This is your last decision in this experiment. Again, we will describe the decision situation in general terms. The numerical values of the variables W and Z that are introduced below will be shown onscreen during the course of the experiment.

There are two kinds of participants, A and B. You will participate as participant B. Your anonymity and your randomly assigned participant A’s anonymity will be ensured during and after the experiment. Each pair consists of a real participant A and a real participant B.

You as a participant B receive an endowment amounting to W points. Participant A also receives an endowment of W points.

As participant B, you choose an integer transfer amount that you would like to take from participant A’s endowment. Participant A does not make a decision and cannot influence your payoff. For each point that you take from A, you receive Z points. Z is smaller than one.

Your income is given by your endowment of W points plus Z times your chosen transfer amount. Participant A receives an income that equals his endowment of W points minus the transfer amount determined by you.

Specifically: You determine how many points are transferred from participant A to you. Your income is (W + Z*transfer amount) points. Participant A receives an income amounting to (W – transfer amount) points.

In order to determine how many points you would like to take from participant A, specify the number of points in the according cell on screen and press the OK-button.

At the end of the experiment, all participants A and B will receive their income resulting from the transfer decision **in cash**.

You will make this decision once.

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