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ABSTRACT

This dissertation focuses on understanding the psychological and behavioral causes of poverty. It also uses insights into the resultant behaviors that affect those that live in poverty to create solutions that leverage behavior for more effective poverty alleviation. First, I use a laboratory experiment to investigate a possible psychological determinant of sub-optimal decision-making, stress. There exists evidence that poverty causes stress, and mixed evidence for the effect of stress on economic decision-making. Contrary to evidence collected in the developed world, I find no evidence for the effect of social or physical stress on economic decision-making among urban poor in Nairobi Kenya. Next, I use a randomized controlled trial to investigate the efficacy of a novel savings mechanism based on the concept of prize-linked savings. I exploit people's love for gambling to create and test a new savings mechanism that allows people to earn savings interest probabilistically. I find that participants prefer prize-linked savings accounts to interest bearing accounts, despite the fact that prize-linked savings accounts paid less in expectation. I also find that relative to a control group, participants assigned to prize-linked savings saved significantly more money overall. My results highlight the need to understand and harness the psychological underpinnings of poverty in order to develop solutions to alleviate it. On one side, more work needs to be done to understand if the neurobiological and psychological effects of stress lead to sub-optimal decision-making. In addition, we should continue to use these insights to develop novel products and mechanisms that can help those escape this global problem.

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PREAMBLE

When choosing a topic for my dissertation, I decided to investigate something I knew very little about. As a male born to middle class parents in one of the world's wealthiest countries, it's safe to say that my expertise on the subject of poverty is severely lacking. Certainly, there are more than a billion people who know more about poverty than I do. This document is a humble attempt to bridge the knowledge gap between those that want to know about poverty, and those who know poverty all too well.

From the little I do know, it seems clear that while the symptoms are not well understood, the causes of and solutions to poverty are completely opaque. We can see firsthand the effects of poverty, whether it be a lack of material wealth or the psycho-social aspects of uncertainty, depression, anxiety, and stress that accompany it. But, we know very little about what causes people to be poor, how these symptoms can feed back into poverty traps, and how we can develop solutions for breaking them.

Specifically, I focus on the psychological roots and behavioral consequences of poverty. Indeed, there are many ways to understand and tackle this problem, but I focus on behavior and psychology, as I believe they are fundamental actors that need to be taken into account if we are to develop practical, sustainable solutions to global poverty. We know that poverty is more than the lack of material wealth, and to ignore the psychological and behavioral consequences is to ignore the issue altogether. Importantly, my research in this dissertation focuses on lab and field experiments in the developing world, with participants who themselves live in poverty. If the ultimate goal of this research is creating or informing policy that is relevant to poor populations, it is important to conduct research that attempts to understand poverty not only generally, but also directly from those that experience it first-hand.

The first two chapters of my dissertation are focused on investigating a feedback mechanism between a symptom of poverty, namely stress, and economic decision-making. There exists correlational evidence that poor people are subject to greater negative affect, including anxiety, stress, and depression, and there is causal evidence that poverty causes increases in stress. A natural question that remains is whether stress has any effect on economic decision-making that could perpetuate a cycle of poverty. There exists mixed evidence to the effect of stress on economic decision-making, and critically all of the studies are run in developed countries.

I address this question by conducting two lab experiments that randomly induce stress in participants and subsequently measure changes in their time preference, risk preference, or productivity. These studies are run among the urban poor in Nairobi, Kenya. The first experiment borrows from psychology and utilizes the Trier Social Stress Test (TSST) to experimentally manipulate stress. The TSST is considered a social stressor that relies on an individual's aversion to social evaluation. Participants are judged in a mock job interview as well as an evaluated arithmetic task. Although this stress induction method is validated in western countries, this is one of the very first studies to attempt stress induction via TSST in the developing world. I find that, although its stress induction properties are well documented in the developed world, the TSST does only a marginal job at inducing stress for the poor in Kenya. This is an important methodological contribution for further research, particularly as more and more work is done directly with populations that we seek to understand and help. The second study utilizes another frequently used and validated stress induction method, the Cold Pressor Test (CPT). Much like the TSST, the CPT has been used to successfully manipulate stress in the western world. Unlike the TSST, which relies on activating a particular social stress, the CPT is a physical stressor. Participants individually immerse their hand in cold water, which has been shown to release the stress hormone cortisol. After stress induction (or control), I measure levels of risk preference, time preference, effort, productivity, and overconfidence. I find that the CPT reliably increases stress among participants. However, despite evidence to the contrary that exists in developed countries, I show no effect of stress on risk preference, time preference or any productivity related measures.

Though I find no evidence for an effect of stress on economic decision-making, this is not the last stop in understanding how stress may affect poverty. What has become clear to me is that great care must be taken in understanding the most appropriate ways in induce affective states that resemble the stress that poverty induces. By being among the first to investigate causal linkages between stress and decision-making in the developing world, I hope to encourage a greater line of research that uses lab experiments among the poor to understand the psychological consequences of poverty.

The last chapter of my dissertation is an attempt to find ways to alleviate poverty. If poverty changes the fundamental ways that people think about the world, we can use insights into these behaviors to nudge people towards actions that can help alleviate poverty. In this study, I use the poor's proclivity for gambling to create and test a novel savings mechanism. This mechanism is inspired by prize-linked savings, a tool used for hundreds of years to encourage savings. In prize-linked savings, rather than individuals receiving smaller, certain interest payments, the interest is bundled among many and distributed probabilistically to few. Among the urban poor in Manila, Philippines, I test, via a randomized field experiment, the effect of take-up and savings for a prize-linked savings product versus a more familiar interest-bearing account. I find that individuals greatly prefer prize-linked savings accounts to interest accounts, even when the interest accounts pay higher interest with complete certainty. I also find that prize-linked savings accounts increase total savings compared to a control group. While this experiment should be regarded more as a test than a policy recommendation, I find that understanding and using behaviors to influence the design of products can encourage greater take-up, use and hopefully be more effective as tools for poverty alleviation.

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Chapter 1

THE EFFECT OF ACUTE STRESS ON PRODUCTIVITY, INTER-TEMPORAL CHOICE, AND RISK PREFERENCE

Chaning Jang, Johannes Haushofer, and Linda Kleppin[1]

1.1 Introduction

Many of life's important choices are made under stress, precisely because they are important. Think for instance of the choices a CEO has to make on a daily basis or the tradeoff between labor and education for a poor Kenyan family; many of these decisions are made under stress. There is a body of evidence that shows a relationship between stress and a host of negative outcomes including obesity (Dallman et al., 2003; Dallman, 2010), cognition (Buchanan et al., 2006; Schoofs et al., 2008), child development (Nair et al., 2003; Crnic et al., 2005), decision-making (Starcke and Brand, 2012; Preston et al., 2007), and psychological well-being (Lindfors and Lundberg, 2002). Moreover, a recent review by Haushofer and Fehr (2014) suggests that there

[1] Johannes Haushofer, Princeton University Department of Psychology and Linda Kleppin, Comparative Psychology, Institute of Experimental Psychology, Heinrich-Heine University Dusseldorf. We are grateful to the study participants for generously giving their time; to Jennifer Adhiambo, Marie Collins, Faizan Diwan, Amal Devani, Irene Gachungi, Monica Kay, Joseph Njoroge, and James Vancel, for excellent research assistance. All errors are our own. This research was supported by NIH Grant R01AG039297 and Cogito Foundation Grant R-116/10 to Johannes Haushofer.

is a link between stress and suboptimal economic choice. Amongst others, the authors report evidence from experiments that show that stress and fear increase risk aversion and time discounting. These findings are particularly relevant to poverty alleviation efforts as recent research suggests that poverty itself may cause stress (Chemin et al., 2013)[2]. For instance, increased risk aversion can stand in the way of taking the risk necessary to escape poverty and increased time-discounting can make the attainment of long-term goals such as health or education more difficult. Among the poor, where daily decisions related to investment, savings, and labor can mean the difference between success and subsistence, understanding how stress manifests in the decision-making process is paramount to unpacking root causes of poverty and developing theory and practice to alleviate it. If psychological and neurobiological consequences of poverty could be another channel through which poverty may be perpetuated it is important to conduct rigorous research that allows us to understand the causal mechanisms through with the channel flows.

Another factor that contributes to the perpetuation of poverty is a lack of economic growth in developing countries, where labor revenue productivity, measured in GDP per capita and average sales per employee on a firm level, is lower than in developed countries (Bloom et al., 2010). A large number of explanations as to why this is the case is presented in the literature. Tybout (2000) attributes these lower levels of productivity to issues of infrastructure, informality, regulation, trade policy and human capital, while others (Bartelsman et al., 2009; Hsieh and Klenow, 2009) predominantly see the cause in a mix of financial and organizational factors, i.e. financing constraints and centralized decision-making. While all of these factors add to the explanation of lower levels of productivity, development interventions focused around these factors, i.e. markets, governments or self-governance have not been able to change the fact that poverty prevails in a large number of developing countries (Cardenas and Carpenter, 2008). Given the evidence on the effect of stress on physical, psychological, and developmental outcomes, as well as economic decision-making, there may be direct effects on labor productivity, competition, and effort provision that can explain the documented productivity gap.

Most of the causal evidence we have on the effects of stress on decision-making have been conducted with

[2]Further evidence, including Haushofer and Shapiro (2013) shows that the alleviation of poverty causes reduction in stress.

subjects from western societies that are relatively well-educated and wealthy. As recent research has identified cross-cultural differences in fundamental aspects of psychology, motivation and behavior (Henrich et al., 2010), it has become increasingly clear that generalizing research built from a sample (of western subjects) that is both rare and unique should be approached cautiously. In order to improve our understanding of the links between stress and economic choices of the poor, which can inform the theories upon which poverty alleviation efforts are built, it is important to conduct research with subjects from a wide range of cultural and socio-economic backgrounds.

1.1.1 Review of the Literature

Stress is defined as environmental demands that exceed an organisms ability to cope and the organism's response. A growing body of literature suggests an effect of stress and negative affect on economic choice. Cohn et al. (2013) conducted an experiment in which one type of negative affect (fear) was induced during an investment task by exposing participants to the threat of mild or painful electric shocks, with each participant facing randomly administered blocks of high and low fear trials. The main outcome of this study was that risk aversion was significantly higher in high-threat trials than in the low-threat trials. Additional experimental studies (Kugler et al., 2012; Raghunathan and Pham, 1999) found distinct effects of different types of negative affect on risk taking. For instance, Raghunathan and Pham (1999) tested the effect of anxiety and sadness on choices involving risk by randomly assigning participants to one of three mood conditions (neutral, anxious, sadness), which were induced by means of cover stories. Subsequently participants made choices between gambles with varying risk and payoff options, but equal expected value. Anxiety significantly increased preferences for lower-risk / lower-payoff gambles, while sadness increased preferences for higher-risk / higher-payoff gambles.

Research on the effect of negative affect on time discounting has shown to be fruitful. A study by Lerner et al. (2013) investigated the effect of sadness on time-discounting. In this study, participants were assigned to a sad or neutral mood condition (in a total of 3 experiments) and were then asked to make inter-temporal choices. The main result was that median sad participants valued future rewards between 13-34 % less than the median neutral state participants. Another study by Cornelisse et al. (2013) reports a time dependent effect of the stress hormone hydrocortisone on inter-temporal choice. In this study participants were assigned to one of three treatment groups, for which the time between the application of the stressor and completing the inter-temporal choice task was varied (15 minutes/ 195 min/ administration of placebo at both time points). It was found that hydrocortisone increased impatience in the subsequent inter-temporal choice task when it was administered 15 minutes before playing the task, but not when it was administered 195 minutes beforehand. A recent study (Delaney et al., 2014) also found, for the elderly, increased time discounting after exposure to stress. Conversely, no effect of stress on time-discounting was found when employing the Trier Social Stress Test, a proven stress test for the induction of psycho-social stress in the laboratory, neither when conducting it with a sample of Swiss University students (Haushofer et al., 2013b) nor with a sample of urban poor from Nairobi, Kenya (Haushofer et al., 2014). These contradictory results suggest that the mechanisms through which stress affects time-discounting remain incompletely understood.

A number of studies on the effect of stress on risky choices (Mather et al., 2009; Lighthall et al., 2009; Porcelli and Delgado, 2009; Buckert et al., 2014) deliver supportive evidence for the hypothesis of a link between stress and economic choice. Porcelli and Delgado (2009) conducted an experiment in which acute stress was induced before a gambling task, which involved choices between two alternatives of equal expected value but varied probability. These were either presented in the loss or gain domain and it was found that under acute stress there was a trend towards an increase in the proportion of risky choices in the loss domain. This suggests that acute stress increases the reflection effect, that is a greater preference for risky choices when decisions involve losses rather than gains.

Data on the effect of stress on productivity is lacking for participants from non-western societies. A single paper (Johnson and Oxoby, 2014) on this topic was available when this paper was being prepared and the study was conducted with participants from a western society. Participants were randomly assigned to a treatment or a control group where the treatment group was stressed by means of a horror image, while participants in the control condition were shown an image of something pleasant. This manipulation lead to a significant difference in productivity between groups, with significantly greater productivity in the treatment than in the control group. Another study on the relationship between affectivity and productivity (Oswald et al., 2009), in this case positive affect, showed that a happiness intervention led to a 12% increase in productivity in a real effort task in comparison to the productivity of participants who did not receive the happiness intervention, but a placebo control exercise.

1.1.2 This Study

As poverty is expected to increase over the next two decades, particularly in urban areas in developing countries (Habitat, 2003) and as the consequences of economic choices weigh heavier for those who are poor than for the wealthy, it is crucial to improve our understanding of the factors (i.e., stress) that suggest to influence the economic choices of the poor. This study investigates the effect of stress on productivity, risk and time preferences on a sample of urban poor from Nairobi, Kenya. We conduct two laboratory experiments, one experiment on the effect of stress on productivity and a second experiment on the effect of stress on risk and time preferences. The Cold Pressor Test, hereafter CPT, (Hines and Brown, 1932) is used to induce stress. It is a proven and widely used stress protocol that involves participants immersing their hand in ice-cold water, causing mild pain, which leads to a physiological stress reaction (Buchanan et al., 2006; Cahill et al., 2003; McRae et al., 2006). Participants assigned to the control group participate in a similar, but non-stressful placebo exercise. Following stress induction, subjects participate in a number of tasks to quantify productivity, effort, and risk and time preference. Critically, random assignment of stress induction allow us to investigate the causal effect of stress on productivity and economic choice. This study contributes to the body of knowledge on the effects of stress on economic decision-making in two ways. First, we add to the evidence linking stress, or negative affect more broadly, to a host of outcomes including productivity, for which evidence is sparse. Second, this study provides the most comprehensive evidence to date on the effect of stress on economic decision-making and productivity in the developing world. As a preview of our results, we show no effect of stress on productivity, inter-temporal choice, or risk preference.

The remainder of the paper will proceed as follows: Section 1.2 describes the general method, tasks, and experimental timeline. Section 1.3 includes the data and econometric approach, section 1.4 covers the results of the experiments, section 1.5 offers some discussion on the results before concluding in section 1.6.

1.2 General Method

Participants and experimental background

Participants were volunteers recruited from the subject pool of the Busara Center for Behavioral Economics[3] and were paid for participation. Participants were current residents of either Kibera or Viwandani, two of Nairobi's largest informal settlements, and met the selection criteria if they were male and had not yet participated in other stress-related studies conducted at the research center. The decision to exclude females was taken due to the fact that levels of the stress hormone cortisol are affected by the female ovarian cycle, which is logistically difficult to control for. Also, participation was denied to those who came to the research center intoxicated or with an open wound on their hand or forearm.[4] Participants were randomly selected to be invited to either experiment 1 or experiment 2, but never both. Demographic information about the subject pools for each study will be presented in their respective sections below.

Upon telephone recruitment participants were asked to refrain from food, alcoholic beverages, smoking or usage of any other kind of drugs the day prior to the study and on the day of the study itself, as these alter the functioning of the hypothalamic-pituitary-adrenocortical (HPA) axis (Lovallo, 2006), a key structure in the physical response to stress (Tsigos and Chrousos, 2002). To measure cortisol at its circadian trough, this study was conducted in the afternoon, between 13:00-18:00 hrs. Both experiments were conducted on the premises of the Busara Center for Behavioral Economics in Nairobi, Kenya and an experimental

[3]Please refer to Haushofer et al. (2013a) for an overview of the physical contents and layout of the the laboratory, and detailed recruitment and study protocols.

[4] The CPT could not be conducted with an open wound on one's forearm or hand as it involved immersing one's hand in water, which could have lead to infection.

session lasted approximately 1.5 hrs. On average, participation was reimbursed with an amount equivalent to approximately \$6. This fee included transportation costs to the research center and back and a varying amount based on earnings during the study. This study met the ethical standards of the Committee on the Use of Humans as Experimental Subjects, MIT, Cambridge, MA 02139, USA as well as the ethical standards of the Maseno University Ethics Committee, Maseno, Kenya.

Stress Manipulation: The Cold Pressor Test

In the experiments reported here the Cold Pressor Test (Hines and Brown, 1932) was used to study the effect of stress on productivity, time and risk preferences. The procedure involved immersing one's hand in a container filled with ice water (0-4° C) for the duration of 30 seconds, followed by a second immersion lasting 60 seconds. Participants assigned to the control group were asked to immerse their left hand in a container filled with water heated to body temperature (35-37° C) for the same duration. By means of an iron partitioner, two compartments were created inside the container, one in which six kilograms of ice cubes were placed and another one, in which participants immersed their hand in water up to their wrist, with stretched out fingers. As it is essential to avoid heat build up around the hand in the CPT (Mitchell et al., 2004), a waterproof RS-2001 electrical filter pump was used to circulate the water. Commercial-grade submersible aquarium thermometers were used to monitor and measure the water temperature.

Random assignment of stress was conducted via a double-blind procedure. Upon arrival at the lab, participants are randomly assigned seat numbers (between 1 and 8) by a research assistant who is not involved in the administration of the experimental session. Before each session, a different research assistant, who is also not involved in administration, randomly draws seat numbers from an envelope to assign to each seat containers of ice or body-temperature water. Upon positioning the containers at their respective seats, the containers are covered such that the research assistant(s) administering the session cannot determine which seat contains which type of water. Participants are similarly unaware of their treatment status until the administration of the CPT. The layout of the lab is such that participants cannot identify which others (if any) are in a given group.

1.2.1 Experiment 1 Overview - Effect of Stress on Productivity

Experiment 1 considered the effect of stress on productivity, effort, and overconfidence.

Sample size and demographics

A total of N = 434 males from two of Nairobi's largest slums participated in this study. Table 1.1 summarizes relevant variables used as demographic controls in the analysis.

Table 1.1: Experiment 1 - Summary of Demographic Data

Type	**Stat**	**BMI**	**Age**	**Income**	**Disposable**	**Dependents**	**Debt**
Control	Mean	23	30.2	4584	1979	2.76	.667
	S.D.	3.54	11.2	5579	7421	2.77	.472
	Median	22.7	26	4000	500	2	1
	Min	15	19	0	0	0	0
	Max	36.7	68	50000	100000	16	1
	N	216	216	216	216	216	216
Treatment	Mean	22.9	29.2	6230	1596	2.74	.656
	S.D.	3.99	9.5	20718	2899	2.73	.476
	Median	22.1	26	3000	500	2	1
	Min	13.8	18	0	0	0	0
	Max	37.5	63	300000	20000	12	1
	N	218	218	218	218	218	218
Total	Mean	22.9	29.7	5411	1786	2.75	.661
	S.D.	3.77	10.4	15207	5621	2.75	.474
	Median	22.4	26	3500	500	2	1
	Min	13.8	18	0	0	0	0
	Max	37.5	68	300000	100000	16	1
	N	434	434	434	434	434	434

Notes:
Self-reported demographic characteristics. "BMI" refers to body mass index, "Income" refers to total monthly income, "Disposable" is disposable monthly income, "Dependents" referes to the total number of people who depend solely on this person's income, "Debt" is an indicator that equals one when the person is in debt.

There are no significant differences between participants in Control and Treatment groups for any of control variables (not reported). Participants' average age was 29.7 ± 10.4 years (mean ± S.D.). Average self-reported monthly income was KES 5,411 ± 15,207 (~$64)[5]. Participants reported an average of 2.75 ± 2.75 dependents who relied solely on their income and roughly two-thirds reported currently being in debt. The

[5]Exchange rate during the study period was roughly KES85/USD.

study took place between May 28, 2013 and July 30, 2013. A total of 59 sessions were conducted, with each session containing between six and eight participants.

Measures and Design

Salivary Sampling Analysis. Throughout the experiment, five saliva samples were collected to measure salivary cortisol. Salivary cortisol is considered to be a reliable and valid reflection of cortisol in the blood stream (Kirschbaum and Hellhammer, 1994). Samples were obtained using salivettes (Sarsted, Nürmbrecht, Germany) and were stored in a freezer at -20° Celsius. Due to budget constraints arising from unexpected increases in costs of analyzing salivary cortisol in Kenya, the salivary samples were not analyzed for this study.[6] The results section therefore omits analyses on changes in salivary cortisol.

Assessment of Negative Affect. Subjective ratings of negative affect were assessed using the 10-item negative mood scale of the PANAS (Watson et al., 1988). Subjective ratings were collected by means of a visual analogue scale (VAS) with answering options to the affect in question ranging from 0 "not at all" to 100 "very much". In addition to the negative affective scales from the PANAS, ratings of stress and pain were also collected using the same methods. Negative mood was assessed at the beginning and at the end of the study. Subjective stress and pain ratings were assessed three times, serving as baseline, midline and end-line measures. For the exact point in time please refer to Section 1.2.1. Section 1.3.1 lists the outcome variables of interest.

Real-Effort Task. Productivity was measured via a series of two-minute effort tasks that were repeated three times under different incentive schemes. The effort task was adapted from Abeler et al. (2011) and consisted of counting the number of zeros in as many 7 x 5 grids of zeros and ones as possible, which were presented one at a time. Between-subject randomization placed participants in either "easy" or "difficult" versions of the task, where easy versions contained 4 to 7 zeros, and difficult versions contained between 14 to 21 zeros. Participants were placed in groups of 6, 7, or 8 at the session-level with both treated and control

[6]The cost of analyzing salivary cortisol in Kenya rose unexpectedly from $6 - $12 per sample over the course of the study. However, salivary samples continued to be stored for future analysis.

participants in the same group. The three incentive schemes for the effort task were adapted from Niederle and Vesterlund (2007) and include a piece-rate, tournament, and choice task. Under the piece-rate task, participants were paid KES 1 per correct answer. Under the tournament task, the winner (who counted the most number of grids correctly) was paid KES n per correct answer, where $n \in \{6,7,8\}$ represents the group size, while the other participants were paid nothing. Under the choice task, each participant had the option to be paid under the piece-rate incentive, or under a modified tournament. The modified tournament paid the participant KES n per correct answer if and only if (s)he had more correct answers than the winner of the previous tournament task. This allows for measurement of participant selection without strategic effects of other potential tournament entrants. After the piece-rate and tournament tasks, participants were asked to rate their relative performance. Finally, after the choice task, participants were shown their performance under the piece-rate incentive scheme and were asked whether they would like to enter their past performance into a tournament, thereby potentially increasing their earnings from the piece rate task by a factor of n. This task was not further analyzed and will therefore not be included in the results section of this paper. Outcome variables from the real effort task are outlined in Section 1.3.2.

Risk Preference Task. This task, adapted from Gneezy and Potters (1997) and Charness and Genicot (2009) has been shown to be an effective risk elicitation method, especially with respect to populations which may have low comprehension for these types of tasks (Charness and Viceisza, 2012). In this task, participants were endowed with KES 50. They could chose to keep all of it, or to invest some or all of it in a coin flip which would return four times if the computer flipped a heads, and would be lost if the computer flipped a tails. The outcome variable from this risk preference task is the amount invested in the coin flip.

Working Memory. A computerized version of the digit span task forward was used for the assessment of working memory capacity. Over 8 rounds, participants were asked to remember series of digits, starting with a series of four digits and ending with a series of 11 digits, thereby increasing working memory load by one digit each round. A series of digits was presented on the screen, located above the aforementioned touch pad and was simultaneously read out aloud by the Research Assistant. After that it disappeared for five seconds during which participants were to remember the series of digits. After five seconds participants were prompted to type the remembered series of digits into the touch pad. The digit span task was scored by adding up the amount of digits the participant was able to remember in each test.

Design. The study employed a factorial design around the real-effort task (Treatment ([treatment, control], Task Difficulty [easy, difficult] and Incentive Scheme [piece rate, tournament, choice]), whereby the factor incentive scheme was the within factor and the factors treatment and task difficulty were between-subject factors.

Compensation. Participants were reimbursed a standard rate for travel expenses to and from the lab. If participants held their hand immersed in water for the 60-duration, they earned an additional KES 100. In addition each round of the real effort task was paid and the outcome of the risk-preference task was incentivized.

Procedure

Upon arrival at the research center, participants were ushered into the waiting room, where they were provided with general information on the study, but were not informed about details of the stress protocol or the tasks. Subsequently, participants entered the computer room and were seated. At this point, a first saliva sample was taken, which was followed by a short task meant to familiarize respondents with using the touch-screen computers to enter their responses. Next came the first measurement of negative affect and the working memory task. Afterwards the real-effort task was practiced, which was followed by a 30-second CPT. Prior to hand immersion, participants were reminded that the procedure could cause pain and stress and that participation was optional and did not exclude them from further participation in the study. Towards the end of the 30-second CPT respondents were asked to asses their current level of stress and pain. Participants were instructed to make ratings with their free (right) hand while their other hand remained submerged. Successively, they gave a second saliva sample, after which the CPT was carried out once more, this time for the duration of 60 seconds. Participants (both in treatment and control) who kept their hand submerged for the full duration were remunerated with an additional KES 100. Once the second

CPT was completed, the third cortisol sample was taken. Respondents now performed the effort task, which was played for three rounds under three different incentive schemes. Afterwards participants were instructed to give a fourth saliva sample, which was followed by the risk-preference task. Next, the end-line measure for negative mood was taken. A demographic questionnaire was then taken followed by the presentation of earnings. Lastly, participants provided a final saliva sample and were debriefed. Excluding the stressor, all tasks were completed via touch-screen computer using zTree (Fischbacher, 2007).

1.2.2 Experiment 2

This study was conducted to research the effect of stress on time and risk preference.

Sample size, and demographics

A total of N = 235 male participants, also from the subject pool of the Busara Center for Behavioral Economics, were recruited to participate in this study. Demographic characteristics of the participants for this study were nearly identical to those in experiment 1. Participants' mean age was 29.3 ± 9.7 years (mean ± S.D.). Average monthly income was reported as KES 5,414 ± 8,647 (~$64). Respondents indicated an average of 2.51 ± 2.71 dependents and 64% of respondents indicated being currently in debt. This study took place between June 4th, 2013 and August 7th, 2013. 39 total sessions were conducted, with each session containing between four and eight participants.

Measures and Design

Salivary Sampling Analysis. Salivary procedures are identical to those in experiment 1. See section 1.2.1 for details.

Assessment of Negative Affect. The assessment of Negative Affect is identical to that in experiment 1. See section 1.2.1 for details.

Time preference 1. Participants were asked about their preferences between a sooner smaller reward and a later larger reward. There were three time blocks (today vs. 1 month, today vs. 2 months, 1 month vs. 2 months) and three questions per time block for a total of 9 questions. For all time blocks, the later larger reward was KES 150, while the sooner smaller rewards were KES 95, KES 55, and KES 15, respectively. All amounts were perturbed with mean-zero gaussian noise to reduce anchoring to amounts across blocks. Participants completed this task during the 60-second CPT. The results of this task are left for a separate study and unreported here.

Time preference 2 (Titration). This second task used to investigate time preference was adapted from Haushofer et al. (2013c). Participants were asked about their preferences between a sooner smaller reward and a later larger reward. There were six time blocks (today vs. 3 months, today vs. 6 months, today vs. 9 months, today vs. 12 months, 6 months vs. 9 months, and 6 months vs. 12 months) and six questions per time block for a total of 36 questions[7]. The larger later reward was fixed at KES 200, while the sooner smaller reward started at KES 100 and was then adjusted with a titration algorithm according to the choices the subject made. Titration is a standard method for identifying discount rates in the discounting literature (Mazur, 1988; Green and Myerson, 2004; Kable and Glimcher, 2007; Rachlin et al., 1991). The titration used a bisection algorithm which set the initial sooner small amount to 50% of the later larger amount, and gradually adjusted the sooner small amount to approximate the participant's indifference point for each time block. For both time preference tasks, "today", strictly speaking, referred to sometime within the next 24 hours. All time preference tasks were paid via MPESA[8], which allows for equal transaction costs over the time delays.

Risk Preference 2. This task was adapted from Binswanger (1980) and Eckel and Grossman (2002) and is a simple risk-elicitation mechanism used in developing countries (Bauer et al., 2012; Cameron and Shah, 2012). Participants chose a gamble from a list of six 50/50 gambles where the expected payoff increased

[7]The first five questions used the titration method to approximate the indifference point, while the sixth and final question was a repeat of the first question (a choice between the sooner smaller reward of KES 100 and the later larger reward of KES 200) to check for comprehension / preference reversal. These results are not reported.

[8]MPESA is a mobile money platform in Kenya, which is run by Safaricom. All participants in the Busara subject pool have access to MPESA to receive mobile payments.

with the variance for gambles 1-5. Gamble 6 increased the variance, but maintained the expected payoff. Participants made a single decision on the gamble they preferred. The outcome of the gamble was realized through a computer simulated coin flip.

Design. All respondents participated in all tasks described above. Between-subject randomization allocated respondents to either stressful or non-stressful conditions.

Compensation. Participants were reimbursed a standard rate for travel expenses and KES 100 if they held their hand immersed in water for 60-seconds. Two comprehension questions related to time preference were compensated. In addition, one of the decisions in each of time preference 1 & 2 were selected for payment as well as the result of the risk preference 2 task.

Procedure

The procedure was similar to the procedure used in experiment 1. After briefing and an introduction to using the touchscreen interface for entering responses, participants started with the baseline negative affect measurement. Next, participants were described the time-preference decision process and answered a number of comprehension questions (both incentivized and non-incentivized) to ensure that all respondents had a sufficient understanding of our titration task.[9], followed by the 30-second CPT with simultaneous midline affective assessment. Next was the 60-second CPT with simultaneous time preference 1 administration. Time preference 2 (titration) and the risk preference task followed. The end-line negative assessment, demographic questionnaire and the presentation of earnings concluded the experiment. Five salivary samples were taken at similar times in the process to experiment 1 (at the outset of the experiment, after each of the CPT immersions, after the time preference 2 task, and at the conclusion) Excluding the stressor, all tasks were completed via touch-screen computer using zTree experimental software (Fischbacher, 2007).

[9]Respondents participated in a number of hypothetical decisions and were then asked to choose their financial outcome and payment date under a number of scenarios. Furthermore, participants made two "dominated" decisions for real money to increase the saliency of the task. The first question was a choice between receiving KES 50 today versus receiving KES 50 in six months. The second question was a choice between receiving KES 50 today versus receiving KES 30 today.

1.3 Data and econometric approach

In the following sections we outline the outcome and control variables of interest and the econometric specification we use to analyze the data for both experiments. Analysis follows closely our pre-analysis plan (PAP)[10], with analyses beyond the scope of the pre-analysis plan noted.

1.3.1 Negative affect

To test for the effectiveness of the CPT at increasing subjective negative affect we analyze our 10+2-item negative mood scale in differences and levels in the following linear model:

$$y_i = \alpha + \beta T_i + \sigma X_i' + \epsilon_i$$

Where y_i is the outcome variable of interest for individual i, T_i is a dummy for the acute-stress treatment, X_i' is a vector of control variables, and ϵ_i is the residual. This model will be estimated with and without controls using OLS with session fixed effects and robust standard errors. Outcome variables of interest are:[11]

[10] A pre-analysis plan for this study was submitted to the AEA registry for randomized controlled trials and can be found at: http://www.socialscienceregistry.org/trials/218.

[11] Analysis of PANAS+ and PANAS Short are included in the PAP.

Variable Name	Variable Description
PANAS 1 & 3	Sum of 10-item negative mood scale (first and last administration)
ΔPANAS 3-1	Difference between PANAS Total 3 and 1
PANAS+ 1 & 3	Sum of 10+2-item negative mood scale (first and last administration)
ΔPANAS+ 3-1	Difference between PANAS Total 3 and 1
PANAS Short 1, 2 & 3	Sum of Stress and Pain response (all administrations)
ΔPANAS Short 2-1	Difference between PANAS Short 2 and 1
ΔPANAS Short 3-2	Difference between PANAS Short 3 and 2
ΔPANAS Short 3-1	Difference between PANAS Short 3 and 1
Stress/Pain 1, 2 & 3	Individual Stress and Pain response (all administrations)
ΔPain/Stress Short 2-1	Difference between Pain/Stress 2 and 1
ΔPain/Stress Short 3-2	Difference between Pain/Stress 3 and 2
ΔPain/Stress Short 3-1	Difference between Pain/Stress 3 and 1

1.3.2 Productivity

Model 1

Our primary specification for analysis of productivity-related outcomes will take the form of a linear model:

$$y_{ik} = \alpha + \eta T_i \times DIFF_i + \theta T_i \times EASY_i + \gamma DIFF_i + \omega TASK_k + \sigma X_i' + \epsilon_{ik}$$

Where y_{ik} is the outcome variable of interest for individual i and task $k = (PieceRate, Tournament)$, T_i is a dummy for the acute-stress treatment, $DIFF_i$ is a dummy for assignment to the difficult treatment, $EASY_i$ is a dummy for assignment to the easy treatment, X_i' is a vector of control variables, and ϵ_{ik} is the residual. This model will be estimated using OLS with session fixed effects and standard errors clustered on the individual level. For robustness, we test the model without clustering and with standard errors clustered at the session level, as well as with and without session fixed effects.

Model 2

For robustness we also test the following linear model, which utilizes data from all three real-effort tasks:

$$y_{ikl} = \alpha + \eta T_i + \sum_k \theta_k I_K(TASK) + \sum_l \gamma_l I_L(DIFF) + \sum_k \sum_l \omega_{kl} I_K(TASK) * I_L(DIFF) + \sigma X_i' + \epsilon_{ikl}$$

Where K is the set of effort task types $k = (PieceRate, Tournament, Choice)$, L is the set of difficulty types $l = (Easy, Difficult)$ and the other values as earlier defined. The indicator functions $I_K(TASK)$ and $I_L(DIFF)$ take on the value of one for a given k and l. This is equivalent to creating dummy variables for each task type and difficulty and allowing for effects from all direct and interactions of the variables.

Finally, we test a parsimonious model on aggregate productivity variables for basic exploratory analysis;

$$y_i = \alpha + \beta T_i + \sigma X_i' + \epsilon_i$$

Where y_i represents aggregate outcome variables for the number of grids counted, attempted, and total accuracy and other variables as defined previously.

For productivity, we are interested in the following outcome variables:[12]

Variable name	Variable Description
Correct	# of correct grids counted
Effort	# of grids attempted
Accuracy	Correct grids divided by attempts
Belief	Belief in relative group rank
Rank	Actual ranking
Error	Extent to which participant overstated belief $(Rank - Belief)/Accuracy$
Overconfidence	Indicator for overconfidence, measured where $Rank > Belief$

[12] Variables “Correct”, “Effort”, “Accuracy”, and “Belief” are included in the PAP. Furthermore, in the PAP, “Correct” was referred to as “Productivity” and “Belief” as “Rank”.

Time Preference

To test the effect of stress on time preference, we estimate the following linear model (model 1):

$$y_{ik} = \alpha + \beta T_i + \sum_k \gamma_k I_K(k) + \sigma X_i' + \epsilon_{ik}$$

Where y_{ik} is the outcome variable of interest for individual i and time preference delay combination k, T_i is a dummy for the stress treatment, $I_K(k)$ is an indicator function that takes the value of one for a given delay combination $k = (0m3m, 0m6m, 0m9m, 0m12m, 6m9m, 6m12m)$ and zero otherwise, X_i' is a vector of control variables, and ϵ_i is the residual. This model will be estimated using OLS with session fixed effects and standard errors clustered on the individual level.

For robustness we test the following linear model (model 2) that allows for interaction between the treatment status and the time block:

$$y_{ijk} = \alpha + \sum_j \gamma_j I_J(STRESS) + \sum_k \theta_k I_K(BLOCK) + \sum_j \sum_k \omega_{jk} I_J(STRESS) * I_K(BLOCK) + \sigma X_i' + \epsilon_{ijk}$$

This is identical to model 1 with the addition of interactions between the stress treatment and each time delay. That is, the model is now fully saturated with respect to stress and delay combinations. Model 2 will be tested with session fixed-effects and standard errors clustered on the individual levels.

For time preference, we are interested in the following outcome variables[13]:

[13] All variables except the hyperbolic growth parameter are in the PAP.

Variable Name	Variable Description
Indifference	Calculated indifference point
AUC	Area under the curve
Proportion	Proportion of patient responses
Discount Rate	Geometric Discount rate
Exp k	Exponential growth parameter
Hyp k	Hyperbolic growth parameter
Impatience	Extent to which the growth parameter is changing with time horizon
Stationarity	Extent to which growth parameter is changing with delay

Indifference point. First, we use the indifference points implied by the titration exercise. The indifference point was calculated as the final sooner small reward implied by the final decision made by each subject for each time block. This represents the subjective value of KES 200 at a later time point, as seen from an earlier time point.

Area under the curve. For each participant, we calculate the area under the curve implied by their revealed indifference points for the given time delay combination. We use the trapezoidal formula and time blocks with "today" to calculate the area.

Proportion of patient responses. Each participant faces 6 questions associated with each time block. To determine the proportion of impatient responses, we simply take the ratio of all choices for 'larger later' payments to the total number of choices made.

Geometric discount rate. For each participant, and each time delay, the geometric discount rate is calculated as:

$$x_1 = x_2[1/(1+r)]^T$$

Where r represents the geometric discount rate, T is the time delay, and x_1, x_2 represent the indifference point, and larger later payment, respectively.

Exponential growth parameter. Each of the six indifference points is associated with an exponential growth parameter which we calculate in the following way. For each participant i and each time block $(t_1 = 0, t_2 = 3)$, $(t_1 = 0, t_2 = 6)$, $(t_1 = 0, t_2 = 9)$, $(t_1 = 0, t_2 = 12)$, $(t_1 = 6, t_2 = 9)$, and $(t_1 = 6, t_2 = 12)$, and the amount of the larger later payment, x_2:

$$x_1 = exp(-\delta_{t_1,t_2}\frac{t_2 - t_1}{12})x_2$$

This implies:

$$\delta_{t_1,t_2} = -\frac{12}{t_2 - t_1}ln\frac{x_1}{x_2}$$

From here, we can compute an index for decreasing impatience:

$$\Delta_{DI_i} = \delta_{short} - \delta_{long}$$

Where $(short, long)$ represent relative time horizons. For any two time blocks A, B time block B is defined as *long* and time block A is defined as *short* if $t_{1A} = t_{1B}$ and $t_{2B} > t_{2A}$.

We also compute an index for departures from stationarity:

$$\Delta_{DS_1} = \delta_{0,3} - \delta_{6,9}$$

$$\Delta_{DS_2} = \delta_{0,6} - \delta_{6,12}$$

Hyperbolic growth parameter. Likewise we can calculate a hyperbolic growth parameter from the following equation.

$$x_1 = x_2[1/(1 + h\frac{t_2 - t_1}{12})]$$

which implies:

$$h = (\frac{x_2}{x_1} - 1)/(\frac{t_2 - t_1}{12})$$

Indices for decreasing impatience and departure for stationarity can be calculated analogously to those for the exponential growth parameter.

Risk Preference

To test the effect of stress on risk preference, we estimate the following linear model:

$$y_i = \alpha + \beta T_i + \sigma X_i' + \epsilon_i$$

Where y_i is the outcome variable of interest for individual i, T_i is a dummy for the acute-stress treatment, X_i' is a vector of control variables, and ϵ_i is the residual. This model will be estimated using OLS and ordered logit with session fixed effects and standard errors clustered on the individual level.

For risk preference, we are interested in the following outcome variables:[14]

Variable Name	Variable Description
Invested	Amount invested in Gneezy & Potter risk task (Experiment 1)
List	Chosen list from Binswanger risk task (Experiment 2)
CRRA	Midpoint of implied relative risk aversion from Binswanger risk task (Experiment 2)

The relative risk aversion coefficient is calculated according to Charness et al. (2013). Each of the 6 choices implies bounds on the CRRA risk coefficient. For interior points, we take the midpoint of the two risk aversion coefficients, while for choices without upper / lower bounds (the safest and most risky choice, respectively), we use the minimum and maximum.

1.3.3 Control Variables

We test these effects with and without a number of control variables. The control variables used in the analysis are:[15]

[14] All variables below listed in the PAP.

[15] All variables below listed in the PAP. In the PAP, "Dependents" are referred to as "Children" and "Disposable" referred to as "Disposable Income". In analysis, a dummy variable for each level of education is included.

Variable Name	Variable Description
Education	Highest level of education attained
BMI	Body mass index
Age	Age in years
Dependents	Number of dependents
Income	Monthly income
Disposable	Monthly disposable income
Debt	Binary debt status

1.4 Results

1.4.1 Stress / Negative Affect Induction

Experiment 1

Table 1.2 provides a summary of stress+pain scores by treatment group.[16] We see large variation in negative affect. Average self-reported stress at baseline was 14.7 out of 100. Self-reported pain was 34.7 out of 100. Considering stress and pain together, the aggregate stress + pain ratings increase between baseline and midline for the treatment group before falling again at end-line. For the control group, stress + pain ratings fall from baseline to midline, remaining relatively flat during the end-line administration.

[16] For other outcome measures including PANAS and pain and stress separately, see appendix section 1.7.2.

Table 1.2: Experiment 1 - Summary of Stress + Pain

Type	**Stat**	**S+P 1**	**S+P 2**	**S+P 3**	**S+P 3-1**	**S+P 2-1**	**S+P 3-2**
Control	Mean	52.6	35.8	41.5	-11.1	-16.8	5.72
	S.D.	48.9	41.2	45.7	39.5	45.3	46.9
	Median	43.5	20.5	25	-4	-9.5	1
	Min	0	0	0	-168	-190	-190
	Max	200	200	200	130	170	170
	N	216	216	216	216	216	216
Treatment	Mean	46.3	122	41.3	-5	75.6	-80.6
	S.D.	45.7	55.8	47.8	40.5	67.2	66.8
	Median	30.5	126	23.5	-4	68	-83.5
	Min	0	0	0	-132	-105	-200
	Max	199	200	200	179	200	192
	N	218	218	218	218	218	218
Total	Mean	49.4	79.1	41.4	-8.03	29.6	-37.6
	S.D.	47.4	65.3	46.7	40.1	73.7	72.1
	Median	37	69.5	24	-4	9.5	-21.5
	Min	0	0	0	-168	-190	-200
	Max	200	200	200	179	200	192
	N	434	434	434	434	434	434

Notes: PANAS+ (PANAS + Stress + Pain) summary statistics split by treatment type. "1" refers to baseline, "3" refers to end-line. Difference refers to the difference between baseline and end-line.

Tables 1.3 and 1.4 report the results of the regressions with 10-item and 12-item negative affect. The results indicate no statistically significant difference at end-line in levels or differences between treatment and control groups. There is a marginally significant difference at baseline between groups ($p = 0.045, p = 0.048$) for both indices of negative affect.

Table 1.3: Experiment 1 - Effect of CPT on 10-Item Negative Affect

	(1) PANAS 1	(2) PANAS 3	(3) Diff	(4) PANAS 1(c)	(5) PANAS 3(c)	(6) Diff(c)
Treatment	-38.44**	-23.27	15.16	-39.43**	-26.73	12.70
	(19.10)	(19.92)	(15.78)	(19.78)	(20.43)	(16.34)
Controls	No	No	No	Yes	Yes	Yes
p-value	.045	.243	.337	.047	.191	.437
R-squared	0.181	0.161	0.117	0.229	0.212	0.177
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.4: Experiment 1 - Effect of CPT on 12-Item Negative Affect

	(1) PANAS+ 1	(2) PANAS+ 3	(3) Diff	(4) PANAS+ 1(c)	(5) PANAS+ 3(c)	(6) Diff(c)
Treatment	-44.78**	-23.66	21.13	-45.31*	-28.51	16.79
	(22.60)	(23.54)	(18.09)	(23.58)	(24.15)	(18.79)
Controls	No	No	No	Yes	Yes	Yes
p-value	.048	.316	.243	.055	.238	.372
R-squared	0.187	0.160	0.117	0.227	0.208	0.179
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

This suggests there may not be balance between groups at baseline, however, balance on demographic variables and on Stress and Pain (individually and aggregate) assuage these concerns. Regarding stress, Tables 1.5 and 1.6 indicate that the CPT was successful at manipulating stress levels among participants in the Treatment group.

Table 1.5: Experiment 1 - Effect of CPT on Stress

	(1) Stress 1	(2) Stress 2	(3) Stress 3	(4) Stress 3-1	(5) Stress 2-1	(6) Stress 3-2
Treatment	-3.676	38.72***	-2.270	1.406	42.40***	-40.99***
	(2.790)	(2.865)	(2.742)	(2.718)	(3.531)	(3.384)
Controls	No	No	No	No	No	No
p-value	.188	0	.408	.605	0	0
R-squared	0.210	0.391	0.180	0.131	0.369	0.357
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.6: Experiment 1 - Effect of CPT on Stress (Controls)

	(1) Stress 1	(2) Stress 2	(3) Stress 3	(4) Stress 3-1	(5) Stress 2-1	(6) Stress 3-2
Treatment	-3.789	38.75***	-2.906	0.883	42.54***	-41.66***
	(2.917)	(2.965)	(2.842)	(2.863)	(3.589)	(3.464)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.195	0	.307	.758	0	0
R-squared	0.253	0.422	0.209	0.180	0.433	0.403
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

The treatment effect on subjective stress levels show that the CPT increased reported stress levels by 38 points relative to those in the Control group. In differences, while the Control group stress levels fell, the Treatment group stress levels increased. The treatment effect is 42 points. Both of these results are significant at the 1-percent level ($p = 0.00$) with and without controls. Furthermore, we see similar results for both pain and stress+pain variables.

Further analysis of the data reveal insight into the null result for the 10 and 12-item negative affect. We see that the third administration of stress, pain, and stress+pain show no significant differences between Treatment and Control. This is due to a significant decline in ratings between the second and third mood assessment. It seems, then, that the effect of the CPT on negative affect was temporary and that the timing of the end-line administration was not close enough to the manipulation to measure the change in negative affect. Nevertheless, based on the strength of the results for changes in stress and pain from the midline assessment, we conclude that the CPT was successful at inducing subjective stress for Treated individuals.

Experiment 2

Table 1.7 summarize self-reported stress and pain affect for experiment 2.[17] Baseline self-reported stress and pain assessments are similar to those in experiment 1. Participants indicated a mean baseline stress of 14.3 out of 100, and a baseline pain of 33.4 out of 100. The path of stress + pain ratings for treatment and control ratings are similar to that of experiment 1. Stress + pain ratings for the treatment group rise between baseline and midline, before falling at end-line. For the control, stress + pain falls at midline and remains flat at end-line.

Table 1.7: Experiment 2 - Summary of Stress + Pain

Type	**Stat**	**S+P 1**	**S+P 2**	**S+P 3**	**S+P 3-1**	**S+P 2-1**	**S+P 3-2**
Control	Mean	44.3	26.4	33.5	-10.8	-17.8	7.04
	S.D.	43.7	33.8	41.1	36.3	41.1	37.8
	Median	31	13	14	-3	-10	0
	Min	0	0	0	-138	-138	-106
	Max	196	195	179	101	102	144
	N	117	117	117	117	117	117
Treatment	Mean	51.1	108	45	-6.03	56.6	-62.6
	S.D.	44.9	54.8	47.8	39	58.5	59
	Median	40.5	112	34	-1.5	63	-60.5
	Min	0	0	0	-132	-143	-200
	Max	180	200	191	99	200	120
	N	118	118	118	118	118	118
Total	Mean	47.7	67.2	39.3	-8.4	19.5	-27.9
	S.D.	44.3	61	44.9	37.7	62.7	60.5
	Median	40	52	19	-3	10	-11
	Min	0	0	0	-138	-143	-200
	Max	196	200	191	101	200	144
	N	235	235	235	235	235	235

Notes: PANAS+ (PANAS + Stress + Pain) summary statistics split by treatment type. "1" refers to baseline, "3" refers to end-line. Difference refers to the difference between baseline and end-line.

The results of the analysis on the effect of the CPT on negative affect are found on tables 1.8 and 1.9.

[17] See appendix for other outcome measures on affect.

Table 1.8: Experiment 2 - Effect of CPT on Stress

	(1) Stress 1	(2) Stress 2	(3) Stress 3	(4) Stress 3-1	(5) Stress 2-1	(6) Stress 3-2
Treatment	-3.676	38.72***	-2.270	1.406	42.40***	-40.99***
	(2.790)	(2.865)	(2.742)	(2.718)	(3.531)	(3.384)
Controls	No	No	No	No	No	No
p-value	.188	0	.408	.605	0	0
R-squared	0.210	0.391	0.180	0.131	0.369	0.357
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.9: Experiment 2 - Effect of CPT on Stress (Controls)

	(1) Stress 1	(2) Stress 2	(3) Stress 3	(4) Stress 3-1	(5) Stress 2-1	(6) Stress 3-2
Treatment	7.977*	38.04***	7.735*	-0.242	30.07***	-30.31***
	(4.225)	(3.579)	(4.120)	(3.722)	(4.702)	(4.416)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.06	0	.062	.948	0	0
R-squared	0.242	0.540	0.285	0.243	0.397	0.445
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Compared to experiment 1, the results are quantitatively similar. There seems to be some marginally significant different at baseline between groups when comparing the 10-item and 12-item negative affect, but stress and pain reports are largely balanced at baseline. Much as in experiment 1, we see successful manipulation of the CPT on stress and pain ratings. Measurements in levels and differences on stress and pain are significant at the 1% level ($p = 0.00$), both with and without controls.

Taken together, we see that the cold pressor task was indeed a successful stress inducer. This contrasts with the earlier work done by the authors (Haushofer et al., 2014) that indicate the stress induction method of the Trier Social Stress Test for Groups (TSST-G) was not as successful as a manipulation device for stress. Physical stress induction via immersion in ice-water proves to be a reliable method for increasing stress levels among our sample of urban poor from a developing country.

Comparison of effect sizes to related literature

Based on a two-sided t-test, we obtain estimates of effect size for our stressor to compare with the literature. For comparison we use the subject rating for stress and for stress+pain taken at mid-line. For experiment 1, the effect size (Cohen's d) of the CPT on stress+pain is 1.75, while for stress the effect size 1.31. Experiment 2 yields similar effect sizes, with stress+pain at 1.78 and stress only at 1.44. According to Cohen (1992), the Cohen's d cutoff for small, medium, and large effect sizes are 0.20, 0.50, and 0.80, respectively. This makes our measured effect sizes for our stressor very large. Using the regression model from earlier, the η^2 for stress+pain is 0.47 and 0.33 for stress (Experiment 1). Experiment 2 η^2 are 0.49 for stress+pain and 0.40 stress.

In comparison to the current literature, Porcelli and Delgado (2009) (who use the CPT as a stressor) report an effect size (Cohen's d) of 0.28 for skin conductance and 0.80 for subjective stress. Cornelisse et al. (2013) report an η^2 of 0.79 for salivary cortisol based on a hydrocortisone stressor. Pabst et al. (2013) show an η^2 of 0.29 for cortisol using the Trier Social Stress Test. Thus we see effect sizes as large as the current literature, suggesting that the stressor increased subjective stress levels to a similar degree as previous literature on stress.

1.4.2 Productivity

After confirming that the CPT was successful at increasing stress levels among participants in the Treatment group, we turn our attention to the effects of stress on productivity. Tables 1.10 and 1.11 summarize the results of the real-effort task.

Table 1.10: Experiment 1 - Summary of Productivity

Type	Stat	Correct 1	Correct 2	Correct 3	Effort 1	Effort 2	Effort 3	Acc 1	Acc 2	Acc 3
Control	Mean	14.4	14.4	15.6	16.4	16.8	17.6	.866	.842	.861
	S.D.	7.37	7.72	8.17	7.81	7.9	7.91	.193	.205	.195
	Median	13	12	13	13.5	14	16.5	.917	.9	.917
	Min	0	0	0	0	0	1	0	0	0
	Max	32	31	37	45	40	37	1	1	1
	N	216	216	216	216	216	216	215	215	216
Treatment	Mean	14.6	15	16.1	16.5	16.9	18	.857	.862	.877
	S.D.	7.63	7.45	7.98	7.48	7.42	7.98	.207	.187	.168
	Median	12	13	14	14	15.5	17	.913	.913	.923
	Min	0	0	0	2	3	5	0	0	0
	Max	32	31	35	36	32	43	1	1	1
	N	218	218	218	218	218	218	218	218	218
Total	Mean	14.5	14.7	15.8	16.5	16.8	17.8	.861	.852	.869
	S.D.	7.5	7.58	8.07	7.64	7.65	7.94	.2	.196	.182
	Median	12	12	14	14	14.5	17	.917	.909	.918
	Min	0	0	0	0	0	1	0	0	0
	Max	32	31	37	45	40	43	1	1	1
	N	434	434	434	434	434	434	433	433	434

Notes: Productivity summary statistics. 1, 2, 3, refer to piece-rate, tournament, and choice tasks respectively.

Table 1.11: Experiment 1 - Summary of Overconfidence

Type	Stat	Belief 1	Belief 2	Rank 1	Rank 2	Error 1	Error 2	Overconf 1	Overconf 2
Control	Mean	2.32	2.34	4.03	4.16	.231	.245	.736	.69
	S.D.	1.61	1.71	2.19	2.24	.274	.274	.442	.464
	Median	2	2	4	4	.25	.25	1	1
	Min	1	1	1	1	-.75	-.75	0	0
	Max	8	8	8	8	.875	.875	1	1
	N	216	216	216	216	216	216	216	216
Treatment	Mean	2.3	2.18	3.91	3.87	.213	.226	.656	.697
	S.D.	1.64	1.55	2.22	2.15	.293	.273	.476	.461
	Median	2	2	4	4	.167	.208	1	1
	Min	1	1	1	1	-.75	-.714	0	0
	Max	8	8	8	8	.875	.875	1	1
	N	218	218	218	218	218	218	218	218
Total	Mean	2.31	2.26	3.97	4.01	.222	.235	.696	.694
	S.D.	1.62	1.63	2.21	2.2	.284	.273	.461	.462
	Median	2	2	4	4	.208	.25	1	1
	Min	1	1	1	1	-.75	-.75	0	0
	Max	8	8	8	8	.875	.875	1	1
	N	434	434	434	434	434	434	434	434

Notes: Productivity summary statistics. 1, 2, refer to piece-rate, and tournament tasks respectively.

On average, participants counted roughly 15 grids correctly in the two-minute time frame with high accuracy (~86%). We see broad overall evidence of overconfidence in the effort tasks; the median participant ranked his performance as second-best in his group (of 6, 7, or 8). 70% of participants in piece-rate and tournament task rated themselves more highly than their actual performance indicates. As expected we see an effect of the level of task difficulty on the number of correct grids counted by participants. Interestingly, this seems to be driven by declines in attempts, rather than declines in accuracy. Table 1.12 models 4-6 show that among all participants, those randomly assigned to the difficult task counted 11 fewer grids and attempted

11 fewer grids, while accuracy was unchanged.

Table 1.12: Experiment 1 - Effect of CPT on Productivity Model 1

	(1) Correct	(2) Effort	(3) Accuracy	(4) Correct(c)	(5) Effort(c)	(6) Accuracy(c)
TreatmentXEasy	0.422	-0.186	0.0153	-0.0298	-0.559	0.00330
	(0.681)	(0.612)	(0.0190)	(0.590)	(0.553)	(0.0190)
TreatmentXDifficult	0.203	0.229	-0.00560	0.0888	0.120	-0.00989
	(0.378)	(0.288)	(0.0270)	(0.354)	(0.302)	(0.0247)
Difficult	-15.37***	-15.83***	-0.00864	-11.45***	-11.64***	-0.122
	(1.932)	(1.382)	(0.0645)	(1.282)	(1.268)	(0.0833)
Tournament	0.212	0.364**	-0.00925	0.212	0.364**	-0.00925
	(0.181)	(0.169)	(0.00950)	(0.183)	(0.171)	(0.00962)
Controls	No	No	No	Yes	Yes	Yes
F-statistic	.336	.361	.346	.033	.604	.097
p-value	.715	.697	.708	.967	.547	.908
F-statistic for equality	.079	.376	.4	.031	1.195	.183
p-value for equality	.779	.54	.527	.861	.275	.669
N	868	868	866	868	868	866

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

However, we see little to no evidence for the effect of stress on productivity-related outcomes. Using our preferred Model 1, Table 1.12 shows no significant relationship between stress and the number of grids counted, the number of grids attempted, nor the accuracy. This result is robust to the relaxation of session fixed effects, controls, and clustering. Model 2 and regressions on aggregated variables mirror the null results of Model 1.[18]

Considering the effect of stress on outcomes related to overconfidence, we see from Table 1.13 no overall effect on belief rank, error, nor overconfidence.

Table 1.13: Experiment 1 - Effect of CPT on Overconfidence Model 1

	(1) Belief	(2) Rank	(3) Error	(4) Overconf	(5) Belief(c)	(6) Rank(c)	(7) Error(c)	(8) Overconf(c)
TreatmentXEasy	0.0476	-0.315	-0.0555*	-0.0965**	0.189	-0.140	-0.0503	-0.0866*
	(0.181)	(0.268)	(0.0327)	(0.0468)	(0.171)	(0.242)	(0.0326)	(0.0466)
TreatmentXDifficult	-0.246	-0.0664	0.0245	0.0365	-0.241	-0.0191	0.0305	0.0345
	(0.209)	(0.277)	(0.0311)	(0.0543)	(0.184)	(0.248)	(0.0298)	(0.0547)
Difficult	0.147	-1.229	-0.133	-0.233	-0.0138	0.487	0.0648	0.0629
	(0.598)	(1.059)	(0.119)	(0.194)	(0.477)	(0.564)	(0.0888)	(0.166)
Tournament	-0.0507	0.0392	0.0129	-0.00230	-0.0507	0.0392	0.0129	-0.00230
	(0.0691)	(0.0970)	(0.0142)	(0.0261)	(0.0700)	(0.0982)	(0.0144)	(0.0264)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
F-statistic	.726	.72	1.744	2.349	1.475	.168	1.769	1.957
p-value	.484	.487	.176	.097	.23	.845	.172	.143
F-statistic for equality	1.128	.417	3.135	3.441	2.945	.126	3.46	2.92
p-value for equality	.289	.519	.077	.064	.087	.723	.064	.088
N	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

[18] For robustness and results from Model 2 see appendix section 1.7.3.

Joint testing of the treatment variables yield p-values above significant levels, except in the case of overconfidence which is marginally significant ($p = 0.097$) but not robust to the inclusion of controls. There is evidence of an effect of stress on error and overconfidence measures for participants in the "easy" group, which is robust to controls at the 10% level. Thus, it seems that among participants randomly assigned to the easy condition, those that were stressed were less likely to exhibit overconfidence.

Robustness Checks

In addition to Models 1 and 2 and the systematic relaxation of controls, clustering, and fixed effects, we test for robustness in two ways. First, we exclude the top and bottom 1% of observations (as measured by effort). This effectively excludes observations with effort below 5 and above 33 (25 of 1,302 total observations). We then re-run Models 1 and 2 on the restricted sample. We see similar results to those of the full sample.[19] Significance of the effect of stress on overconfidence among those in the easy condition is reduced slightly (without controls), but the other null results remain unchanged.

Next, we investigate the potential effect of task order. As mentioned previously, all participants completed three effort tasks under different incentive schemes (piece-rate, tournament, and choice). To control for the learning effect between rounds, we randomized on the session level the order of the piece-rate and tournament task. That is, approximately half of the participants (215/434) completed the piece-rate task before the tournament, and the other half completed the tournament before the piece-rate task.[20] Task order could be an important issue as the first effort task was closer in time to the administration of the stressor, and thus, we might see stronger effects during the first task than the second (controlling for type and difficulty).

Taking into account task order, observations can placed into one of 16 groups. That is, each observation is either in the control or treatment group, the easy or difficult group, the piece-rate task first or tournament first, and either piece-rate or tournament. We test a model with 4-way interactions and then test the effect

[19] See appendix section 1.7.3.

[20] The choice task was always administered last by design as participants needed to experience the task under the piece-rate and tournament incentive schemes before deciding which they would choose.

of stress for the 8 subgroups. This model is estimated with session fixed effects and standard errors clustered on the individual level, but without controls. We see strong effects on effort and productivity for even-numbered Types. Even numbered Types are all classified into the "difficult" task, so this is not surprising to see. The only other significant result of interest is a weakly significant relationship for overconfidence with Type 9. This precisely the same result as in Model 1, except the further restriction here that it holds for the subsample of piece-rate tasks in the group who completed that piece-rate task first.

Next we split the sample by task and run a simple regression with the treatment indicator. The result for overconfidence from the previous regression is confirmed in Table 1.14.

Table 1.14: Experiment 1 - Effect of CPT by Treatment Order (Type 1)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	0.268 (1.051)	0.807 (0.951)	-0.000835 (0.0305)	-0.0808 (0.266)	-0.532 (0.450)	-0.0621 (0.0563)	-0.151* (0.0835)
p-value	.799	.398	.978	.762	.24	.272	.074
R-squared	0.14	0.16	0.09	0.09	0.04	0.07	0.09
N	110	110	110	110	110	110	110

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

We also see a significant effect of stress on overconfidence for Type 4 (difficult tournament, piece-rate first) and Type 5 (easy piece-rate, tournament first). This further confirms our finding that stress mitigates overconfidence in self-evaluation of productivity. None of the other outcome variables are significant for any of the Types, further confirming the null result for other outcome measures.

1.4.3 Inter-temporal Choice

We now turn our attention to the effect of stress on time preference, as measured in the titration exercise in experiment 2. Summary statistics are highlighted in Table 1.15 and in the appendix.

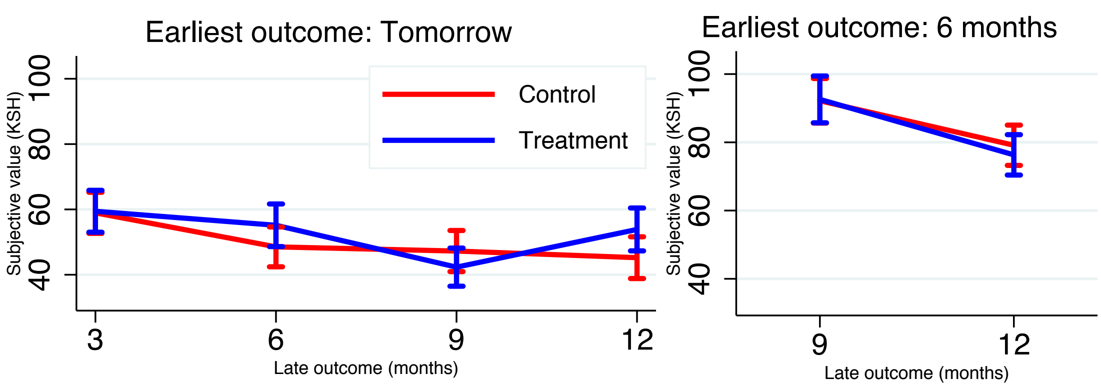
Table 1.15: Experiment 2 - Summary of risk, area under the curve, and indifference points

Type	Stat	Risk	AUC	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	3.9	69.3	58.9	48.5	47.2	45.2	92.2	79.1
	S.D.	1.9	51.2	68	65.9	68	69.1	70.7	63.9
	Median	4	49.6	28.1	15.6	9.38	9.38	96.9	90.6
	Min	1	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	6	197	197	197	197	197	197	197
	N	117	117	117	117	117	117	117	117
Treatment	Mean	3.8	71	59.4	55.1	42.3	53.9	92.6	76.3
	S.D.	1.9	50.8	69.7	70.9	63.5	71.3	74.4	64.3
	Median	4	48.4	21.9	12.5	3.13	9.38	96.9	84.4
	Min	1	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	6	197	197	197	197	197	197	197
	N	118	118	118	118	118	118	118	118
Total	Mean	3.88	70.1	59.2	51.8	44.8	49.6	92.4	77.7
	S.D.	1.88	50.9	68.7	68.4	65.7	70.2	72.4	63.9
	Median	4	49.6	21.9	15.6	9.38	9.38	96.9	90.6
	Min	1	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	6	197	197	197	197	197	197	197
	N	235	235	235	235	235	235	235	235

Notes: Non-parametric summary statistics split by treatment type. Risk refers to the raw choice between 6 gambles with 50/50 outcomes whose variance increases with the expected payoff (1 being the safest and 6 the riskiest choice). AUC refers to the area under the curve. Subsequent columns represent raw indifference points for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

Figure 1.1 graphs the indifference point for each time block, by treatment type.

Figure 1.1: Indifference points by treatment type



We see somewhat typical discounting patterns for choices with front end delays, as indifference points for 6m9m and 6m12m are much greater than 0m3m and 0m6m respectively, despite the fact that the time delay is the same. As expected, we also see a generally downward-sloping trend in time, indicating that longer delays are discounted more heavily than shorter ones. Regarding the effect of stress on time preference, tables 1.16 and 1.17 report the results from Model 1 and 2, respectively.

Table 1.16: Experiment 2 - Effect of CPT on Time Preference

	(1) Indiff	(2) Fract	(3) Exp k	(4) Hyp k	(5) Indiff(c)	(6) Fract(c)	(7) Exp k(c)	(8) Hyp k(c)
Treatment	0.767	-0.00222	0.154	5.225	2.345	-0.00124	0.228	7.359
	(6.280)	(0.0324)	(0.367)	(6.411)	(6.362)	(0.0325)	(0.370)	(6.456)
0m vs. 6m	-7.340*	-0.0390**	-3.952***	-41.01***	-7.340*	-0.0390**	-3.952***	-41.01***
	(3.860)	(0.0187)	(0.329)	(5.773)	(3.893)	(0.0189)	(0.331)	(5.822)
0m vs. 9m	-14.41***	-0.0667***	-5.342***	-56.14***	-14.41***	-0.0667***	-5.342***	-56.14***
	(4.132)	(0.0198)	(0.369)	(6.523)	(4.168)	(0.0200)	(0.372)	(6.578)
0m vs. 12m	-9.628**	-0.0589***	-6.283***	-67.26***	-9.628**	-0.0589***	-6.283***	-67.26***
	(4.197)	(0.0203)	(0.376)	(6.617)	(4.233)	(0.0205)	(0.379)	(6.673)
6m vs. 9m	33.19***	0.138***	-2.849***	-36.04***	33.19***	0.138***	-2.849***	-36.04***
	(5.236)	(0.0245)	(0.452)	(7.565)	(5.280)	(0.0247)	(0.456)	(7.629)
6m vs. 12m	18.54***	0.0929***	-5.576***	-65.63***	18.54***	0.0929***	-5.576***	-65.63***
	(4.910)	(0.0258)	(0.400)	(7.066)	(4.952)	(0.0260)	(0.403)	(7.126)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.903	.946	.675	.416	.713	.97	.538	.256
R-squared	0.160	0.145	0.254	0.152	0.217	0.208	0.295	0.198
N	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.17: Experiment 2 - Effect of CPT on Time Preference Model 2

	(1) Indiff	(2) Fract	(3) Exp k	(4) Hyp k	(5) Indiff(c)	(6) Fract(c)	(7) Exp k(c)	(8) Hyp k(c)
Treatment	-0.152	0.00000505	0.437	14.89	1.425	0.000982	0.511	17.03
	(8.585)	(0.0431)	(0.821)	(14.44)	(8.597)	(0.0430)	(0.814)	(14.36)
0m vs. 6m	-10.42**	-0.0399	-3.663***	-33.37***	-10.42**	-0.0399	-3.663***	-33.37***
	(5.226)	(0.0245)	(0.450)	(7.863)	(5.271)	(0.0248)	(0.454)	(7.930)
0m vs. 9m	-11.70**	-0.0527**	-5.241***	-51.67***	-11.70**	-0.0527*	-5.241***	-51.67***
	(5.543)	(0.0267)	(0.499)	(8.846)	(5.590)	(0.0269)	(0.503)	(8.922)
0m vs. 12m	-13.73**	-0.0641**	-6.006***	-60.10***	-13.73**	-0.0641**	-6.006***	-60.10***
	(6.202)	(0.0291)	(0.532)	(9.317)	(6.255)	(0.0294)	(0.537)	(9.397)
6m vs. 9m	33.23***	0.137***	-2.791***	-31.94***	33.23***	0.137***	-2.791***	-31.94***
	(7.540)	(0.0363)	(0.672)	(11.37)	(7.604)	(0.0366)	(0.678)	(11.47)
6m vs. 12m	20.19***	0.0926**	-5.448***	-59.89***	20.19***	0.0926**	-5.448***	-59.89***
	(7.571)	(0.0375)	(0.577)	(10.01)	(7.636)	(0.0378)	(0.582)	(10.10)
Treat x 0m6m	6.126	0.00175	-0.576	-15.21	6.126	0.00175	-0.576	-15.21
	(7.721)	(0.0375)	(0.657)	(11.52)	(7.788)	(0.0378)	(0.663)	(11.62)
Treat x 0m9m	-5.409	-0.0278	-0.202	-8.910	-5.409	-0.0278	-0.202	-8.910
	(8.268)	(0.0397)	(0.739)	(13.05)	(8.339)	(0.0400)	(0.745)	(13.16)
Treat x 0m12m	8.167	0.0104	-0.552	-14.28	8.167	0.0104	-0.552	-14.28
	(8.396)	(0.0407)	(0.752)	(13.22)	(8.468)	(0.0410)	(0.758)	(13.34)
Treat x 6m9m	-0.0697	0.00167	-0.115	-8.175	-0.0697	0.00167	-0.115	-8.175
	(10.49)	(0.0491)	(0.906)	(15.16)	(10.58)	(0.0495)	(0.914)	(15.29)
Treat x 6m12m	-3.296	0.000628	-0.254	-11.43	-3.296	0.000628	-0.254	-11.43
	(9.843)	(0.0517)	(0.801)	(14.14)	(9.928)	(0.0521)	(0.808)	(14.26)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
F-statistic	.791	.23	.806	.769	.774	.224	.796	.844
p-value	.578	.967	.566	.595	.591	.969	.574	.537
R-squared	0.161	0.146	0.254	0.153	0.218	0.208	0.295	0.199
N	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

We see no effect of stress on any of the non-parametric or calculated time preference outcome variables. As a robustness check, we test model 1 using the 12 permutations of fixed-effects, clustering, and controls.[21] These results verify our claim of no effect of stress on inter-temporal choice. Turning to the calculated indices for decreasing impatience and departure from stationarity, tables 1.18 and 1.19 indicate no results for either index, whether calculated with the exponential or hyperbolic growth parameter.

Table 1.18: Experiment 2 - Effect of CPT on DI / DS (Exponential)

	(1) DI-1(exp)	(2) DI-2(exp)	(3) DS-1(exp)	(4) DS-2(exp)	(5) DI-1(exp)(c)	(6) DI-2(exp)(c)	(7) DS-1(exp)(c)	(8) DS-2(exp)(c)
Treatment	-0.0262	-0.0349	0.596	0.707	-0.274	-0.690	0.0517	-0.150
	(0.313)	(0.346)	(0.639)	(0.681)	(0.438)	(0.482)	(0.863)	(0.890)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.933	.92	.352	.3	.532	.154	.952	.867
R-squared	0.184	0.238	0.182	0.316	0.246	0.335	0.219	0.336
N	235	235	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.19: Experiment 2 - Effect of CPT on DI / DS (Hyperbolic)

	(1) DI-1(hyp)	(2) DI-2(hyp)	(3) DS-1(hyp)	(4) DS-2(hyp)	(5) DI-1(hyp)(c)	(6) DI-2(hyp)(c)	(7) DS-1(hyp)(c)	(8) DS-2(hyp)(c)
Treatment	-1.233	-0.132	15.77	17.18	-3.340	-8.534	7.237	5.135
	(5.704)	(6.317)	(11.26)	(11.85)	(7.543)	(8.409)	(14.36)	(15.17)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.829	.983	.163	.149	.658	.311	.615	.735
R-squared	0.171	0.237	0.171	0.292	0.261	0.333	0.224	0.316
N	235	235	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

We show evidence that there is no effect of stress (induced via the CPT) on inter-temporal choice among the urban poor in Kenya. This is, to our knowledge, the best evidence we have of the effect of stress on inter-temporal choice in the developing world. We see that unlike results in the developed world that show an effect of various stressors on time preference, results are not necessarily generalizable to non-standard subject pools from developing countries. Certainly the nuance in both stress induction and time preference task could be partial explanations for the discrepancy in findings, a full discussion follows in the next section.

1.4.4 Risk Preference

We find no significant difference in the amount invested in the Gneezy and Potter risk preference task. Likewise, we see no difference in raw choices or implied risk-aversion coefficients between stress and non-

[21] See appendix section 1.8.3.

stressed individuals in experiment 2 (appendix section 1.8.3). As with the other analyses presented, this result is robust to the inclusion of demographic controls.

1.5 Discussion

As outlined previously, a growing body of literature suggests an effect of stress on economic choice. Evidence for this link was derived from experiments conducted with standard samples, that is samples comprised of participants from western, educated, industrialized, and rich societies. Interestingly, the results of the two experiments on the effect of stress on economic choice at hand starkly contrast with these previous findings, as no effect of stress on economic choice was found. More precisely, no stress effects were found for productivity, effort, time or risk preference. This may be due to the fact that these experiments were conducted with a non-standard sample, that is poor participants from the developing part of the world, who might be less sensitive to stress as a result of having lived under adverse conditions all their lives. From this it is concluded that generalizations of stress effects on economic choice from standard samples to non-standard samples, such as the one at hand, should be made with caution.

Manipulation checks suggest a successful manipulation of stress levels, as statistically significant differences were found in subjective ratings of stress and pain between the treatment and the control group in both experiments. The primary finding of experiment 1 was that there is little to no evidence for an effect of stress on productivity-related outcomes. This result was robust to relaxation of session fixed effects, controls and clustering. Further testing under a second model mirrored this null-result. The primary finding of experiment 2 was that neither non-parametric nor calculated time preference outcome variables showed an effect of stress on time preference. This claim was verified by robustness checks. Furthermore, stress did not have an effect on risk preference.

1.5.1 Post-hoc explanations

A potential overarching explanation for these null results could be a lower degree of sensitivity towards stress amongst participants from this sample, than amongst participants of standard samples. This could be a result of having lived under adverse conditions throughout one's life, as for instance, when having lived in informal settlements. These are characterized by inadequate access to safe water, inadequate access to sanitation and other infrastructure, poor structural quality of housing, overcrowding and insecure residential status (Habitat, 2003). Previous research lends support to this post-hoc explanation as it suggests that successful engagement with adversity steels people rather than sensitizing them (Pellegrini, 1990; Rutter, 1985).

While manipulation checks on subjective ratings of stress and pain suggest that the manipulation was successful, it remains to be tested whether the manipulation also lead to the desired physiological stress response, that is an activation of the HPA-axis, which would have been necessary in order for stress to affect behavior. Thus, the lack of recruiting the mechanism that should have lead to a physiological stress reaction could be an alternative explanation of these null results. This would then suggest that the CPT is not a viable method for the induction of stress in a controlled setting for poor participants from the developing part of the world.

Yet another explanation for these null results could be the chosen interval between the CPT and the economic tasks, that is the productivity, time and risk preference tasks. It was decided to set the interval to 5-15 minutes, as each experiment already lasted between 1.5-2hrs and a certain number of sessions needed to be conducted within a certain period of time in order to achieve a sample size big enough to acquire an adequate level of testing power. Thus, increasing the interval would have lowered the sample size. Nonetheless, in hindsight, the interval between the stressor and the tasks should have been extended to 20-30 minutes, as previous research with a similar, yet extended cold pressor test, showed that cortisol reaches its peak levels in response to this test after 20-30 minutes (Schwabe et al., 2008). Hence, the chosen interval may have been to short to capture the effect of stress on economic choice. However, this explanation rests at odds with our manipulation checks that show subjective levels of stress and pain falling significantly between mid-line and end-line, with no statistically significant differences between the treatment and control group at the end-line administration.

1.5.2 Generalizability of findings

Given the demand for studies conducted with poor participants from developing countries, both of these experiments were conducted with samples of urban poor from Nairobi, Kenya. In this sense, we can gain a better understanding of the ways stress may manifest itself into economic behavior, particularly for the poor. Nonetheless, threats to external validity also exist for this study, which may limit its degree of generalizability. One problem encountered when generalizing the results to the population of poor participants from Kenya is that potential differences exist between the accessed sample and the target population. One aim of this study was to collect data that can be generalized to the majority of poor participants from Kenya, but limited health screenings might have lead to the inclusion of participants with poor health, more precisely, it may have led to the inclusion of participants with chronic diseases and burdens such as hypertension, diabetes, asthma, chronic squelae, and mental illnesses, as these are common amongst those living in informal settlements (Riley et al., 2007). Likewise, it needs to mentioned that the effect of acute stress on economic choice was investigated and the question is whether this is viable in the attempt of understanding the impact of stress on the economic choices of poor people, as they are subject to chronic rather than acute stress, given the existential fears one faces when living in poverty.

1.6 Conclusion

The relationship between stress and economic decision-making is, to this point, not well understood. Certainly not among poor subjects or those from the developing world. However, understanding this relationship is important as there is evidence that stress and poverty are closely linked. Understanding if stress can create a feedback loop with poverty through sub-optimal decision-making can help to unpack the mechanisms through which poverty perpetuates. To investigate this phenomena, we conducted a pair of experiments to test the effect of stress on productivity, risk and time preference. We randomly allocated subjects from informal settlements around Nairobi, Kenya to stressful (treatment) and non-stressful (control) groups and induce stress via the Cold Pressor Task, a frequently studied and validated stress induction method. Following stress induction, subjects participated in a number of tasks meant to measure productivity, effort, overconfidence, risk preference, and inter-temporal choice. This is, to our knowledge, the largest study of its kind conducted in the developing world.

We find no effect of stress on productivity, risk preference, or time preference. This is in spite of evidence that the Cold Pressor manipulation was successful at inducing stress. This null result is robust to different econometric specifications and the relaxing of control variables. We discuss potential explanations for the divergence between our results and those that show significant relationships between stress and decision-making - primarily that our experiment utilizes a sample of urban poor that is significantly different than the WEIRD participants in most other studies, and that those living under chronic poverty are more resilient to stress than their relatively rich counterparts.

Although we find no evidence for a relationship between stress and economic choice in this context, we realize that our subject pool, choice of stressor, type of stress induced, and tasks for measuring economic choice are a but a small subset of the possible combinations that could be tested. Future studies should continue to push the boundaries in choosing samples from a variety of socio-economic backgrounds, use stressors that activate different types of stressful states (including chronic stress), and investigate a wide variety of tests to measure economic and social choice.

Improving our understanding of the economic choice of the poor is important, as it can inform the design of poverty alleviation interventions and make them more effective. These are needed as urban poverty is expected to increase worldwide over the next two decades, particularly in developing countries. Knowledge gained from the manipulation of a variable that may influence economic choices in real-life improves our ability to make generalizations from the laboratory to real-life situations, increasing the likelihood to develop tools, theories, and interventions, which counteract this lingering global problem more effectively.

1.7 Appendix: Experiment 1 - Effect of stress on productivity

1.7.1 Figures

Figure 1.2: Total number of grids counted by Treatment and task difficulty

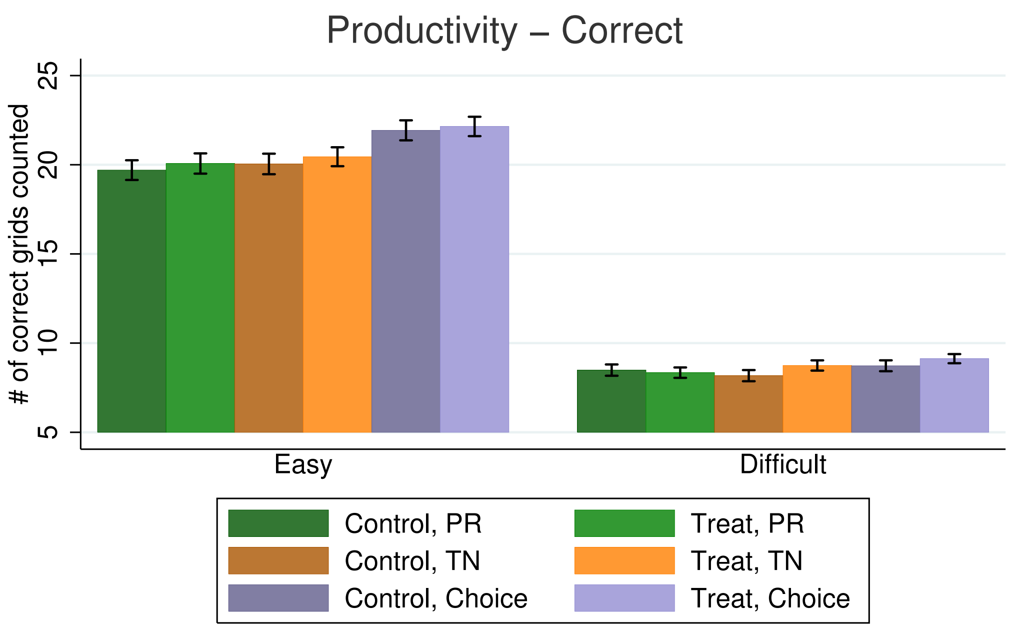


Figure 1.3: Total number of grids attempted by Treatment and task difficulty

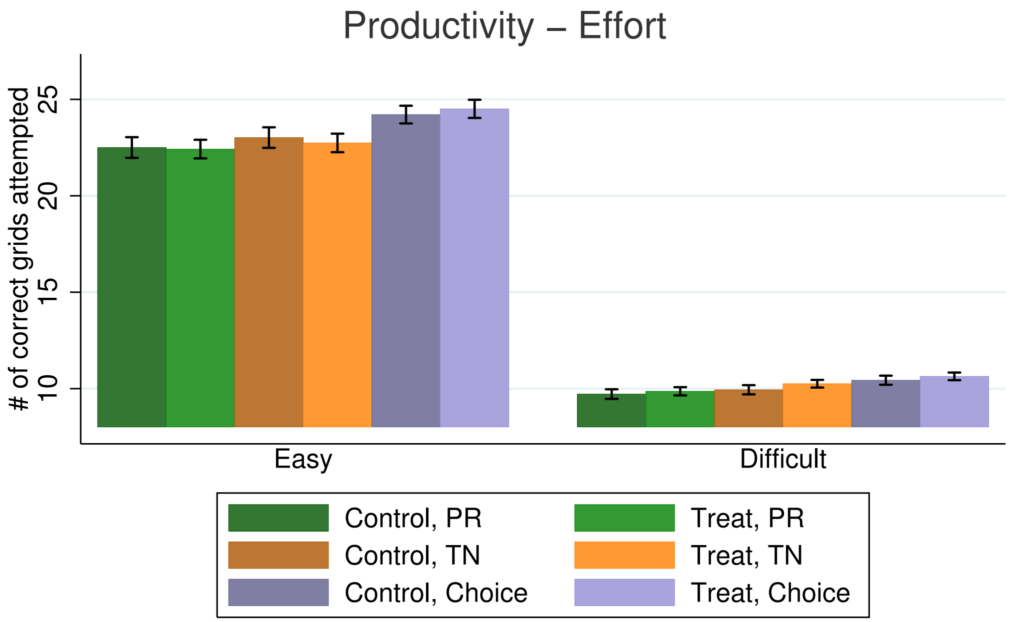
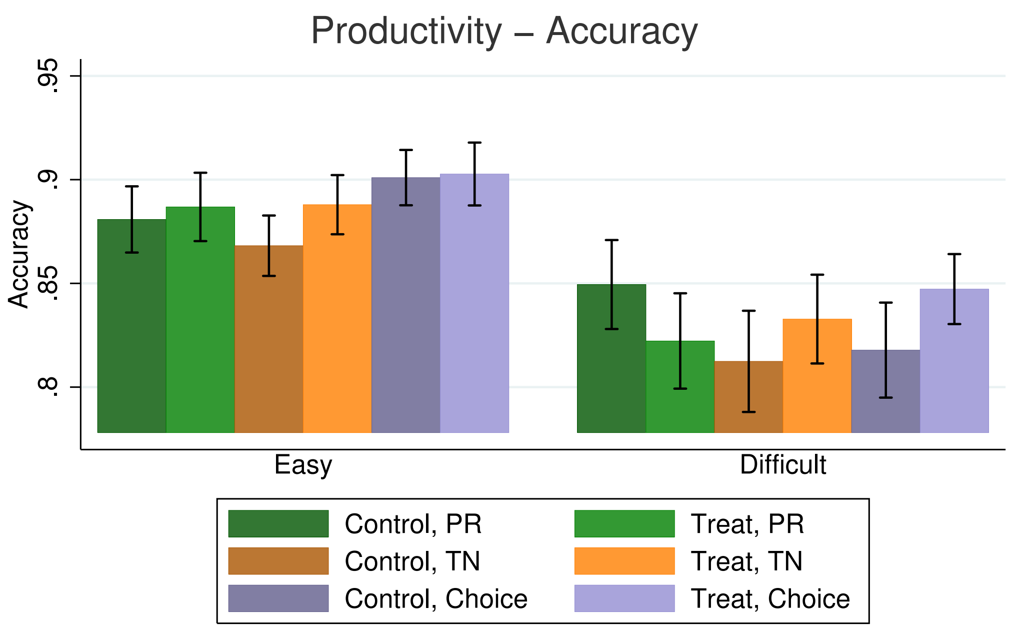


Figure 1.4: Total accuracy by Treatment and task difficulty



1.7.2 Summary Tables

Treatment type overview

Table 1.20: Experiment 1 - Overview of Treatment Groups

Task Difficulty	**Treatment Type**		
	Control	**Treatment**	**Total**
	No.	No.	No.
Easy	113	116	229
Difficult	103	102	205
Total	216	218	434

Notes:

Negative affect

Table 1.21: Experiment 1 - Summary of PANAS (Negative Affect)

Type	Stat	PANAS 1	PANAS 3	Difference
Control	Mean	252	202	-50.2
	S.D.	217	218	162
	Median	195	125	-39
	Min	0	0	-525
	Max	974	914	491
	N	216	216	216
Treatment	Mean	213	181	-32.4
	S.D.	186	198	163
	Median	169	110	-32.5
	Min	0	0	-640
	Max	913	950	569
	N	218	218	218
Total	Mean	232	191	-41.3
	S.D.	203	208	163
	Median	176	114	-35
	Min	0	0	-640
	Max	974	950	569
	N	434	434	434

Notes: 10-item Negative Affect summary statistics split by treatment type. "1" refers to baseline, "3" refers to end-line. Difference refers to the difference between baseline and end-line.

Table 1.22: Experiment 1 - Summary of PANAS + Stress + Pain

Type	Stat	PANAS+ 1	PANAS+ 3	Difference
Control	Mean	305	243	-61.3
	S.D.	258	254	184
	Median	240	168	-51
	Min	0	0	-625
	Max	1161	1094	595
	N	216	216	216
Treatment	Mean	259	222	-37.4
	S.D.	222	239	191
	Median	206	139	-39
	Min	0	0	-735
	Max	1111	1150	748
	N	218	218	218
Total	Mean	282	233	-49.3
	S.D.	241	247	187
	Median	228	150	-46.5
	Min	0	0	-735
	Max	1161	1150	748
	N	434	434	434

Notes: PANAS+ (PANAS + Stress + Pain) summary statistics split by treatment type. "1" refers to baseline, "3" refers to end-line. Difference refers to the difference between baseline and end-line.

Table 1.23: Experiment 1 - Summary of Self Reported Stress

Type	Stat	Stress 1	Stress 2	Stress 3	Stress 3-1	Stress 2-1	Stress 3-2
Control	Mean	15.9	14.3	12.3	-3.61	-1.58	-2.03
	S.D.	25.8	20.7	22.7	21.8	25.8	26
	Median	0	7	0	0	0	0
	Min	0	0	0	-97	-100	-100
	Max	100	100	100	83	95	100
	N	216	216	216	216	216	216
Treatment	Mean	13.5	62.1	14.6	1.11	48.6	-47.5
	S.D.	24.2	31.8	25.5	20.8	37.1	38.1
	Median	0	69	0	0	50.5	-50.5
	Min	0	0	0	-90	-50	-100
	Max	99	100	100	83	100	92
	N	218	218	218	218	218	218
Total	Mean	14.7	38.3	13.5	-1.24	23.6	-24.9
	S.D.	25	35.9	24.1	21.4	40.6	39.8
	Median	0	29	0	0	11	-12.5
	Min	0	0	0	-97	-100	-100
	Max	100	100	100	83	100	100
	N	434	434	434	434	434	434

Notes: Self-reported stress ratings. 1, 2, 3, refer to the baseline, midline and end-line measures, respectively. 2-1, 3-1, 3-2, refer to differences in the measures at baseline, midline and end-line.

Table 1.24: Experiment 1 - Summary of Self Reported Pain

Type	Stat	Pain 1	Pain 2	Pain 3	Pain 3-1	Pain 2-1	Pain 3-2
Control	Mean	36.7	21.4	29.2	-7.48	-15.2	7.75
	S.D.	30.4	26.5	30	27.9	31.1	31
	Median	30	10	20	-2	-10	3
	Min	0	0	0	-100	-100	-100
	Max	100	100	100	79	98	95
	N	216	216	216	216	216	216
Treatment	Mean	32.9	59.8	26.7	-6.11	27	-33.1
	S.D.	29.9	31.8	28.4	29.2	41.4	38.8
	Median	25.5	65.5	17	-4.5	21.5	-34.5
	Min	0	0	0	-100	-76	-100
	Max	100	100	100	100	100	100
	N	218	218	218	218	218	218
Total	Mean	34.7	40.7	28	-6.79	5.98	-12.8
	S.D.	30.2	35	29.2	28.6	42.2	40.6
	Median	29	35.5	18	-3	0	-3
	Min	0	0	0	-100	-100	-100
	Max	100	100	100	100	100	100
	N	434	434	434	434	434	434

Notes: Self-reported pain ratings. 1, 2, 3, refer to the baseline, midline and end-line measures, respectively. 2-1, 3-1, 3-2, refer to differences in the measures at baseline, midline and end-line.

1.7.3 Regressions

Effect of stress on negative affect

Table 1.25: Experiment 1 - Effect of CPT on Stress + Pain

	(1) P+S 1	(2) P+S 2	(3) P+S 3	(4) P+S 3-1	(5) P+S 2-1	(6) P+S 3-2
Treatment	-6.348	86.20***	-0.381	5.968	92.54***	-86.58***
	(4.402)	(4.846)	(4.447)	(3.761)	(5.629)	(5.534)
Controls	No	No	No	No	No	No
p-value	.15	0	.932	.113	0	0
R-squared	0.203	0.510	0.160	0.156	0.493	0.460
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.26: Experiment 1 - Effect of CPT on Stress + Pain (Controls)

	(1) P+S 1	(2) P+S 2	(3) P+S 3	(4) P+S 3-1	(5) P+S 2-1	(6) P+S 3-2
Treatment	-5.872	85.87***	-1.778	4.095	91.74***	-87.64***
	(4.722)	(5.027)	(4.564)	(3.931)	(5.770)	(5.708)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.214	0	.697	.298	0	0
R-squared	0.221	0.538	0.194	0.218	0.538	0.501
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.27: Experiment 1 - Effect of CPT on Pain

	(1) Pain 1	(2) Pain 2	(3) Pain 3	(4) Pain 3-1	(5) Pain 2-1	(6) Pain 3-2
Treatment	-2.673	47.47***	1.889	4.562**	50.15***	-45.59***
	(2.377)	(2.630)	(2.352)	(2.061)	(3.132)	(3.132)
Controls	No	No	No	No	No	No
p-value	.261	0	.422	.027	0	0
R-squared	0.163	0.519	0.138	0.162	0.482	0.438
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.28: Experiment 1 - Effect of CPT on Pain (Controls)

	(1) Pain 1	(2) Pain 2	(3) Pain 3	(4) Pain 3-1	(5) Pain 2-1	(6) Pain 3-2
Treatment	-2.083	47.12***	1.129	3.212	49.20***	-45.99***
	(2.558)	(2.759)	(2.439)	(2.173)	(3.237)	(3.279)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.416	0	.644	.14	0	0
R-squared	0.182	0.544	0.180	0.223	0.515	0.473
N	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Effect of stress on productivity, overconfidence and risk

Table 1.29: Experiment 1 - Effect of CPT on Aggregate Variables

	(1) Total Correct	(2) Total Effort	(3) Total Accuracy	(4) Risk	(5) Total Correct(c)	(6) Total Effort(c)	(7) Total Accuracy(c)	(8) Risk(c)
Treatment	0.944	0.283	0.0114	-1.350	0.0215	-0.498	0.00218	-1.788
	(1.236)	(1.050)	(0.0163)	(1.312)	(1.112)	(0.982)	(0.0158)	(1.363)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.445	.788	.484	.304	.985	.613	.89	.19
R-squared	0.715	0.797	0.133	0.185	0.792	0.842	0.286	0.233
N	434	434	434	434	434	434	434	434

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Robustness checks - clustering, session fixed-effects, and controls

Table 1.30: Experiment 1 - Effect of CPT on Correct Tables (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	0.387	0.422	0.0665	-0.0298	0.387	0.422	0.0665	-0.0298	0.387	0.422	0.0665	-0.0298
	(0.556)	(0.524)	(0.506)	(0.472)	(0.733)	(0.681)	(0.649)	(0.590)	(0.817)	(0.867)	(0.751)	(0.749)
TreatmentXDifficult	0.214	0.203	0.0788	0.0888	0.214	0.203	0.0788	0.0888	0.214	0.203	0.0788	0.0888
	(0.302)	(0.299)	(0.292)	(0.286)	(0.387)	(0.378)	(0.368)	(0.354)	(0.373)	(0.396)	(0.365)	(0.390)
Difficult	-11.54***	-15.37***	-11.80***	-11.45***	-11.54***	-15.37***	-11.80***	-11.45***	-11.54***	-15.37***	-11.80***	-11.45***
	(0.457)	(1.535)	(0.419)	(1.167)	(0.599)	(1.932)	(0.538)	(1.282)	(0.678)	(0.477)	(0.568)	(0.587)
Tournament	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212
	(0.326)	(0.311)	(0.290)	(0.278)	(0.175)	(0.181)	(0.177)	(0.183)	(0.185)	(0.191)	(0.188)	(0.194)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	.493	.554	.044	.051	.292	.336	.028	.033	.277	.25	.026	.027
p-value	.611	.575	.957	.951	.747	.715	.973	.967	.759	.78	.974	.973
F-statistic for equality	.075	.131	0	.047	.044	.079	0	.031	.037	.053	0	.021
p-value for equality	.785	.718	.983	.828	.835	.779	.987	.861	.848	.820	.988	.887
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.31: Experiment 1 - Effect of CPT on Effort (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	-0.179	-0.186	-0.439	-0.559	-0.179	-0.186	-0.439	-0.559	-0.179	-0.186	-0.439	-0.559
	(0.508)	(0.483)	(0.472)	(0.450)	(0.657)	(0.612)	(0.595)	(0.553)	(0.777)	(0.826)	(0.769)	(0.790)
TreatmentXDifficult	0.229	0.229	0.0942	0.120	0.229	0.229	0.0942	0.120	0.229	0.229	0.0942	0.120
	(0.225)	(0.221)	(0.240)	(0.233)	(0.298)	(0.288)	(0.317)	(0.302)	(0.282)	(0.304)	(0.338)	(0.366)
Difficult	-12.93***	-15.83***	-13.09***	-11.64***	-12.93***	-15.83***	-13.09***	-11.64***	-12.93***	-15.83***	-13.09***	-11.64***
	(0.415)	(1.110)	(0.388)	(1.034)	(0.536)	(1.382)	(0.499)	(1.268)	(0.618)	(0.440)	(0.571)	(0.596)
Tournament	0.364	0.364	0.364	0.364	0.364**	0.364**	0.364**	0.364**	0.364*	0.364	0.364	0.364
	(0.288)	(0.275)	(0.266)	(0.255)	(0.163)	(0.169)	(0.166)	(0.171)	(0.216)	(0.223)	(0.219)	(0.226)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	.577	.61	.519	.93	.332	.361	.322	.604	.356	.308	.217	.333
p-value	.562	.544	.595	.395	.717	.697	.725	.547	.702	.736	.805	.718
F-statistic for equality	.538	.611	1.035	1.854	.32	.376	.639	1.195	.243	.223	.431	.663
p-value for equality	.464	.435	.309	.174	.572	.54	.425	.275	.624	.639	.514	.419
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.32: Experiment 1 - Effect of CPT on Accuracy (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	0.0129	0.0153	0.00436	0.00330	0.0129	0.0153	0.00436	0.00330	0.0129	0.0153	0.00436	0.00330
	(0.0153)	(0.0150)	(0.0157)	(0.0151)	(0.0197)	(0.0190)	(0.0201)	(0.0190)	(0.0187)	(0.0197)	(0.0195)	(0.0195)
TreatmentXDifficult	-0.00341	-0.00560	-0.00726	-0.00989	-0.00341	-0.00560	-0.00726	-0.00989	-0.00341	-0.00560	-0.00726	-0.00989
	(0.0226)	(0.0226)	(0.0213)	(0.0213)	(0.0273)	(0.0270)	(0.0251)	(0.0247)	(0.0273)	(0.0288)	(0.0234)	(0.0242)
Difficult	-0.0436**	-0.00864	-0.0509***	-0.122*	-0.0436*	-0.00864	-0.0509**	-0.122	-0.0436*	-0.00864	-0.0509**	-0.122***
	(0.0195)	(0.0538)	(0.0187)	(0.0656)	(0.0233)	(0.0645)	(0.0218)	(0.0833)	(0.0222)	(0.0216)	(0.0204)	(0.0310)
Tournament	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925	-0.00925
	(0.0134)	(0.0131)	(0.0125)	(0.0123)	(0.00918)	(0.00950)	(0.00931)	(0.00962)	(0.00965)	(0.00998)	(0.00978)	(0.0101)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	.366	.552	.099	.134	.222	.346	.067	.097	.245	.318	.071	.096
p-value	.694	.576	.906	.874	.801	.708	.935	.908	.783	.729	.931	.908
F-statistic for equality	.358	.592	.196	.261	.235	.4	.134	.183	.242	.358	.142	.176
p-value for equality	.55	.442	.658	.61	.628	.527	.714	.669	.624	.552	.708	.676
N	866	866	866	866	866	866	866	866	866	866	866	866

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.33: Experiment 1 - Effect of CPT on Belief (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	0.0621	0.0476	0.184	0.189	0.0621	0.0476	0.184	0.189	0.0621	0.0476	0.184	0.189
	(0.142)	(0.141)	(0.138)	(0.136)	(0.184)	(0.181)	(0.174)	(0.171)	(0.179)	(0.189)	(0.168)	(0.178)
TreatmentXDifficult	-0.244	-0.246	-0.210	-0.241	-0.244	-0.246	-0.210	-0.241	-0.244	-0.246	-0.210	-0.241
	(0.170)	(0.167)	(0.156)	(0.153)	(0.215)	(0.209)	(0.192)	(0.184)	(0.204)	(0.211)	(0.170)	(0.174)
Difficult	0.485***	0.147	0.517***	-0.0138	0.485**	0.147	0.517***	-0.0138	0.485**	0.147	0.517***	-0.0138
	(0.160)	(0.519)	(0.150)	(0.379)	(0.204)	(0.598)	(0.187)	(0.477)	(0.190)	(0.142)	(0.165)	(0.183)
Tournament	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507	-0.0507
	(0.110)	(0.108)	(0.101)	(0.0996)	(0.0668)	(0.0691)	(0.0678)	(0.0700)	(0.0609)	(0.0630)	(0.0618)	(0.0639)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	1.133	1.135	1.813	2.222	.705	.726	1.159	1.475	.78	.707	1.377	1.546
p-value	.323	.322	.164	.109	.494	.484	.315	.23	.463	.497	.261	.222
F-statistic for equality	1.917	1.796	3.614	4.443	1.177	1.128	2.315	2.945	1.278	1.07	2.746	3.031
p-value for equality	.167	.181	.058	.035	.279	.289	.129	.087	.263	.305	.103	.087
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.34: Experiment 1 - Effect of CPT on Rank (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	-0.326	-0.315	-0.193	-0.140	-0.326	-0.315	-0.193	-0.140	-0.326	-0.315	-0.193	-0.140
	(0.204)	(0.211)	(0.192)	(0.197)	(0.261)	(0.268)	(0.238)	(0.242)	(0.336)	(0.350)	(0.297)	(0.303)
TreatmentXDifficult	-0.0744	-0.0664	-0.0366	-0.0191	-0.0744	-0.0664	-0.0366	-0.0191	-0.0744	-0.0664	-0.0366	-0.0191
	(0.218)	(0.223)	(0.206)	(0.207)	(0.274)	(0.277)	(0.251)	(0.248)	(0.301)	(0.315)	(0.285)	(0.293)
Difficult	-0.358*	-1.229	-0.235	0.487	-0.358	-1.229	-0.235	0.487	-0.358	-1.229***	-0.235	0.487*
	(0.213)	(0.828)	(0.199)	(0.516)	(0.277)	(1.059)	(0.253)	(0.564)	(0.251)	(0.236)	(0.224)	(0.287)
Tournament	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392	0.0392
	(0.149)	(0.152)	(0.136)	(0.138)	(0.0937)	(0.0970)	(0.0950)	(0.0982)	(0.0377)	(0.0390)	(0.0382)	(0.0395)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	1.329	1.165	.518	.255	.814	.72	.335	.168	.501	.428	.216	.108
p-value	.265	.312	.596	.775	.444	.487	.716	.845	.609	.654	.807	.898
F-statistic for equality	.707	.66	.315	.183	.44	.417	.21	.126	.31	.279	.151	.085
p-value for equality	.401	.417	.575	.669	.507	.519	.647	.723	.58	.599	.699	.771
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.35: Experiment 1 - Effect of CPT on Error (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	-0.0580**	-0.0555**	-0.0567**	-0.0503*	-0.0580*	-0.0555*	-0.0567*	-0.0503	-0.0580	-0.0555	-0.0567*	-0.0503
	(0.0260)	(0.0265)	(0.0264)	(0.0268)	(0.0324)	(0.0327)	(0.0325)	(0.0326)	(0.0353)	(0.0367)	(0.0336)	(0.0338)
TreatmentXDifficult	0.0238	0.0245	0.0238	0.0305	0.0238	0.0245	0.0238	0.0305	0.0238	0.0245	0.0238	0.0305
	(0.0269)	(0.0271)	(0.0269)	(0.0267)	(0.0314)	(0.0311)	(0.0310)	(0.0298)	(0.0344)	(0.0355)	(0.0328)	(0.0341)
Difficult	-0.113***	-0.133	-0.102***	0.0648	-0.113***	-0.133	-0.102***	0.0648	-0.113***	-0.133***	-0.102***	0.0648*
	(0.0259)	(0.112)	(0.0268)	(0.0757)	(0.0315)	(0.119)	(0.0325)	(0.0888)	(0.0287)	(0.0255)	(0.0286)	(0.0349)
Tournament	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129	0.0129
	(0.0187)	(0.0189)	(0.0184)	(0.0184)	(0.0137)	(0.0142)	(0.0139)	(0.0144)	(0.00882)	(0.00912)	(0.00894)	(0.00925)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	2.874	2.592	2.746	2.458	1.888	1.744	1.868	1.769	1.59	1.379	1.804	1.588
p-value	.057	.076	.065	.086	.153	.176	.156	.172	.213	.26	.174	.213
F-statistic for equality	4.778	4.441	4.672	4.652	3.284	3.135	3.33	3.46	2.754	2.45	3.212	3.002
p-value for equality	.029	.035	.031	.031	.071	.077	.069	.064	.102	.123	.078	.088
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.36: Experiment 1 - Effect of CPT on Overconfidence (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TreatmentXEasy	-0.102**	-0.0965**	-0.0975**	-0.0866**	-0.102**	-0.0965**	-0.0975**	-0.0866*	-0.102**	-0.0965*	-0.0975**	-0.0866*
	(0.0408)	(0.0412)	(0.0415)	(0.0419)	(0.0472)	(0.0468)	(0.0475)	(0.0466)	(0.0500)	(0.0514)	(0.0475)	(0.0470)
TreatmentXDifficult	0.0356	0.0365	0.0249	0.0345	0.0356	0.0365	0.0249	0.0345	0.0356	0.0365	0.0249	0.0345
	(0.0474)	(0.0478)	(0.0485)	(0.0489)	(0.0549)	(0.0543)	(0.0555)	(0.0547)	(0.0653)	(0.0673)	(0.0640)	(0.0668)
Difficult	-0.166***	-0.233	-0.150***	0.0629	-0.166***	-0.233	-0.150***	0.0629	-0.166***	-0.233***	-0.150***	0.0629
	(0.0433)	(0.185)	(0.0442)	(0.140)	(0.0489)	(0.194)	(0.0501)	(0.166)	(0.0481)	(0.0423)	(0.0458)	(0.0598)
Tournament	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230	-0.00230
	(0.0311)	(0.0313)	(0.0310)	(0.0310)	(0.0252)	(0.0261)	(0.0256)	(0.0264)	(0.0225)	(0.0232)	(0.0228)	(0.0236)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	3.437	3.039	2.902	2.405	2.558	2.349	2.221	1.957	2.245	1.91	2.258	1.907
p-value	.033	.048	.055	.091	.079	.097	.11	.143	.115	.157	.114	.158
F-statistic for equality	4.869	4.442	3.721	3.59	3.626	3.441	2.859	2.92	2.815	2.468	2.553	2.353
p-value for equality	.028	.035	.054	.059	.058	.064	.092	.088	.099	.122	.116	.13
N	868	868	868	868	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Robustness checks - alternative specification

Table 1.37: Experiment 1 - Effect of CPT on Productivity Model 2

	(1) Correct	(2) Effort	(3) Accuracy	(4) Correct(c)	(5) Effort(c)	(6) Accuracy(c)
Treatment	0.315	0.0943	0.00880	0.00716	-0.166	0.000111
	(0.392)	(0.333)	(0.0151)	(0.346)	(0.306)	(0.0144)
Difficult	-12.78***	-14.07***	-0.114	-11.66***	-11.25***	-0.107
	(1.294)	(1.028)	(0.0734)	(1.172)	(1.119)	(0.0752)
Tournament	0.362	0.415	-0.00570	0.362	0.415	-0.00570
	(0.294)	(0.299)	(0.00923)	(0.297)	(0.301)	(0.00931)
Choice	2.153***	1.900***	0.0180*	2.153***	1.900***	0.0180*
	(0.284)	(0.247)	(0.00933)	(0.286)	(0.249)	(0.00941)
DifficultXTourney	-0.319	-0.108	-0.00755	-0.319	-0.108	-0.00755
	(0.348)	(0.321)	(0.0194)	(0.351)	(0.324)	(0.0195)
DifficultXChoice	-1.641***	-1.153***	-0.0213	-1.641***	-1.153***	-0.0213
	(0.332)	(0.277)	(0.0179)	(0.335)	(0.280)	(0.0181)
Controls	No	No	No	Yes	Yes	Yes
p-value	.423	.777	.560	.983	.588	.994
R-squared	0.671	0.755	0.101	0.743	0.797	0.218
N	1302	1302	1300	1302	1302	1300

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.38: Experiment 1 - Effect of CPT on Overconfidence Model 2

	(1) Belief	(2) Rank	(3) Error	(4) Overconf	(5) Belief(c)	(6) Rank(c)	(7) Error(c)	(8) Overconf(c)
Treatment	-0.0917	-0.197	-0.0175	-0.0333	-0.0153	-0.0825	-0.0119	-0.0291
	(0.137)	(0.193)	(0.0228)	(0.0358)	(0.126)	(0.177)	(0.0227)	(0.0363)
Difficult	0.0398	-1.053	-0.0910	-0.187	-0.187	0.598	0.107	0.102
	(0.577)	(1.065)	(0.120)	(0.197)	(0.477)	(0.538)	(0.0885)	(0.166)
Tournament	-0.0131	0.0873	0.0146	-0.0218	-0.0131	0.0873	0.0146	-0.0218
	(0.0852)	(0.128)	(0.0181)	(0.0342)	(0.0863)	(0.130)	(0.0184)	(0.0347)
DifficultXTourney	-0.0796	-0.102	-0.00372	0.0413	-0.0796	-0.102	-0.00372	0.0413
	(0.140)	(0.195)	(0.0286)	(0.0525)	(0.142)	(0.198)	(0.0290)	(0.0532)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.505	.307	.443	.353	.903	.641	.598	.423
R-squared	0.108	0.036	0.067	0.063	0.258	0.232	0.139	0.105
N	868	868	868	868	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Robustness checks - excluding outliers

Table 1.39: Experiment 1 - Effect of CPT on Productivity Model 1 (excl. outliers)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Correct(c)	(5) Effort(c)	(6) Accuracy(c)
TreatmentXEasy	0.248	0.0400	0.00717	-0.202	-0.315	-0.00436
	(0.651)	(0.586)	(0.0164)	(0.567)	(0.522)	(0.0168)
TreatmentXDifficult	0.0782	0.0793	-0.00378	-0.0846	0.000639	-0.0101
	(0.352)	(0.246)	(0.0252)	(0.344)	(0.278)	(0.0232)
Difficult	-14.94***	-15.17***	-0.203	-11.03***	-11.80***	-0.0763
	(1.935)	(1.227)	(0.146)	(1.124)	(0.878)	(0.0669)
Tournament	0.165	0.436***	-0.0143	0.147	0.422***	-0.0148
	(0.185)	(0.148)	(0.00924)	(0.187)	(0.150)	(0.00935)
Controls	No	No	No	Yes	Yes	Yes
F-statistic	.097	.054	.107	.09	.182	.127
p-value	.907	.947	.899	.914	.834	.881
F-statistic for equality	.053	.004	.132	.032	.29	.04
p-value for equality	.818	.951	.716	.857	.591	.841
N	852	852	852	852	852	852

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.40: Experiment 1 - Effect of CPT on Overconfidence Model 1 (excl. outliers)

	(1) Belief	(2) Rank	(3) Error	(4) Overconf	(5) Belief(c)	(6) Rank(c)	(7) Error(c)	(8) Overconf(c)
TreatmentXEasy	0.0845	-0.261	-0.0534	-0.0896*	0.219	-0.0919	-0.0483	-0.0797*
	(0.177)	(0.266)	(0.0331)	(0.0471)	(0.166)	(0.241)	(0.0329)	(0.0469)
TreatmentXDifficult	-0.182	-0.0258	0.0214	0.0324	-0.178	0.0362	0.0295	0.0313
	(0.208)	(0.273)	(0.0314)	(0.0554)	(0.185)	(0.249)	(0.0304)	(0.0559)
Difficult	0.235	-1.305	-0.161	-0.267	0.189	-1.356**	-0.212**	-0.392**
	(0.620)	(1.091)	(0.112)	(0.190)	(0.526)	(0.637)	(0.0879)	(0.162)
Tournament	-0.0479	0.0385	0.0128	-0.00557	-0.0444	0.0463	0.0133	-0.00504
	(0.0710)	(0.101)	(0.0145)	(0.0266)	(0.0718)	(0.102)	(0.0147)	(0.0270)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
F-statistic	.499	.486	1.53	1.981	1.341	.086	1.607	1.629
p-value	.608	.616	.218	.139	.263	.918	.202	.197
F-statistic for equality	.956	.379	2.685	2.818	2.57	.143	3.138	2.38
p-value for equality	.329	.538	.102	.094	.11	.706	.077	.124
N	852	852	852	852	852	852	852	852

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.41: Experiment 1 - Effect of CPT on Productivity Model 2 (excl. outliers)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Correct(c)	(5) Effort(c)	(6) Accuracy(c)
Treatment	0.221	0.118	0.00396	-0.0951	-0.103	-0.00492
	(0.369)	(0.311)	(0.0134)	(0.331)	(0.285)	(0.0130)
Difficult	-14.95***	-15.04***	-0.199	-11.06***	-12.02***	-0.0621
	(1.928)	(1.097)	(0.139)	(1.104)	(1.020)	(0.0687)
Tournament	0.319	0.584**	-0.00995	0.317	0.585**	-0.0102
	(0.304)	(0.256)	(0.00903)	(0.305)	(0.258)	(0.00909)
Choice	1.891***	1.830***	0.0133	1.922***	1.850***	0.0145
	(0.300)	(0.239)	(0.00963)	(0.300)	(0.239)	(0.00970)
DifficultXTourney	-0.335	-0.317	-0.00975	-0.371	-0.353	-0.0101
	(0.356)	(0.280)	(0.0188)	(0.358)	(0.282)	(0.0190)
DifficultXChoice	-1.498***	-1.191***	-0.0213	-1.541***	-1.223***	-0.0224
	(0.348)	(0.271)	(0.0181)	(0.345)	(0.269)	(0.0179)
Controls	No	No	No	Yes	Yes	Yes
p-value	.549	.705	.768	.774	.717	.705
R-squared	0.686	0.774	0.093	0.755	0.818	0.205
N	1277	1277	1277	1277	1277	1277

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.42: Experiment 1 - Effect of CPT on Overconfidence Model 2 (excl. outliers)

	(1) Belief	(2) Rank	(3) Error	(4) Overconf	(5) Belief(c)	(6) Rank(c)	(7) Error(c)	(8) Overconf(c)
Treatment	-0.0410	-0.150	-0.0182	-0.0321	0.0322	-0.0317	-0.0117	-0.0274
	(0.135)	(0.191)	(0.0230)	(0.0362)	(0.124)	(0.177)	(0.0231)	(0.0368)
Difficult	0.132	-1.133	-0.120	-0.224	0.000523	-1.244**	-0.167*	-0.352**
	(0.600)	(1.101)	(0.115)	(0.195)	(0.511)	(0.615)	(0.0870)	(0.158)
Tournament	-0.0146	0.0827	0.0143	-0.0246	-0.0168	0.0836	0.0147	-0.0242
	(0.0886)	(0.132)	(0.0184)	(0.0349)	(0.0893)	(0.134)	(0.0187)	(0.0355)
DifficultXTourney	-0.0705	-0.0947	-0.00337	0.0404	-0.0578	-0.0798	-0.00312	0.0406
	(0.144)	(0.203)	(0.0294)	(0.0536)	(0.145)	(0.205)	(0.0297)	(0.0543)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
p-value	.762	.432	.431	.376	.796	.858	.612	.456
R-squared	0.101	0.038	0.071	0.066	0.250	0.228	0.140	0.107
N	852	852	852	852	852	852	852	852

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Robustness checks - by treatment order

	Task Order	Task Type	Task Difficulty	Treatment
Type 1 (9)	PR first	PR	Easy	(Stress)
Type 2 (10)	PR first	PR	Difficult	(Stress)
Type 3 (11)	PR first	TN	Easy	(Stress)
Type 4 (12)	PR first	TN	Difficult	(Stress)
Type 5 (13)	TN first	PR	Easy	(Stress)
Type 6 (14)	TN first	PR	Difficult	(Stress)
Type 7 (15)	TN first	TN	Easy	(Stress)
Type 8 (16)	TN first	TN	Difficult	(Stress)

Table 1.43: Experiment 1 - Effect of CPT by Treatment Order

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Type 2	-14.74***	-14.92***	-0.225	-0.0156	-1.340	-0.122	-0.195
	(2.012)	(1.482)	(0.139)	(0.611)	(1.104)	(0.124)	(0.207)
Type 3	0.710	1.028	-0.0417	-0.312	-0.652	0.0323	-0.0725
	(2.570)	(2.747)	(0.0655)	(0.441)	(1.054)	(0.138)	(0.172)
Type 4	-13.77***	-14.11***	-0.0501	0.116	-1.082	-0.0969	-0.230
	(1.736)	(1.145)	(0.0696)	(0.413)	(1.112)	(0.159)	(0.247)
Type 5	1.829	1.977	-0.0159	-0.617	-0.889	0.0465	0.0461
	(2.526)	(2.731)	(0.0661)	(0.435)	(1.036)	(0.136)	(0.164)
Type 6	-13.07***	-13.75***	-0.00306	-0.0640	-1.142	-0.0805	-0.250
	(1.680)	(1.137)	(0.0670)	(0.409)	(1.122)	(0.164)	(0.247)
Type 7	1.944***	2.111***	0.00173	-0.370***	-0.148	0.0359	-0.0741
	(0.476)	(0.432)	(0.0169)	(0.140)	(0.204)	(0.0325)	(0.0602)
Type 8	-14.69***	-14.15***	-0.253*	-0.0722	-1.000	-0.0722	-0.195
	(1.990)	(1.468)	(0.138)	(0.608)	(1.118)	(0.124)	(0.209)
Type 9	0.243	0.735	-0.000478	-0.0802	-0.525	-0.0616	-0.144*
	(1.035)	(0.935)	(0.0299)	(0.260)	(0.434)	(0.0544)	(0.0813)
Type 10	-14.92***	-14.69***	-0.264*	-0.145	-1.250	-0.0925	-0.274
	(2.013)	(1.417)	(0.147)	(0.643)	(1.120)	(0.123)	(0.202)
Type 11	2.058	0.717	0.000815	-0.476	-1.239	-0.0261	-0.116
	(2.459)	(2.691)	(0.0630)	(0.430)	(1.024)	(0.132)	(0.165)
Type 12	-13.32***	-13.57***	-0.0567	-0.461	-1.041	-0.0125	-0.0317
	(1.660)	(1.140)	(0.0686)	(0.398)	(1.086)	(0.156)	(0.245)
Type 13	2.375	1.150	0.000285	-0.459	-1.073	-0.0121	-0.149
	(2.500)	(2.718)	(0.0632)	(0.446)	(1.034)	(0.135)	(0.172)
Type 14	-13.20***	-13.69***	-0.0226	-0.121	-0.921	-0.0472	-0.112
	(1.635)	(1.127)	(0.0679)	(0.411)	(1.078)	(0.157)	(0.245)
Type 15	1.368	1.860*	0.00121	-0.0802	-0.0963	-0.00648	-0.0727
	(1.037)	(0.964)	(0.0262)	(0.280)	(0.426)	(0.0564)	(0.0769)
Type 16	-14.01***	-14.04***	-0.211	-0.298	-1.596	-0.117	-0.293
	(1.978)	(1.409)	(0.140)	(0.615)	(1.124)	(0.124)	(0.202)
F-statistic	15.116	31.84	.796	.536	.709	.575	.861
p-value	0	0	.606	.829	.684	.799	.549
R-squared	0.66	0.74	0.12	0.12	0.04	0.08	0.08
N	868	868	866	868	868	868	868

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.44: Experiment 1 - Effect of CPT by Treatment Order (Type 2)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	-0.175	0.224	-0.0392	-0.126	0.0956	0.0293	-0.0792
	(0.632)	(0.471)	(0.0509)	(0.342)	(0.461)	(0.0576)	(0.0959)
p-value	.782	.635	.443	.714	.836	.612	.411
R-squared	0.19	0.21	0.16	0.13	0.03	0.10	0.10
N	105	105	105	105	105	105	105

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.45: Experiment 1 - Effect of CPT by Treatment Order (Type 3)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	1.349	-0.293	0.0419	-0.166	-0.587	-0.0580	-0.0409
	(1.066)	(0.956)	(0.0322)	(0.302)	(0.421)	(0.0497)	(0.0860)
p-value	.208	.76	.195	.584	.166	.245	.636
R-squared	0.23	0.28	0.18	0.18	0.05	0.11	0.09
N	119	119	119	119	119	119	119

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.46: Experiment 1 - Effect of CPT by Treatment Order (Type 4)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	0.468	0.554	-0.00499	-0.566	0.0394	0.0825	0.194**
	(0.627)	(0.478)	(0.0458)	(0.343)	(0.441)	(0.0557)	(0.0973)
p-value	.457	.25	.914	.102	.929	.142	.049
R-squared	0.07	0.06	0.07	0.14	0.05	0.08	0.10
N	100	100	99	100	100	100	100

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.47: Experiment 1 - Effect of CPT by Treatment Order (Type 5)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	0.546	-0.844	0.0168	0.159	-0.185	-0.0590	-0.197**
	(1.093)	(1.028)	(0.0338)	(0.298)	(0.430)	(0.0531)	(0.0805)
p-value	.619	.414	.62	.595	.668	.268	.016
R-squared	0.22	0.16	0.18	0.12	0.03	0.07	0.11
N	119	119	119	119	119	119	119

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.48: Experiment 1 - Effect of CPT by Treatment Order (Type 6)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	-0.158	0.0346	-0.0212	-0.0683	0.221	0.0353	0.143
	(0.570)	(0.453)	(0.0340)	(0.364)	(0.460)	(0.0599)	(0.0994)
p-value	.783	.939	.535	.852	.632	.558	.153
R-squared	0.07	0.05	0.18	0.07	0.05	0.02	0.09
N	100	100	99	100	100	100	100

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.49: Experiment 1 - Effect of CPT by Treatment Order (Type 7)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	-0.602	-0.324	-0.000163	0.291	0.0592	-0.0419	0.00808
	(1.098)	(0.977)	(0.0248)	(0.284)	(0.453)	(0.0615)	(0.0857)
p-value	.585	.741	.995	.309	.896	.497	.925
R-squared	0.11	0.12	0.07	0.08	0.03	0.05	0.06
N	110	110	110	110	110	110	110

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

Table 1.50: Experiment 1 - Effect of CPT by Treatment Order (Type 8)

	(1) Correct	(2) Effort	(3) Accuracy	(4) Belief	(5) Rank	(6) Error	(7) Overconf
Treatment	0.672	0.109	0.0420	-0.230	-0.601	-0.0456	-0.0984
	(0.609)	(0.411)	(0.0495)	(0.331)	(0.479)	(0.0494)	(0.0940)
p-value	.272	.791	.399	.49	.213	.358	.298
R-squared	0.14	0.20	0.10	0.12	0.05	0.09	0.15
N	105	105	105	105	105	105	105

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. Refer to the key (above) for a description of the types.

1.7.4 Experimental instructions

PANAS and VAS

Now we will ask you to fill out a questionnaire on your computer again that asks about your feelings at the moment. In this questionnaire you will tell us how you feel right now. You will be shown several words, referring to different feelings and emotions. Listen to, or read, every word carefully and indicate how you feel at this moment by placing your finger on the position on the screen, which corresponds to your current feeling. For each item, the green end of the scale means "not at all", the blue end means "very much", and the region between means something in between. You can use the entire blue-green gradient for your response, not just the ends. Do you have any questions?

Real Effort Task

Effort Task 1 - this is the task that you got to know during the practice rounds. Please count the number of 0s in the table. Count as many tables as you can and be as fast and accurate as possible.

Beliefs Assessment 1 - Now, please guess how you ranked in this task in comparison to all other players in the room. If you guess your rank correctly, you will get paid 22 Shillings extra.

Effort Task 2 - this task is very similar to the task you just played, as you will again count the number of 0s in the table. However, now you will play against all other participants in the room. The person who answers most questions correctly wins the tournament. Should more than one person answer the same number of questions correctly, the winner will be chosen randomly. If you are not the winner, you do not earn any money with this task.

Beliefs Assessment 2 - Now, please guess how you ranked in this task again. If you guess your rank correctly, you will get paid 22 Shillings, if you guessed your rank correctly.

Effort Task 3 - You have just played the same task twice under two types of payment schemes, the piece rate and the tournament. In the following task, Task 3, you choose which of the two payment schemes you would like to apply to your performance in Task 3. In order to win the tournament you have to beat the maximum score during the tournament you played previously. If you chose the piece rate, you will be paid 1 Shilling per correct answer. Please make your choice by pushing the button labeled with the corresponding payment scheme.

Task 4 – Now you are asked to make a decision about your past performance during the first piece rate task you played. You have two options. You can either stick to your piece rate payment of 1 Shilling per correct answer, or you can enter your Task 1 performance into a tournament and receive 8 Shillings per correct answer if you are the winner of the tournament. You win the tournament if your number of correct answers during task 1 were the highest in the group. If you enter the tournament and you are not the winner, you will lose your earnings from the piece rate task. If you don't enter the tournament, you keep your earnings from the piece rate task.

Risk Preference

For the next task, you have been given 50 shillings. You can keep all of it, or invest some or all of it in a coin flip which can win you money. Whatever money you decide to KEEP will be added to your total payment for the day. The money you invest will return 4 times if the computer flips a heads, and you will lose all of your investment if the computer flips a tails. You choose how much you would like to keep and how much you would like to invest. You can keep all, invest all, or do anything in between. There is no right or wrong answer, only your preference. You can change your decision at anytime by pressing the red "CHANGE" button.

1.8 Appendix: Experiment 2 - Effect of stress on time and risk preference

1.8.1 Figures

Figure 1.5: Fraction of patient responses by treatment type

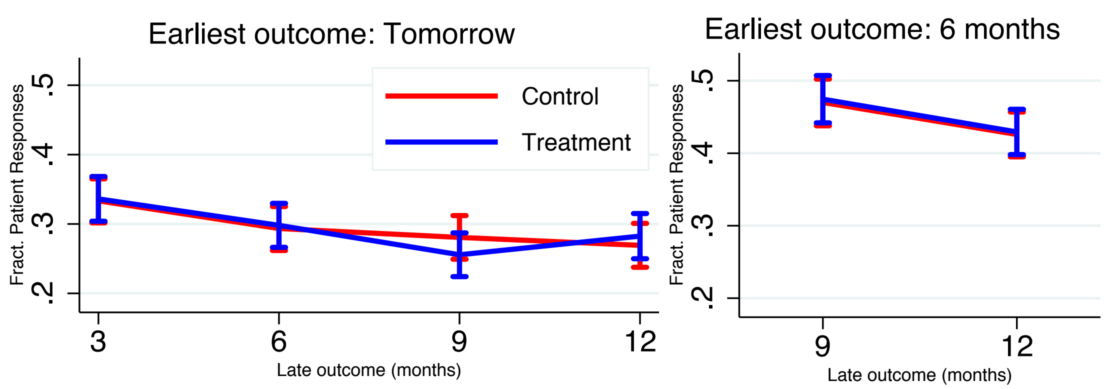


Figure 1.6: Exponential discount rate by treatment type

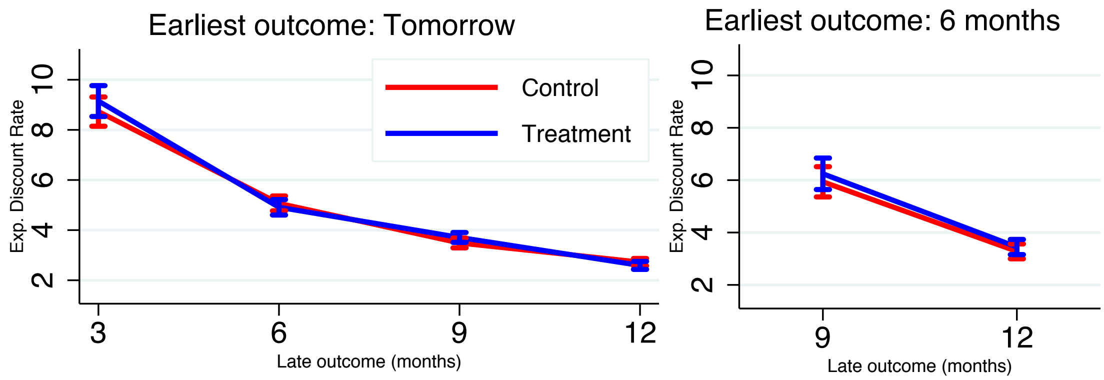
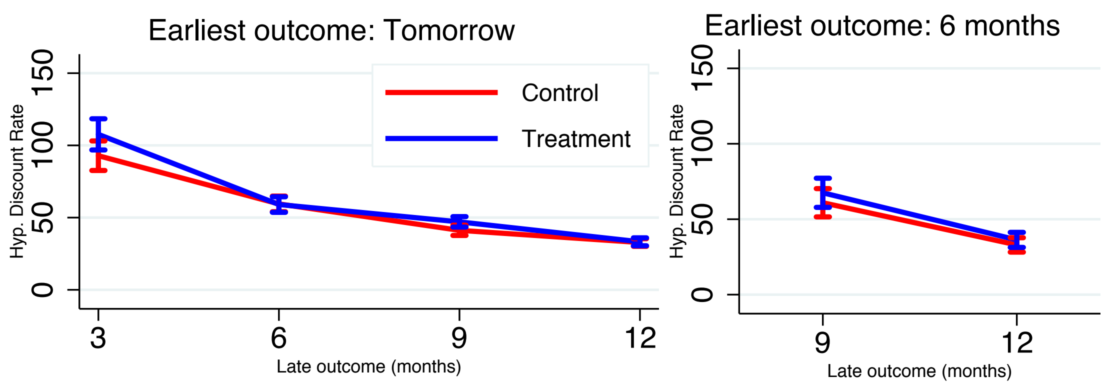


Figure 1.7: Hyperbolic discount rate by treatment type



1.8.2 Summary Tables

Demographic variables

Table 1.51: Experiment 2 - Summary of Demographic Data

Type	**Stat**	**BMI**	**Age**	**Income**	**Disposable**	**Dependents**	**Debt**
Control	Mean	23	31.1	5794	1426	2.65	.658
	S.D.	3.43	11	10751	3241	2.71	.476
	Median	22.4	27	3000	300	2	1
	Min	15.5	19	0	0	0	0
	Max	32.3	61	95000	30000	12	1
	N	117	117	117	117	117	117
Treatment	Mean	23.8	27.6	5038	2786	2.36	.627
	S.D.	4.43	7.74	5885	8930	2.71	.486
	Median	23.4	25	3750	500	2	1
	Min	13.3	19	0	0	0	0
	Max	37.5	53	30000	80860	21	1
	S.D.	118	118	118	118	118	118
Total	Mean	23.4	29.3	5414	2109	2.51	.643
	S.D.	3.97	9.67	8647	6748	2.71	.48
	Median	22.8	26	3500	400	2	1
	Min	13.3	19	0	0	0	0
	Max	37.5	61	95000	80860	21	1
	N	235	235	235	235	235	235

Notes:
Self-reported demographic characteristics. “BMI” refers to body mass index, “Income” refers to total monthly income, “Disposable” is disposable monthly income, “Dependents” referes to the total number of people who depend solely on this person’s income, “Debt” is an indicator that equals one when the person is in debt.

Negative affect

Table 1.52: Experiment 2 - Summary of PANAS (Negative Affect)

Type	Stat	PANAS 1	PANAS 3	Difference
Control	Mean	215	172	-42.6
	S.D.	177	199	146
	Median	198	83	-31
	Min	0	0	-395
	Max	847	836	440
	N	117	117	117
Treatment	Mean	253	193	-60
	S.D.	203	214	165
	Median	217	105	-59
	Min	0	0	-467
	Max	821	873	511
	N	118	118	118
Total	Mean	234	183	-51.4
	S.D.	191	207	156
	Median	202	97	-43
	Min	0	0	-467
	Max	847	873	511
	N	235	235	235

Notes: 10-item Negative Affect summary statistics split by treatment type. “1” refers to baseline, “3” refers to end-line. Difference refers to the difference between baseline and end-line.

Table 1.53: Experiment 2 - Summary of PANAS + Stress + Pain

Type	Stat	PANAS+ 1	PANAS+ 3	Difference
Control	Mean	259	205	-53.4
	S.D.	207	231	167
	Median	239	112	-42
	Min	0	0	-462
	Max	947	1015	475
	N	117	117	117
Treatment	Mean	304	238	-66.1
	S.D.	237	255	190
	Median	269	138	-69.5
	Min	0	0	-498
	Max	1001	1064	591
	N	118	118	118
Total	Mean	282	222	-59.8
	S.D.	223	243	179
	Median	246	118	-56
	Min	0	0	-498
	Max	1001	1064	591
	N	235	235	235

Notes: PANAS+ (PANAS + Stress + Pain) summary statistics split by treatment type. “1” refers to baseline, “3” refers to end-line. Difference refers to the difference between baseline and end-line.

Table 1.54: Experiment 2 - Summary of Self Reported Stress

Type	Stat	Stress 1	Stress 2	Stress 3	Stress 3-1	Stress 2-1	Stress 3-2
Control	Mean	13.7	11.6	10.7	-3.01	-2.14	-.872
	S.D.	24.8	19.9	20.3	21.4	27.8	23
	Median	0	2	0	0	0	0
	Min	0	0	0	-95	-90	-100
	Max	99	100	90	79	99	79
	N	117	117	117	117	117	117
Treatment	Mean	14.8	54.5	16.6	1.8	39.7	-37.9
	S.D.	22.4	31.4	24.4	23.4	34	34.1
	Median	2	53	5	0	40	-35.5
	Min	0	0	0	-90	-63	-100
	Max	90	100	98	93	100	39
	N	118	118	118	118	118	118
Total	Mean	14.3	33.1	13.7	-.596	18.9	-19.5
	S.D.	23.6	34	22.6	22.5	37.4	34.5
	Median	1	20	1	0	10	-7
	Min	0	0	0	-95	-90	-100
	Max	99	100	98	93	100	79
	N	235	235	235	235	235	235

Notes: Self-reported stress ratings. 1, 2, 3, refer to the baseline, midline and end-line measures, respectively. 2-1, 3-1, 3-2, refer to differences in the measures at baseline, midline and end-line.

Table 1.55: Experiment 2 - Summary of Self Reported Pain

Type	Stat	Pain 1	Pain 2	Pain 3	Pain 3-1	Pain 2-1	Pain 3-2
Control	Mean	30.6	11.6	22.8	-7.79	-15.7	7.91
	S.D.	30	19.9	28	26.2	29.5	26.5
	Median	21	2	10	-2	-8	1
	Min	0	0	0	-91	-98	-81
	Max	100	100	100	97	87	98
	N	117	117	117	117	117	117
Treatment	Mean	36.2	54.5	28.4	-7.82	16.9	-24.7
	S.D.	30.7	31.4	29.1	24.7	36.7	35
	Median	33	53	20	-2.5	14	-20.5
	Min	0	0	0	-76	-80	-100
	Max	100	100	100	57	100	81
	N	118	118	118	118	118	118
Total	Mean	33.4	33.1	25.6	-7.81	.66	-8.47
	S.D.	30.4	34	28.6	25.4	37	35
	Median	28	20	13	-2	0	-1
	Min	0	0	0	-91	-98	-100
	Max	100	100	100	97	100	98
	N	235	235	235	235	235	235

Notes: Self-reported pain ratings. 1, 2, 3, refer to the baseline, midline and end-line measures, respectively. 2-1, 3-1, 3-2, refer to differences in the measures at baseline, midline and end-line.

Time and risk preference

Table 1.56: Experiment 2 - Summary of exponential discount parameter

Type	Stat	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	8.73	5.07	3.49	2.72	5.94	3.28
	S.D.	6.32	3.2	2.12	1.58	6.25	3.07
	Median	7.85	5.1	4.08	3.06	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	117	117	117	117	117	117
Treatment	Mean	9.15	4.91	3.71	2.59	6.24	3.45
	S.D.	6.69	3.35	2.14	1.72	6.54	3.15
	Median	8.85	5.61	5.55	3.06	2.9	1.73
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	118	118	118	118	118	118
Total	Mean	8.94	4.99	3.6	2.66	6.09	3.36
	S.D.	6.5	3.27	2.13	1.65	6.38	3.1
	Median	8.85	5.1	4.08	3.06	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	235	235	235	235	235	235

Notes: Exponential discount parameter. Columns represent raw indifference points for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

Table 1.57: Experiment 2 - Summary of hyperbolic discount parameter

Type	Stat	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	92.9	59.5	41.2	32.8	60.9	33
	S.D.	111	58.3	38.4	28.6	101	51.7
	Median	24.4	23.6	27.1	20.3	4.26	2.41
	Min	.0635	.0317	.0212	.0159	.0635	.0317
	Max	252	126	84	63	252	126
	N	117	117	117	117	117	117
Treatment	Mean	108	59	47	33.3	67.5	36.3
	S.D.	117	58.5	39.4	29.8	105	54.1
	Median	32.6	32.1	84	20.3	4.26	2.77
	Min	.0635	.0317	.0212	.0159	.0635	.0317
	Max	252	126	84	63	252	126
	N	118	118	118	118	118	118
Total	Mean	100	59.3	44.1	33	64.2	34.6
	S.D.	114	58.3	38.9	29.1	103	52.8
	Median	32.6	23.6	27.1	20.3	4.26	2.41
	Min	.0635	.0317	.0212	.0159	.0635	.0317
	Max	252	126	84	63	252	126
	N	235	235	235	235	235	235

Notes: Hyperbolic discount parameter. Columns represent raw indifference points for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

Table 1.58: Experiment 2 - Summary of impatience and stationarity

Type	**Stat**	**DI-1(exp)**	**DI-2(exp)**	**DS-1(exp)**	**DS-2(exp)**	**DI-1(hyp)**	**DI-1(hyp)**	**DS-1(hyp)**	**DS-1(hyp)**
Control	Mean	2.34	3.66	1.79	2.79	26.7	33.4	26.5	31.9
	S.D.	2.54	4.8	3.77	7.16	45.8	83.7	63.5	121
	Median	2.21	3.72	1.45	1.19	8.14	4.23	4.4	2.87
	Min	-4.13	-8.25	-8.29	-16.6	-63	-126	-126	-252
	Max	8.3	16.6	8.29	16.6	126	252	126	252
	N	117	117	117	117	117	117	117	117
Treatment	Mean	2.32	4.24	1.46	2.91	25.8	48.6	22.7	40.1
	S.D.	2.34	5.12	3.18	6.5	42.1	90	58.6	107
	Median	2.44	3.92	.251	0	8.14	7.75	.503	0
	Min	-4.13	-8.25	-8.29	-16.6	-63	-126	-126	-252
	Max	8.3	16.6	8.29	16.6	126	252	126	252
	N	118	118	118	118	118	118	118	118
Total	Mean	2.33	3.95	1.62	2.85	26.3	41	24.6	36
	S.D.	2.44	4.96	3.48	6.82	43.9	87.1	61	114
	Median	2.25	3.92	.916	.641	8.14	6.53	2.1	1.06
	Min	-4.13	-8.25	-8.29	-16.6	-63	-126	-126	-252
	Max	8.3	16.6	8.29	16.6	126	252	126	252
	N	235	235	235	235	235	235	235	235

Notes: Index for decreasing impatience ("DI") and departure from stationarity ("DS") for both exponential ("exp") and hyperbolic ("hyp") discount parameters. For the DI index, "1" refers to calculation of the index using time points 0m6m and 0m12m and "2" refers to time points 0m3m and 0m6m. For the DS index, "1" refers to calculation of the index using time points 0m6m and 6m12m and "2" refers to time points 0m3m and 6m9m.

1.8.3 Regressions

Effect of stress on negative affect

Table 1.59: Experiment 2 - Effect of CPT on 10-Item Negative Affect

	(1) PANAS 1	(2) PANAS 3	(3) Diff	(4) PANAS 1(c)	(5) PANAS 3(c)	(6) Diff(c)
Treatment	33.63	14.57	-19.06	58.00**	32.97	-25.03
	(24.98)	(26.84)	(20.43)	(26.18)	(28.27)	(22.24)
Controls	No	No	No	Yes	Yes	Yes
p-value	.18	.588	.352	.028	.245	.261
R-squared	0.167	0.186	0.167	0.313	0.359	0.312
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.60: Experiment 2 - Effect of CPT on 12-Item Negative Affect

	(1) PANAS+ 1	(2) PANAS+ 3	(3) Diff	(4) PANAS+ 1(c)	(5) PANAS+ 3(c)	(6) Diff(c)
Treatment	39.81	25.26	-14.55	68.03**	48.92	-19.11
	(29.05)	(31.36)	(23.33)	(30.27)	(33.03)	(25.56)
Controls	No	No	No	Yes	Yes	Yes
p-value	.172	.421	.533	.026	.14	.456
R-squared	0.170	0.194	0.172	0.315	0.367	0.306
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.61: Experiment 2 - Effect of CPT on Stress + Pain

	(1) P+S 1	(2) P+S 2	(3) P+S 3	(4) P+S 3-1	(5) P+S 2-1	(6) P+S 3-2
Treatment	6.175	81.62***	10.69*	4.514	75.45***	-70.93***
	(5.748)	(5.976)	(5.638)	(5.022)	(6.724)	(6.524)
Controls	No	No	No	No	No	No
p-value	.284	0	.059	.37	0	0
R-squared	0.171	0.536	0.213	0.137	0.442	0.438
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.62: Experiment 2 - Effect of CPT on Stress + Pain (Controls)

	(1) P+S 1	(2) P+S 2	(3) P+S 3	(4) P+S 3-1	(5) P+S 2-1	(6) P+S 3-2
Treatment	10.03*	83.37***	15.95***	5.923	73.34***	-67.41***
	(5.775)	(6.206)	(5.960)	(5.353)	(7.101)	(6.991)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.084	0	.008	.27	0	0
R-squared	0.297	0.584	0.367	0.229	0.528	0.511
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.63: Experiment 2 - Effect of CPT on Pain

	(1) Pain 1	(2) Pain 2	(3) Pain 3	(4) Pain 3-1	(5) Pain 2-1	(6) Pain 3-2
Treatment	0.903	43.29***	5.503**	4.599	42.39***	-37.79***
	(3.039)	(3.553)	(2.746)	(2.865)	(4.095)	(3.771)
Controls	No	No	No	No	No	No
p-value	.767	0	.046	.11	0	0
R-squared	0.175	0.466	0.240	0.173	0.423	0.416
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.64: Experiment 2 - Effect of CPT on Pain (Controls)

	(1) Pain 1	(2) Pain 2	(3) Pain 3	(4) Pain 3-1	(5) Pain 2-1	(6) Pain 3-2
Treatment	2.052	45.32***	8.217***	6.165**	43.27***	-37.11***
	(3.083)	(3.679)	(2.922)	(3.072)	(4.307)	(3.889)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value	.506	0	.005	.046	0	0
R-squared	0.318	0.521	0.404	0.271	0.497	0.473
N	235	235	235	235	235	235

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Effect of stress on time and risk preference

Table 1.65: Experiment 2 - Effect of CPT Risk and Area Under the Curve

	(1) Risk	(2) CRRA	(3) AUC	(4) Risk(c)	(5) CRRA(c)	(6) AUC(c)
Treatment	-0.0665	0.0833	0.913	-0.310	0.246	4.080
	(0.263)	(0.172)	(6.508)	(0.295)	(0.183)	(6.976)
Controls	No	No	No	Yes	Yes	Yes
p-value	0.8	0.628	0.889	0.292	0.181	0.5591
R-squared	0.498	0.169	0.208	0.0943	0.280	0.302
N	235	235	235	235	235	235

Notes: Model 1 and 4 are ordered logistic regressions with pseudo R-squared reported. Models 2,3,5, and 6 are estimated via OLS. Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Robustness checks - clustering, session fixed-effects, and controls

Table 1.66: Experiment 1 - Effect of CPT on Indifference Point (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	1.400	0.767	2.757	2.345	1.400	0.767	2.757	2.345	1.400	0.767	2.757	2.345
	(3.638)	(3.497)	(3.721)	(3.657)	(6.856)	(6.280)	(6.823)	(6.362)	(6.433)	(6.369)	(6.810)	(6.670)
0m vs. 6m	-7.340	-7.340	-7.340	-7.340	-7.340*	-7.340*	-7.340*	-7.340*	-7.340*	-7.340*	-7.340*	-7.340*
	(6.324)	(5.966)	(6.188)	(5.802)	(3.808)	(3.860)	(3.839)	(3.893)	(3.976)	(4.031)	(4.009)	(4.066)
0m vs. 9m	-14.41**	-14.41**	-14.41**	-14.41**	-14.41***	-14.41***	-14.41***	-14.41***	-14.41***	-14.41***	-14.41***	-14.41***
	(6.203)	(5.853)	(6.053)	(5.690)	(4.076)	(4.132)	(4.110)	(4.168)	(4.219)	(4.277)	(4.254)	(4.313)
0m vs. 12m	-9.628	-9.628	-9.628	-9.628	-9.628**	-9.628**	-9.628**	-9.628**	-9.628**	-9.628**	-9.628**	-9.628**
	(6.408)	(6.051)	(6.258)	(5.874)	(4.140)	(4.197)	(4.174)	(4.233)	(3.938)	(3.993)	(3.971)	(4.027)
6m vs. 9m	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***	33.19***
	(6.514)	(6.377)	(6.377)	(6.212)	(5.164)	(5.236)	(5.207)	(5.280)	(5.293)	(5.367)	(5.337)	(5.412)
6m vs. 12m	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***	18.54***
	(6.125)	(5.872)	(5.978)	(5.721)	(4.843)	(4.910)	(4.883)	(4.952)	(4.962)	(5.030)	(5.003)	(5.073)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
p-value	.700	.826	.459	.522	.838	.903	.687	.713	.829	.905	.688	.727
R-squared	0.059	0.160	0.117	0.217	0.059	0.160	0.117	0.217	0.059	0.160	0.117	0.217
N	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.67: Experiment 1 - Effect of CPT on Fraction of Patient Responses (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.000604	-0.00222	0.00310	-0.00124	0.000604	-0.00222	0.00310	-0.00124	0.000604	-0.00222	0.00310	-0.00124
	(0.0183)	(0.0176)	(0.0187)	(0.0183)	(0.0351)	(0.0324)	(0.0349)	(0.0325)	(0.0325)	(0.0318)	(0.0338)	(0.0328)
0m vs. 6m	-0.0390	-0.0390	-0.0390	-0.0390	-0.0390**	-0.0390**	-0.0390**	-0.0390**	-0.0390**	-0.0390**	-0.0390**	-0.0390**
	(0.0318)	(0.0303)	(0.0310)	(0.0293)	(0.0185)	(0.0187)	(0.0186)	(0.0189)	(0.0186)	(0.0188)	(0.0187)	(0.0190)
0m vs. 9m	-0.0667**	-0.0667**	-0.0667**	-0.0667**	-0.0667***	-0.0667***	-0.0667***	-0.0667***	-0.0667***	-0.0667***	-0.0667***	-0.0667***
	(0.0317)	(0.0299)	(0.0310)	(0.0291)	(0.0196)	(0.0198)	(0.0197)	(0.0200)	(0.0195)	(0.0198)	(0.0197)	(0.0200)
0m vs. 12m	-0.0589*	-0.0589*	-0.0589*	-0.0589**	-0.0589***	-0.0589***	-0.0589***	-0.0589***	-0.0589***	-0.0589***	-0.0589***	-0.0589***
	(0.0320)	(0.0304)	(0.0312)	(0.0295)	(0.0200)	(0.0203)	(0.0202)	(0.0205)	(0.0201)	(0.0204)	(0.0203)	(0.0205)
6m vs. 9m	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***	0.138***
	(0.0321)	(0.0313)	(0.0314)	(0.0303)	(0.0242)	(0.0245)	(0.0244)	(0.0247)	(0.0248)	(0.0251)	(0.0250)	(0.0253)
6m vs. 12m	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***	0.0929***
	(0.0315)	(0.0304)	(0.0307)	(0.0294)	(0.0254)	(0.0258)	(0.0256)	(0.0260)	(0.0266)	(0.0270)	(0.0268)	(0.0272)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
p-value	.974	.9	.869	.946	.986	.946	.929	.97	.985	.945	.927	.97
R-squared	0.049	0.145	0.110	0.208	0.049	0.145	0.110	0.208	0.049	0.145	0.110	0.208
N	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.68: Experiment 1 - Effect of CPT on Exponential Discount Parameter (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.137	0.154	0.164	0.228	0.137	0.154	0.164	0.228	0.137	0.154	0.164	0.228
	(0.229)	(0.224)	(0.234)	(0.232)	(0.391)	(0.367)	(0.391)	(0.370)	(0.363)	(0.370)	(0.376)	(0.387)
0m vs. 6m	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***	-3.952***
	(0.475)	(0.457)	(0.465)	(0.446)	(0.324)	(0.329)	(0.327)	(0.331)	(0.323)	(0.328)	(0.326)	(0.330)
0m vs. 9m	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***	-5.342***
	(0.446)	(0.430)	(0.438)	(0.421)	(0.364)	(0.369)	(0.367)	(0.372)	(0.373)	(0.379)	(0.376)	(0.382)
0m vs. 12m	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***	-6.283***
	(0.437)	(0.423)	(0.430)	(0.415)	(0.371)	(0.376)	(0.374)	(0.379)	(0.388)	(0.393)	(0.391)	(0.397)
6m vs. 9m	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***	-2.849***
	(0.594)	(0.581)	(0.582)	(0.567)	(0.446)	(0.452)	(0.450)	(0.456)	(0.489)	(0.495)	(0.493)	(0.500)
6m vs. 12m	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***	-5.576***
	(0.470)	(0.454)	(0.459)	(0.444)	(0.394)	(0.400)	(0.397)	(0.403)	(0.450)	(0.456)	(0.453)	(0.460)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
p-value	.548	.492	.484	.326	.726	.675	.676	.538	.707	.68	.666	.559
R-squared	0.196	0.254	0.237	0.295	0.196	0.254	0.237	0.295	0.196	0.254	0.237	0.295
N	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 1.69: Experiment 1 - Effect of CPT on Hyperbolic Discount Parameter (Robust)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	5.104	5.225	6.073	7.359*	5.104	5.225	6.073	7.359	5.104	5.225	6.073	7.359
	(3.897)	(3.837)	(4.015)	(3.978)	(6.753)	(6.411)	(6.815)	(6.456)	(6.380)	(6.523)	(6.580)	(6.840)
0m vs. 6m	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***	-41.01***
	(8.348)	(8.086)	(8.180)	(7.910)	(5.694)	(5.773)	(5.741)	(5.822)	(5.420)	(5.495)	(5.465)	(5.542)
0m vs. 9m	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***	-56.14***
	(7.848)	(7.603)	(7.705)	(7.457)	(6.434)	(6.523)	(6.487)	(6.578)	(6.380)	(6.468)	(6.433)	(6.523)
0m vs. 12m	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***	-67.26***
	(7.668)	(7.460)	(7.539)	(7.318)	(6.526)	(6.617)	(6.580)	(6.673)	(6.752)	(6.845)	(6.808)	(6.903)
6m vs. 9m	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***	-36.04***
	(10.01)	(9.807)	(9.815)	(9.581)	(7.462)	(7.565)	(7.523)	(7.629)	(8.366)	(8.481)	(8.435)	(8.554)
6m vs. 12m	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***	-65.63***
	(8.188)	(7.938)	(8.024)	(7.764)	(6.969)	(7.066)	(7.027)	(7.126)	(7.864)	(7.973)	(7.929)	(8.041)
Clustering	No	No	No	No	Ind	Ind	Ind	Ind	Sess	Sess	Sess	Sess
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Session FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
p-value	.19	.174	.131	.065	.451	.416	.374	.256	.429	.428	.362	.289
R-squared	0.091	0.152	0.137	0.198	0.091	0.152	0.137	0.198	0.091	0.152	0.137	0.198
N	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410	1410

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

1.8.4 Experimental instructions

PANAS and VAS

Now we will ask you to fill out a questionnaire on your computer again that asks about your feelings at the moment. In this questionnaire you will tell us how you feel right now. You will be shown several words, referring to different feelings and emotions. Listen to, or read, every word carefully and indicate how you feel at this moment by placing your finger on the position on the screen, which corresponds to your current feeling. For each item, the green end of the scale means "not at all", the blue end means "very much", and the region between means something in between. You can use the entire blue-green gradient for your response, not just the ends. Do you have any questions?

Risk Preference

Now we will ask you to fill out a questionnaire on your computer again that asks about your feelings at the moment. In this questionnaire you will tell us how you feel right now. You will be shown several words, referring to different feelings and emotions. Listen to, or read, every word carefully and indicate how you feel at this moment by placing your finger on the position on the screen, which corresponds to your current feeling. For each item, the green end of the scale means "not at all", the blue end means "very much", and the region between means something in between. You can use the entire blue-green gradient for your response, not just the ends. Do you have any questions?

Time Preference

In this part of the study, you make a series of decisions. In each of these decisions, you have a choice between an early payment and a late payment. For example, you might be asked whether you would prefer Ksh 100 today or Ksh 200 after 3 months. You can choose one of these options by simply selecting it with your finger on the screen. In this example, if you choose Ksh 100 today, you will be paid Ksh 100 via MPesa, and this payment will be made TODAY. In contrast, if you chose Ksh 200 after 3 months, you will be paid Ksh 200 via MPesa, but we will only send this money to you THREE MONTHS FROM NOW. So you can choose between getting less money sooner, and getting more money after waiting. The smaller, sooner amount will always be shown in blue; the larger, later amount will always be shown in blue. This is just an example; you will make many such choices, and the amounts and delays of the offers will vary. It's important to note that there is no right or wrong answer here; it is purely up to your personal preference what you decide: Would you like to receive less money sooner, or more money later?

0m vs. 3m: We will now start the task. In this next group of decisions, you will make decisions between getting Ksh 200 in 3 months, or a smaller amount today. You will make 6 decisions, and the smaller amount that you can get today will be different in each decision. You can go through the decisions at your own pace. Remember that there is no right or wrong answer, your preference is the only thing that counts. Please raise your hand if you have questions.

0m vs. 6m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in SIX months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace.

0m vs. 9m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in NINE months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace. 0m vs. 12m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in TWELVE months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace.

6m vs. 9m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in NINE months, or a smaller amount in SIX months. When you are ready please press OK and go through the questions at your own pace.

6m vs. 12m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in TWELVE months, or a smaller amount in SIX months. When you are ready please press OK and go through the questions at your own pace.

Chapter 2

SOCIAL STRESS, INTER-TEMPORAL CHOICE, AND RISK PREFERENCE

Chaning Jang, Johannes Haushofer, and Linda Kleppin[1]

2.1 Introduction

Little is known about the factors underlying the choice behavior of the poor, despite the urgent need for an improved understanding of these factors in order to increase the effectiveness of behavioral interventions geared towards poverty alleviation (Banerjee et al., 2011). This is particularly important in light of the large number of behavioral interventions that have failed over the last twenty years (Datta and Mullainathan, 2014). Their failure can partly be attributed to a lack of understanding of the factors underlying the choice behavior of the poor (Datta and Mullainathan, 2014) as many of these behavioral interventions initially applied to the field were based on theories developed and tested on subjects from western, educated, industrialized, rich and democratic (WEIRD) societies. Henrich et al. (2010) shed light on a sampling bias within the behavioral sciences, when they concluded that samples entirely drawn from WEIRD societies are among the least representative populations from which scientists could make generalizations of human

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nature. Cross-cultural differences were found in fundamental aspects of psychology, motivation and behavior. With these cross-cultural differences in mind it becomes understandable why many behavioral interventions have failed. Leading development economists therefore urge policy makers and academics to listen more closely to the poor and to force oneself to understand their logic of choice instead of lazily applying formulaic thinking, by which a broad range of problems is attempted to be solved with the same principles (Banerjee et al., 2011).

The study of time and risk preferences have a long-standing tradition in development economics. This is due, in part, to the fact that impatience and risk preferences are two of the factors considered to play a key role in the perpetuation of poverty (Cardenas and Carpenter, 2008). However, laboratory studies in developing countries through which causal relationships between poverty, time and risk preference could be investigated are lacking. Previous empirical work on the effect of poverty on inter-temporal choice with subjects from WEIRD cultures has shown that an induction of poverty in the laboratory increases discounting rates (Haushofer et al., 2013c), which is a remarkable result, given that poverty was induced merely by means of negative income shocks in a computerized economic game. If this stylized version of the effect of poverty on inter-temporal choice was able to reveal a preference for smaller, sooner rewards, over larger later rewards, there is reason to hypothesize that this preference may also exist amongst those living in poverty. Evidence for this preference among the poor stems from two field experiments on inter-temporal choice. One was conducted with the Tsimane, an Amazonian population of forage-horticulturalists, which revealed that the Tsimane discounted the future 10 times steeper than subjects from WEIRD countries (Godoy et al., 2004). The other experiment was conducted with subjects living in poor villages in Vietnam and found that mean village income is correlated with risk and time preference. This study revealed lower discount rates and greater patience, as well as a lower degree of loss for people living in villages with higher mean income in comparison with people living in villages with lower mean income (Tanaka et al., 2010). Nonetheless, the body of literature on this topic reviewed by Cardenas and Carpenter (2008) paints an inconsistent image, so that as of yet, it remains to be tested, if differences in time preferences exist.

While field experiments on the relationship between poverty and risk preferences have been conducted since the 1980's (Cardenas and Carpenter, 2008), laboratory studies on the risk preference of poor subjects from developing countries are lacking. Binswangers' field experiment (Binswanger, 1980) showed that most peasant farmers from rural India who participated in his study (N = 240 households) were moderately risk averse. This finding is in line with the prevailing conviction that the perpetuation of poverty is partly due to preferences which are inconsistent with growth and which are reflected, amongst others, in risk aversion (Cardenas and Carpenter, 2008). However, the authors come to the conclusion that the poor are not more risk averse than subjects from WEIRD cultures. As mentioned above, the data for differences in time preferences are still inconclusive and little evidence has been found for differences in risk preference. This raises the following question, "Which other factors, if not endogenous preferences, perpetuate poverty?" Recent evidence from a field experiment conducted with poor farmers and metal workers from Kenya (Chemin et al., 2013) gives reason to posit that living in poverty affects the physiological and psychological make-up of a person towards being and feeling more stressed.

In the last fifty years, while several stress definitions have emerged, most refer to the work of Lazarus & Folkman (Lazarus, 1966; Lazarus and Folkman, 1984; Lazarus, 2006) where stress is defined as "a transaction between the person and the context. Stress exists when people confront circumstances that tax or exceed their ability to manage them" (Contrada and Baum, 2011). The most commonly studied physiological systems affected by stress are the HPA-axis and the autonomic nervous system, which regulate the response to stressful events and respond to the diurnal cycle of rest and activity (McEwen, 2000). On a neurobiological level, the experience of a stressful event elevates adrenal glucocorticoids (GCs), i.e. cortisol, and catecholamines, i.e. dopamine, adrenalin. Changes in which are needed for the organism to deal with the stressor. Behaviorally, this may result in fight or flight responses, substance abuse and increased states of vigilance, accompanied by worrying and enhanced anxiety (McEwen, 2000).

Stress has been shown to produce aftereffects, which affect performance on a number of tasks commonly used in psychological experiments (i.e. proof reading task, stroop task). Furthermore, the aftereffects of stress have also shown to impact social behavior in a non-desirable way. Stress for instance decreases helping (Sherrod and Downs, 1974) and increases aggressive behavior (Donnerstein and Wilson, 1976)[2]. According to Cohen (1980) the aftereffects of stress take place because stress causes annoyance and frustration, which in turn decrease ones motivation to perform and dampens the sensitivity towards the needs of others. Annoyance and frustration are affective reactions, and over the last years the relationship between emotional reactions and economic choices has captured the attention of economists. According to Loewenstein (2000), visceral factors, i.e. hunger, sexual desire, sadness, are of central importance to human decision making in general. In particular they play a central role in inter-temporal choice and serve as an explanation as to why humans dramatically discount feature events. While their effect on behavior is underestimated by most, Loewenstein (2000) considers visceral factors to be the main reason behind problems of self - control. An understanding of the emotions people experience at the time of consumption or when thinking about deferring consumption into the future, is therefore crucial, if one wants to understand and predict inconsistencies in inter-temporal choice.

Supporting the notion that affective states perturb inter-temporal choice, Ifcher and Zarghamee (2011) found lower discount rates when participants had previously watched a short film that induced positive affect in comparison to participants who watched a film that did not elicit an affective reaction. In another laboratory study, Lerner et al. (2013) found that sadness significantly increases impatience in comparison to a mood-neutral state. Sad participants valued future rewards between 13-34 % less than those in a mood-neutral state. Cornelisse et al. (2013) study the effect of hydrocortisone on inter-temporal choice. In a double-blind experiment, they administer hydrocortisone, a biological stress marker, to a random sample of participants and find that treated individuals exhibited a greater degree of impatience. In the most closely related study to the one at hand, Haushofer et al. (2013b) find no effect of psychosocially induced stress (administered via the TSST) on inter-temporal choice. The main difference between their study and this one is the subject population. The former uses Swiss university students while our study focuses on the urban poor in Nairobi, Kenya. Because stress causes emotional reactions, like frustration and annoyance, studying the effect of stress on time and risk preferences is important in order to get an improved understanding of choices. This

[2] For a review on the aftereffects of stress see Cohen (1980).

is particularly important in light of the previously mentioned hypothesis that living in poverty may stress the poor.

Based on this conceptual framework, we design an experiment that tests the effect of stress on time and risk preferences on a sample of urban poor in Nairobi, Kenya. The Trier Social Stress Test for groups (TSST-G) was the method of choice for the induction of stress, as the TSST has shown to reliably induce psychosocial stress with large effect sizes (Kirschbaum et al., 1993). Participants were randomly assigned to one of two groups, an experimental and a control group. The experimental group were subjected to the TSST-G, while the control group participated in a similar, but non-stressful placebo exercise. Based on validity of the TSST-G among traditional subjects, it was expected that administration of the TSST-G increases negative mood and subjective stress ratings. Furthermore, based on the body of literature discussed above, we hypothesize that stress causes changes in time and risk preferences, with steeper discounting rates in stressed participants than in not stressed participants.

As a preview of our results, we find weak evidence of the TSST-G inducing either stress or negative affect. We find no evidence for a causal link between the TSST-G and risk preference, and mixed to no result on the affect of the TSST-G on time preference.

The remainder of the paper proceeds as follows: Section 2.2 provides an overview of our subject population, experimental techniques and timeline of events. Section 2.3 discusses our outcome variables of interest and our econometric approach. Section 2.4 provides results. Section 2.5 discusses the implications of our study before concluding remarks in Section 2.6.

2.2 Methods

2.2.1 Participants and experimental background

A total of N = 97 males from two of Nairobi's largest slums[3] with an age range between 19 and 62 years (M = 32.23 ±10.10., N = 97) participated in this study. Participants on average reported 1.38 children and a mean of 14.59 years of schooling completed. See appendix for more details. Participants met the selection criteria if they were male and had not yet participated in other stress studies conducted at the research center. Participants were randomly assigned to one of two conditions: experimental group (N = 47) or control group (N = 50). To measure cortisol at its circadian trough, this study was conducted in the afternoon, between 13:00-18:00 hrs. Upon telephone recruitment, participants were asked to refrain from food, alcoholic beverages, smoking or usage of any other kind of drugs the day prior to the study and on the day of the study itself, as these alter the functioning of the hypothalamic-pituitary-adrenocortical (HPA) axis (Lovallo, 2006), a key structure in the physical response to stress (Tsigos and Chrousos, 2002). An experimental session lasted approximately 2 hrs. On average, participation was reimbursed with an amount equivalent to $4-6. This fee included transportation costs to the research center and back, a fixed amount for participation and a varying amount based on the random selection of one of the choices a participant has made during the study.[4]

Procedure

The study procedure closely follows Haushofer et al. (2013b). Upon arrival at the research center, participants were ushered into the waiting room, where they were provided with general information on the study, but were not informed about details on the stress protocol or on the tasks, i.e. the amounts and delays chosen between. Subsequently, participants entered the computer room and were seated. Then, the first saliva sample was taken, which was followed by the presentation of the negative mood scale of the PANAS (Watson et al.,

[3] This study was conducted at the Busara Center for Economics. We recruited participants from Viwandani and Kibera. For a more detailed description of the recruitment method and general experimental set up see Haushofer et al. (2013a).

[4] The random selection of a single payout is a standard method in experimental economics. This procedure was explained to participants before the study started.

1988) and one additional item, which was added for the purpose of assessing subjective stress. Next was a series of comprehension questions regarding inter-temporal choice, followed by the first set of decision tasks.[5] This was followed by a second sampling of saliva. Afterwards, the TSST-G and control tasks were explained after which the TSST-G started. Participants were given 5 minutes to prepare the first task, a speech for a fictional job interview, which they were to present it to the jury for a duration of two minutes each. Upon completion of this exercise, a third saliva sample was taken, which was followed by the instructions for the second task, the arithmetic task. Immediately after the TSST procedure, saliva was sampled for the fourth time. Next, data on negative mood and stress was collected once more, using the negative mood scale of the PANAS plus the aforementioned additional item. Following the PANAS, the second set of decision tasks were conducted. Exactly 10 minutes after the TSST procedure had ended, a fifth saliva sample was taken. Precisely 30 minutes later, a sixth saliva sample was taken and one last saliva sample was taken 50 minutes after the end of the TSST.

2.2.2 Tasks

Stress Manipulation: The Trier Social Stress Test

Stress was induced using the Trier Social Stress Test for Groups (TSST-G) (von Dawans et al., 2011), which is based on the single-subject Trier Social Stress Test (TSST). It works on the premise that human beings have an interest in sustaining positive social interactions and that circumstances can make social interactions stressful. The underlying paradigm combines the aspects of social evaluation and loss of control. The test involves 5 minutes of preparation, which is followed by a 2-minute public speaking task and a subsequent 2-minute mental arithmetic task, in which participants perform serial subtractions of 16 from a four digit number, while being evaluated by researchers wearing white lab coats who refrain from all socially-supportive mimicry. To increase psychosocial stress even further, participants performed in front of a video recorder. At most, five participants were tested at once. The control group exercise involved a 4-minute period of

[5] The first set of decision tasks are outside of the scope of the study and not discussed here.

reading a magazine, in lieu of preparing a free speech. The aforementioned job interview performed by participants in the experimental group was substituted by a free speech about one's friend, during which everyone talked at the same time. The arithmetic task was the same as in the experimental group, but participants' performance was not rated.

Salivary Sampling and Analysis

Throughout the experiment, seven saliva samples were collected to measure salivary cortisol. It was decided to sample salivary cortisol, as it is considered to be a reliable and valid reflection of cortisol in the blood stream (Kirschbaum et al., 1993). Samples were obtained using salivettes (Sarsted, Nürmbrecht, Germany) and were stored in a freezer at -20° Celsius. Due to the increased costs of analyzing salivary cortisol in Kenya, the salivary samples were not analyzed for this study. The results section therefore omits analyses on changes in salivary cortisol.

Questionnaires

The 10-item negative mood scale of the PANAS was used to assess the effect of the intervention on ratings of negative mood. The PANAS in its original form comprises two 10-item mood scales, which were derived from a principal components analysis based on the mood checklist by Zevon and Tellegen (1982). In addition, subjective stress was measured by using visual analog scales (VAS) presented on a touch screen, supported by a color gradient ranging from green to blue. When participants touched the gradient, a mark appeared on top of the VAS, indicating where exactly the participant had placed his finger and the corresponding value related to that location appeared on top of the mark. Answering options ranged from 0 "not at all" to 100 "very much". Questions were displayed on the screen above the VAS and were read out loud by the Research Assistant in English and in Kiswahili to facilitate comprehension. Negative mood as well as subjective stress ratings were assessed shortly before and right after the TSST-G protocol and the corresponding exercises for the control group. See Table 2 for an overview of the PANAS and VAS scores by group.

Inter-temporal Choice Task

Participants performed two different inter-temporal choice tasks, one of which consisted of a total of five different decisions between smaller sooner and larger later rewards in each of the six delay combinations. The six delays were between 0 months (Today) vs. 3 months, 0 months (Today) vs. 6 months, 0 months (Today) vs. 9 months, 0 months (Today) vs. 12 months, 6 months vs. 9 months, and 6 months vs. 12 months. The larger later reward was fixed at KES 200, equivalent to an amount of ~$2.35 US Dollars[6], while the smaller sooner amount was varied by means of a titration method based on the choices made by each subject. Titration is considered one of the standard methods for identifying time preferences in the discounting literature (Mazur, 1988; Green and Myerson, 2004; Kable and Glimcher, 2007; Rachlin et al., 1991). Titration works by systematically adjusting the smaller-sooner based on the previous choices made by participants. Specifically, for each later reward chosen, the sooner reward is increased by half the difference between it and KES 200 (the fixed later reward). For each sooner reward chosen, the subsequent sooner reward is decreased by half the distance between it and the previously offered soon award. The titration exercise resulted in five decisions that were used to calculate an individual indifference point for that delay combination.

In the second inter-temporal choice task, participants made choices between ten different options instead of two, with each option being associated with a different delay. The results of this task are not reported.

In line with procedural protocol at the Busara Center for Behavioral Economics (Haushofer et al., 2013a), participants were paid later in the day via mPesa, the dominant mobile money platform in Kenya. This allows the researchers to offer inter-temporal choices that can be realized as soon as the same day, while holding the transaction costs of receiving payment constant.

[6] At the time of the experiment, $1 was approximately equal to KES 85.

Experiential Risk Task

Experiential risk was assessed by using a task in which three boxes appeared on the screen, each containing a one Kenyan Shilling coin, except for one box that contained a red "X". It was unknown to participants which box contained the "X". Participants could open as many boxes as they liked and boxes were opened from the lowest number up. Thus, if a participant wanted to open one box, he had to open box one, if a participant wanted to open two boxes he had to open boxes one and two. If all boxes opened contained money, the exact amount found in the box was earned, but if one box contained an "X", a participant did not earn anything. This game was played for nine trials. The first trial contained two possible boxes to open, and subsequent trials increased the number of available boxes by one.

2.3 Data and econometric approach

2.3.1 Construction of outcome variables

Negative affect

Each individual completed the 10-item negative mood scale of the PANAS plus a stress assessment on a visual analog scale between 0 and 100. This assessment was done once at the start of the experiment and again after the TSST-G or associated control task was completed. The scores are used individually as well as aggregated into a 11-item PANAS+VAS score.

Time preference

For each individual and each delay combination, we calculated the raw indifference point implied by their five choices in the titration exercise. We use these raw indifference points as an outcome of interest. Other non-parametric outcomes include plotting the indifference points against time (in years) and calculating the area under the curve, as well as calculating the total fraction of larger-later responses made by each participant. Furthermore, we fit each indifference point to both exponential and hyperbolic discount models to recover parameters that describe the shape of the discount function. See Table 3 for summary statistics on these measures.

Hyperbolic discount model

We use the standard hyperbolic discount model, which takes the following shape:

$$V_t = A/(1 + kt) \tag{2.1}$$

Where A is the amount of the reward, V_t represents the discounted value of that reward at time t, t is the delay until the reward is realized and k is a parameter that describes the shape of the discount function. We calculate k for each individual and each delay combination. Table 4 reports summary statistics for this measure.

Exponential discount model

We also calculate the parameter associated with exponential decay in an exponential discount model:

$$V_t = A * exp(-kt) \tag{2.2}$$

Where A, V_t and t are as described above, and k represents the parameter of interest. We determine k for each individual and each delay combination. Table 4 reports summary statistics for this measures.

Experiential Risk

For each of the nine risk preference trials we calculate the number of boxes chosen as well as the ratio of boxes chosen to the total number of available boxes. Furthermore we aggregate results from all nine trials to calculate the total number of boxes chosen, and a simple average of all the ratios in each of the nine trials.

2.3.2 Econometric approach

Our general specification takes the follow form:

$$y_{ij} = \beta_0 + \beta_1 STRESS_i + \sum_{j=1}^{J} \gamma_j TYPE_J(j) + \epsilon_{ij} \tag{2.3}$$

Where y_{ij} are outcomes of interest for participant i including negative affect, time preference and risk preference, $STRESS_i$ is a dummy for those randomly assigned to the treatment group, $TYPE_J$ is an indicator function that takes the value of one for a particular choice "block" j, namely delay combinations related to time preference ($J = 6$), or risk preference trials ($J = 9$), and ϵ_i is residual term. When outcomes are calculated by aggregating data to the individual level, $TYPE_J$ is omitted from the model. Our analyses include session fixed effects and robust standard errors clustered on the individual level.

We also test a model that includes interactions between the treatment and choice "blocks":

$$y_{ij} = \beta_0 + \beta_1 STRESS_i + \sum_{j=1}^{J} \gamma_j TYPE_J(j) * STRESS_i + \epsilon_{ij} \tag{2.4}$$

2.4 Results

2.4.1 Stress induction

We first investigate the effect of the TSST-G on subjective ratings of negative affective mood and stress. The results are reported in Table 2.1.

Table 2.1: Summary Statistics: PANAS+VAS

Type	**Stat**	**VAS 1**	**VAS2**	**Diff**	**PANAS+ 1**	**PANAS+ 2**	**Diff**
Control	Mean	40.8	38.8	-2.06	284.22	266.34	-17.88
	S.D.	34.5	33.8	25.6	243.50	257.59	165.50
	Median	31.5	36.5	0	205	172	-18
	Min	0	0	-94	0	0	-394
	Max	100	100	51	953	1080	349
	N	50	50	50	50	50	50
Treatment	Mean	33.2	35.6	2.4	235.85	286.83	50.98
	S.D.	33.4	37.5	36.5	190.55	244.76	225.34
	Median	23	21	0	199	257	39
	Min	0	0	-92	0	0	-448
	Max	100	100	72	696	1069	750
	N	47	47	47	47	47	47
Total	Mean	37.1	37.2	.103	260.78	276.27	15.48
	S.D.	34	35.5	31.3	219.66	250.36	198.77
	Median	31	30	0	203	249	5
	Min	0	0	-94	0	0	-448
	Max	100	100	72	953	1080	750
	N	97	97	97	97	97	97

Notes: VAS (stress) and PANAS+ (PANAS + stress) summary statistics split by treatment type. "1" refers to baseline, "2" refers to endline. Difference refers to the difference between baseline and endline.

Overall we see no evidence supporting the TSST-G as a stress inducer (as measured by subjective stress) for our subject population. There are no significant differences between the stress and no-stress groups on either the baseline or end-line VAS measures. There is weak evidence that the TSST-G increased negative affect (table 2.2).

Table 2.2: Effect of TSST on Negative Affect

	(1) VAS1	(2) VAS2	(3) Diff	(4) PANAS+ 1	(5) PANAS+ 2	(6) Diff
Treatment	-7.649 (6.897)	-3.184 (7.260)	4.464 (6.438)	-48.37 (44.26)	20.49 (51.01)	68.86* (40.35)
F-statistic	1.23	.192	.481	1.194	.161	2.913
p-value	.27	.662	.49	.277	.689	.091
R-squared	0.013	0.002	0.005	0.012	0.002	0.030
N	97	97	97	97	97	97

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. VAS refers to subjective stress ratings. PANAS+ includes stress. Diff refers to the difference in endline and baseline. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to testing of Treatment dummy.

There are no significant differences between the two groups at the first PANAS+VAS. Differences between the groups remain insignificant when comparing their responses at the second PANAS+VAS. When comparing the changes in reported PANAS+VAS scores between the first and second test, we see weak support for the effect of the TSST-G on negative affective mood and stress ($p = 0.091$). This null-result is contrary to the existing evidence on the effectiveness of the TSST at inducing stress. We discuss this result and its ramifications in the discussion section.

2.4.2 Inter-temporal choice

Next we analyze the effect of the TSST-G on inter-temporal choice. Overall, we see mixed support for stress administration to increase patience. See Table 2.3 for results.

Table 2.3: Effect of TSST on Time Preference - Full sample

	(1) AUC	(2) Indiff	(3) Fract	(4) Exp k	(5) Hyp k
Treatment	-9.549	1.678	0.102	-1.812	-45.01**
	(22.95)	(28.94)	(0.115)	(1.490)	(18.14)
0m vs. 6m		-13.08***	-0.0447*	-3.200***	-30.07***
		(4.921)	(0.0249)	(0.424)	(7.083)
0m vs. 9m		-22.04***	-0.0756***	-4.376***	-41.18***
		(5.701)	(0.0249)	(0.509)	(8.202)
0m vs. 12m		-18.81***	-0.0601**	-5.204***	-50.43***
		(5.934)	(0.0265)	(0.533)	(8.773)
6m vs. 9m		21.39***	0.0893**	-1.408**	-9.015
		(7.139)	(0.0356)	(0.590)	(9.509)
6m vs. 12m		14.43**	0.0876***	-4.316***	-40.65***
		(6.572)	(0.0331)	(0.494)	(8.319)
F-statistic	.173	.003	.782	1.48	6.154
p-value	.678	.954	.379	.227	.015
R-squared	0.100	0.117	0.114	0.219	0.133
N	97	582	582	582	582

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. AUC refers to the area under the curve generated from plotted indifference points. Indiff refers to raw indifference points from the titration exercise. Fract is the portion of patient responses during the titration exercise. Exp k refers to the discount parameter associated with an exponential discount model. Hyp k refers to the discount parameter associated with a hyperbolic discount model. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to testing of Treatment dummy.

The treatment indicator for all non-parametric outcomes, and for exponential decay parameter are insignificant suggesting no effect of stress on inter-temporal choice. However, we see some evidence ($p = 0.015$) that participants exposed to the TSST-G have a significantly smaller k. Recall that in both exponential and hyperbolic time preference models, indifference points are inversely proportional to k; thus a decrease in k suggest more patience in the models. When analyzing the model with full interactions (see appendix), we see weak evidence overall of any effect - the joint test for the treatment is not significant.

Note that indifference points elicited through the titration method may contain corner solutions. That is, for individuals who choose either the sooner or later reward and never switch, the associated indifference point is unbounded on one end, and imprecisely measured. As an exploratory analysis, we restrict our regressions to indifference points that were generated through at least one switch (from sooner to later or vice versa). This resulted in dropping nearly 40% (224/582) of our observations. Slightly more observations were dropped from the control (122/300) than the treatment group (102/282). In this subsample we see strong support for the effect of TSST-G administration on increasing patience. Raw indifference points ($p = 0.08$), the fraction of patient responses ($p = 0.001$) and both k parameters from the hyperbolic ($p = 0.016$) and exponential discounting models ($p = 0.04$) are all statistically significant, see Table 2.4.

Table 2.4: Effect of TSST on Time Preference - Subsample who switch

	(1) Indiff	(2) Fract	(3) Disc Hyp	(4) Disc Exp
Treatment	13.90^{*}	0.0995^{***}	-4.772^{**}	-0.668^{**}
	(7.820)	(0.0294)	(1.937)	(0.319)
0m vs. 6m	-5.504	0.0107	-8.518^{***}	-2.473^{***}
	(5.193)	(0.0244)	(2.497)	(0.340)
0m vs. 9m	-16.81^{***}	-0.0142	-11.03^{***}	-3.221^{***}
	(5.456)	(0.0190)	(2.768)	(0.385)
0m vs. 12m	-15.56^{**}	-0.0123	-12.43^{***}	-3.702^{***}
	(7.235)	(0.0285)	(2.878)	(0.409)
6m vs. 9m	25.00^{***}	0.102^{***}	-9.530^{***}	-1.754^{***}
	(6.693)	(0.0295)	(3.421)	(0.465)
6m vs. 12m	25.36^{***}	0.152^{***}	-15.00^{***}	-3.605^{***}
	(7.084)	(0.0314)	(3.038)	(0.422)
F-statistic	3.158	11.426	6.07	4.373
p-value	.08	.001	.016	.04
R-squared	0.197	0.167	0.166	0.339
N	358	358	358	358

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. Indiff refers to raw indifference points from the titration exercise. Fract is the portion of patient responses during the titration exercise. Exp k refers to the discount parameter associated with an exponential discount model. Hyp k refers to the discount parameter associated with a hyperbolic discount model. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to testing of Treatment dummy.

This result weakens significantly when adding full interaction terms (see appendix). We do, however, still see joint effects of the TSST-G on the fraction of patient responses. Overall the subsample relationship seems to be non-robust, pointing towards a mixed or null-result on the effect of stress induction on inter-temporal choice.

2.4.3 Risk preference

We see no significant effect of TSST-G administration on risk preference (Table 2.5).

Table 2.5: Effect of TSST on Risk Preference

	(1) Total Boxes	(2) Avg. Ratio	(3) Boxes Chosen	(4) Ratio
Treatment	3.306	0.0535	0.367	0.0535
	(6.934)	(0.114)	(0.729)	(0.108)
3 boxes			0.670***	-0.00344
			(0.0766)	(0.0298)
4 boxes			1.165***	-0.0490
			(0.0946)	(0.0303)
5 boxes			1.536***	-0.101***
			(0.125)	(0.0306)
6 boxes			2.175***	-0.0911***
			(0.154)	(0.0316)
7 boxes			2.515***	-0.127***
			(0.188)	(0.0321)
8 boxes			3.093***	-0.124***
			(0.213)	(0.0325)
9 boxes			3.567***	-0.133***
			(0.237)	(0.0306)
10 boxes			4.206***	-0.124***
			(0.285)	(0.0328)
F-statistic	.227	.218	.254	.244
p-value	.635	.641	.616	.623
R-Squared	0.137	0.148	0.402	0.109
N	97	97	873	873

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. Models 1-2 are pooled statistics (1 observation per participant). "Total boxes" refers to the total boxes uncovered. "Avg. Ratio" is a simple average of all the "Ratios", which themselves are calculated by dividing the boxes uncovered in each round by the total boxes available. Models 3-4 are unpooled and include 9 decisions for each person. "Boxes Chosen" refer to the number of boxes selected in a given round. For any round, "Ratio" is the number of boxes chosen divided by the total number of boxes available in that round. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to testing of Treatment dummy.

Neither the raw number of boxes chosen nor the ratio of boxes chosen were significantly different by treatment status. This is true both for the pooled and full samples. The model with interactions similarly sees no main effect of the TSST-G on risk preference.

2.5 Discussion

In the present study, we investigated the effect of stress on inter-temporal choice and risk preference. As a manipulation check, it was investigated if administration of the TSST-G showed an effect of stress on subjective ratings of negative affect and stress. The pattern of results suggests that the TSST-G affects negative mood and stress, yet the evidence for this effect is rather weak (see Table 6 Effect of TSST on Negative Affect). One may speculate that this may be due to poor administration of the test, given that it has a proven track record of reliably inducing stress in the laboratory. Yet, this is unlikely, as the procedure was closely followed that of von Dawans et al. (2011), who developed the TSST-G. While an effect of the TSST-G on stress and negative mood ratings was found, the TSST-G showed no effect on time preferences (see Table 7). However, excluding observations that did not include any switching behavior results in a significant relationship of the TSST-G on inter-temporal choice – that the TSST-G is positively related to more patient time preference. We found no effect of the TSST-G on risk preference.

2.5.1 TSST-G and stress

The results of this study raises the question of whether TSST-G is a valid method for studying the effect of stress on negative mood, subjective stress, time and risk preference amongst the poor in developing countries. Next to the Cold Pressor Test (Hines and Brown, 1932), the TSST is one of the few proven stress protocols that allows for the induction of stress in a controlled setting. At first sight, its usage for stress studies conducted in a development context therefore seems plausible. Nonetheless, the cultural and socioeconomic background of participants' may have interfered with the usefulness of this scientifically proven stress test. As mentioned in Section 2.2, the TSST-G is meant to induce psychosocial stress, but it is possible that good performance of the tasks in question (performance during a job interview, arithmetic tasks) had little importance to participants, as it was unrelated to self, so that the situation was not cognitively appraised as a situation that taxed or exceeded participants' ability to manage it, which would have been necessary in order for a stress reaction to take place. This line of argument is based on the idea that the need to sustain a positive self-image is a central human motivation. Accordingly, behaviors (i.e. performance on a mock job interview and on an arithmetic task which has no relevance for ones' life) that are irrelevant to sustaining a positive self-image, unlikely cause stress. Given the differences in culture and socio-economic background of participants, the TSST-G may not be the most valid method for conducting controlled stress studies in developing countries with poor participants.

Another explanation for the lack of an effect of the TSST on ratings of negative affect and stress, as well as time and risk preference, could be the inclusion of participants with potentially poor (mental) health, as (mental) health screenings were not conducted, due to the lack of conclusive data about the spectrum, burden and determinants of illnesses in slums (Riley et al., 2007), who explain that this is mainly due to the slums' informal character and its unique social, cultural and behavioral characteristics. They report findings from observations made in a slum community in Salvador, highlighting a spectrum of chronic diseases and burdens slum dwellers are subject to. According to the authors, it is likely that these diseases may also affect people living in slums in other countries, as they can partly be attributed to the living conditions that characterize slums. Among the chronic diseases mentioned are hypertension, diabetes, asthma, chronic squelae and last but not least, mental illness. Despite the health problems of people living in slums mentioned above, the UN's Global Report on Human Settlements (Habitat, 2003) is lacking health indicators for slum dwellers. The study at hand could have been improved by assessing participants' mental health status, with a particular focus on potential mental health problems that arise from being chronically stressed. The aspect of being chronically stressed is of particular importance to the authors in light of the evidence that poverty causes stress (Haushofer et al., 2013c, 2012) and because of the finding on a linkage between chronic stress and the precipitation or exacerbation of depression (Pittenger and Duman, 2008), which is considered as the leading mental health disorder causing burdens attributable to diseases and injuries.

An overarching explanation for the lack of an effect of the TSST-G on the variables of interest could also be greater resilience amongst the poor. Resilience refers to "the positive capacity of people to cope with stress and adversity" (Tignor and Prince-Embury, 2013) and in fact, all participants of this study are faced with adversity on the daily basis as they live in the slums. A place which is characterized by inadequate access to safe water, inadequate access to sanitation and other infrastructure, poor structural quality of housing, overcrowding and insecure residential status (Habitat, 2003). Yet, previous research by Pellegrini (1990) and Schoofs et al. (2008) suggests that successful engagement with adversity steels people rather than that it sensitizes them. It is therefore possible that greater resilience lead to a weaker stress reaction than what the TSST is usually capable of.

2.5.2 The effect of stress on inter-temporal choice and risk preference

We found no conclusive evidence for a causal relationship between stress and inter-temporal choice. If anything, we find that that stress induction results in more patience; a result counterintuitive to our prediction drawn on the literature that suggests that stress and negative affect decrease patience[7]. Because results are mixed – the result is weak in the full sample – it is possible that we either did not have the requisite power to detect the true relationship or it is possible that our parameters for the titration exercise were insufficient to capture interior indifference points for enough of the population. For instance, for the inter-temporal choice task, the shortest time period chosen was three months, which may have been too long for some people, given their living circumstances and the challenges to overcome on a daily basis. Moreover, the amount of the decision, though large relative to participants' daily wage, was small in absolute terms - roughly enough to buy up to two meals. This amount may therefore not have been large enough to induce meaningful variation between subjects. An alternative explanation for this result goes hand in hand with our discussion on the validity of the TSST in developing countries. It could be that our stress manipulation was unsuccessful and that any relationship between stress and inter-temporal choice is an artifact of the data. Or that inter-temporal choice is related to participation in the TSST, but not through the channel of stress. One major takeaway from this study is that ubiquitous, extensively verified experimental techniques used in the developed world have heterogeneous effects on populations in developing countries.

[7] One exception in this literature is the aforementioned Haushofer et al. (2013b) that found no effect of the TSST on time preference.

2.6 Conclusion

Existing literature suggests a causal relationship between poverty and stress. In developing countries with an already high incidence of poverty, it is paramount to understand how the associated elevation in stress levels affect decision-making that can either ameliorate or perpetuate further poverty. Because so much behavior and economic choice rests on time and risk preference, studying these behaviors under stress is a natural start in understanding how stress manifests itself, especially among the poor in a developing country. In association with the Busara Center for Behavioral Economics, we designed and conducted an experiment to test the causal relationship between stress, via the Trier social stress test (TSST), and these economic preferences. Our subject pool consists of urban poor from some of the largest slums in and around Nairobi. This is, to our knowledge, the first examination of the relationship between stress and inter-temporal choice and risk preference in a developing country.

We find no statistically significant relationship between participation in the TSST and risk preference, and mixed support for stress leading to more patient behavior. Overall we conclude a null result for the effect of the TSST on inter-temporal choice and risk preference.The validity of the TSST is also tested using a non-standard subject pool with weak support for TSST leading to stress induction among our sample. Despite the unexpected findings, this study remains an important contribution to the literature on the effect of stress on time preferences and risk preferences.

One strength of the study is that it has greater external validity to developing populations than studies on the same topic conducted with subjects from WEIRD societies, while another of its strengths is that the controlled setting it was conducted in allows questions of causality to be answered, even if the finding is a null-finding that points in the direction that stress does not seem to cause changes in discounting rates and risk preferences. One of the major contributions of this paper is testing the effectiveness of the TSST on stress induction in non-traditional experimental subjects. We see that techniques for behavioral manipulation and measurement must be carefully considered and adapted before being deployed in developing countries. Future studies should continue to explore questions of causality related to time and risk preferences, given the discussion about the role these preferences play in the perpetuation of poverty. However, it should be considered to either conduct stress studies with other existing stress protocols, i.e. the Cold Pressor Test or to test and develop stress protocols with experimental tasks that are more meaningful to participants than tasks of psychosocial evaluation that have mostly been tested on university students from western cultures.

2.7 Appendix

2.7.1 Summary Tables

Table 2.6: Summary Statistics: Demographics

Type	Stat	Age	No. Children	Marital Status	Education
Control	Mean	30.56	1.18	0.42	14.58
	S.D.	10.10	1.69	0.50	3.04
	Median	28	0	0	14
	Min	19	0	0	11
	Max	55	6	1	24
	N	45	50	50	50
Treatment	Mean	33.83	1.60	0.45	14.60
	S.D.	11.90	2.07	0.50	2.43
	Median	31	1	1	14
	Min	20	0	0	11
	Max	67	8	1	22
	N	47	47	47	47
Total	Mean	32.23	1.38	0.43	14.59
	S.D.	11.10	1.88	0.50	2.75
	Median	29	0	1	14
	Min	19	0	0	11
	Max	67	8	1	24
	N	92	97	97	97

Notes: Demographic summary statistics split by treatment type. Columns represent age in years, number of children, a dummy for marital status, and years of education, respectively.

Table 2.7: Summary Statistics: Area under the Curve and Indifference Points

Type	Stat	AUC	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	76.6	66.9	58.8	53	55.3	87.8	77.6
	S.D.	52.5	66.4	64.6	64.6	68.5	71.5	66.7
	Median	60.2	46.9	31.3	21.9	21.9	90.6	96.9
	Min	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	197	197	197	197	197	197	197
	N	50	50	50	50	50	50	50
Treatment	Mean	70.8	70.1	51.8	39.4	43.7	92.1	88.5
	S.D.	41.9	67.1	57.9	45.5	54.2	68	66
	Median	62.9	53.1	21.9	21.9	21.9	96.9	90.6
	Min	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	197	197	197	197	197	197	197
	N	47	47	47	47	47	47	47
Total	Mean	73.8	68.5	55.4	46.4	49.6	89.9	82.9
	S.D.	47.5	66.4	61.2	56.3	62	69.5	66.3
	Median	60.5	46.9	28.1	21.9	21.9	96.9	90.6
	Min	27.7	3.13	3.13	3.13	3.13	3.13	3.13
	Max	197	197	197	197	197	197	197
	N	97	97	97	97	97	97	97

Notes: Non-parametric summary statistics split by treatment type. AUC refers to the area under the curve. Subsequent columns represent raw indifference points for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

Table 2.8: Summary Statistics: Exponential Discount Model Parameter

Type	Stat	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	7.7	4.23	3.06	2.28	6.35	3.49
	S.D.	6.17	3.09	2.08	1.56	6.45	3.25
	Median	5.8	3.72	2.95	2.21	3.17	1.45
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	50	50	50	50	50	50
Treatment	Mean	7.34	4.43	3.25	2.36	5.87	2.91
	S.D.	6.18	3.03	1.9	1.44	6.33	3.01
	Median	5.3	4.43	2.95	2.21	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	47	47	47	47	47	47
Total	Mean	7.53	4.33	3.15	2.32	6.12	3.21
	S.D.	6.15	3.05	1.99	1.5	6.36	3.13
	Median	5.8	3.92	2.95	2.21	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	97	97	97	97	97	97

Notes: Exponential discount model summary statistics split by treatment type. Columns represent the caluclated exponential discount model parameter for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

Table 2.9: Summary Statistics: Hyperbolic Discount Model Parameter

Type	Stat	0m3m	0m6m	0m9m	0m12m	6m9m	6m12m
Control	Mean	7.7	4.23	3.06	2.28	6.35	3.49
	S.D.	6.17	3.09	2.08	1.56	6.45	3.25
	Median	5.8	3.72	2.95	2.21	3.17	1.45
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	50	50	50	50	50	50
Treatment	Mean	7.34	4.43	3.25	2.36	5.87	2.91
	S.D.	6.18	3.03	1.9	1.44	6.33	3.01
	Median	5.3	4.43	2.95	2.21	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	47	47	47	47	47	47
Total	Mean	7.53	4.33	3.15	2.32	6.12	3.21
	S.D.	6.15	3.05	1.99	1.5	6.36	3.13
	Median	5.8	3.92	2.95	2.21	2.9	1.58
	Min	.063	.0315	.021	.0157	.063	.0315
	Max	16.6	8.32	5.55	4.16	16.6	8.32
	N	97	97	97	97	97	97

Notes: Hyperbolic discount model summary statistics split by treatment type. Columns represent the calculated hyperbolic discount model (k) parameter for the six delay combinations. "m" refers to the month delay, where "0m" means "Today". For example "0m6m" represents a combination of "Today vs. 6 months from today".

2.7.2 Regressions with Interactions

Table 2.10: Effect of TSST on Time Preference - Full sample (with interactions)

	(1) Indiff	(2) Fract	(3) Exp k	(4) Hyp k
Treatment	7.218	0.110	-2.015	-44.80*
	(31.06)	(0.124)	(1.866)	(24.87)
0m vs. 6m	-8.125	-0.0400*	-3.473***	-32.45***
	(5.555)	(0.0239)	(0.562)	(10.18)
0m vs. 9m	-13.87*	-0.0500	-4.644***	-42.42***
	(7.192)	(0.0314)	(0.693)	(11.06)
0m vs. 12m	-11.62	-0.0533*	-5.419***	-51.22***
	(7.447)	(0.0288)	(0.712)	(11.49)
6m vs. 9m	20.88**	0.0900*	-1.351*	-7.523
	(8.663)	(0.0459)	(0.713)	(12.57)
6m vs. 12m	10.75*	0.0733**	-4.206***	-37.11***
	(6.469)	(0.0362)	(0.561)	(10.04)
Treat x 0m6m	-10.23	-0.00965	0.563	4.903
	(9.940)	(0.0508)	(0.853)	(14.20)
Treat x 0m9m	-16.84	-0.0528	0.553	2.558
	(11.38)	(0.0501)	(1.023)	(16.52)
Treat x 0m12m	-14.84	-0.0140	0.443	1.629
	(11.89)	(0.0539)	(1.073)	(17.70)
Treat x 6m9m	1.066	-0.00135	-0.119	-3.077
	(14.46)	(0.0719)	(1.196)	(19.18)
Treat x 6m12m	7.601	0.0295	-0.228	-7.298
	(13.40)	(0.0672)	(1.004)	(16.84)
F-statistic	.744	.657	.827	1.573
p-value	.615	.684	.552	.163
R-squared	0.121	0.116	0.220	0.133
N	582	582	582	582

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. AUC refers to the area under the curve generated from plotted indifference points. Indiff refers to raw indifference points from the titration exercise. Fract is the portion of patient responses during the titration exercise. Exp k refers to the discount parameter associated with an exponential discount model. Hyp k refers to the discount parameter associated with a hyperbolic discount model. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to joint testing of the treatment dummy and treatment interaction terms.

Table 2.11: Effect of TSST on Time Preference - Subsample who switch (with interactions)

	(1) Indiff	(2) Fract	(3) Exp k	(4) Hyp k
Treatment	15.65	0.0856*	-1.059	-9.541*
	(10.70)	(0.0444)	(0.767)	(5.434)
0m vs. 6m	-5.382	-0.0191	-2.696***	-10.73**
	(7.713)	(0.0338)	(0.546)	(4.295)
0m vs. 9m	-13.66*	-0.0161	-3.622***	-15.20***
	(7.701)	(0.0276)	(0.600)	(4.555)
0m vs. 12m	-6.716	-0.0144	-4.127***	-16.22***
	(12.70)	(0.0498)	(0.670)	(4.942)
6m vs. 9m	18.58**	0.0825*	-1.593**	-10.16*
	(9.280)	(0.0419)	(0.723)	(5.950)
6m vs. 12m	25.50**	0.164***	-3.901***	-18.42***
	(9.777)	(0.0503)	(0.638)	(4.970)
Treat x 0m6m	-0.299	0.0611	0.467	4.674
	(10.38)	(0.0483)	(0.671)	(4.821)
Treat x 0m9m	-6.203	0.00498	0.805	8.436
	(10.87)	(0.0380)	(0.767)	(5.417)
Treat x 0m12m	-17.83	0.00477	0.871	7.857
	(14.35)	(0.0566)	(0.813)	(5.650)
Treat x 6m9m	12.24	0.0393	-0.276	1.634
	(13.22)	(0.0588)	(0.924)	(6.773)
Treat x 6m12m	-0.432	-0.0224	0.610	7.084
	(14.18)	(0.0632)	(0.841)	(5.982)
F-statistic	1.41	2.481	.979	1.311
p-value	.222	.031	.446	.263
R-squared	0.206	0.172	0.346	0.178
N	358	358	358	358

Notes: Standard errors in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level. OLS regression. Dependent variables are column headers. Indiff refers to raw indifference points from the titration exercise. Fract is the portion of patient responses during the titration exercise. Exp k refers to the discount parameter associated with an exponential discount model. Hyp k refers to the discount parameter associated with a hyperbolic discount model. Includes session fixed effects. Standard errors clustered on the individual level. F-stat and p-value refer to joint testing of the treatment dummy and treatment interaction terms.

2.7.3 Experimental instructions

PANAS and VAS

Now we will ask you to fill out a questionnaire on your computer again that asks about your feelings at the moment. In this questionnaire you will tell us how you feel right now. You will be shown several words, referring to different feelings and emotions. Listen to, or read, every word carefully and indicate how you feel at this moment by placing your finger on the position on the screen, which corresponds to your current feeling. For each item, the green end of the scale means “not at all”, the blue end means “very much”, and the region between means something in between. You can use the entire blue-green gradient for your response, not just the ends. Do you have any questions?

Time Preference

In this part of the study, you make a series of decisions. In each of these decisions, you have a choice between an early payment and a late payment. For example, you might be asked whether you would prefer Ksh 100 today or Ksh 200 after 3 months. You can choose one of these options by simply selecting it with your finger on the screen. In this example, if you choose Ksh 100 today, you will be paid Ksh 100 via MPesa, and this payment will be made TODAY. In contrast, if you chose Ksh 200 after 3 months, you will be paid Ksh 200 via MPesa, but we will only send this money to you THREE MONTHS FROM NOW. So you can choose between getting less money sooner, and getting more money after waiting. The smaller, sooner amount will always be shown in blue; the larger, later amount will always be shown in blue. This is just an example; you will make many such choices, and the amounts and delays of the offers will vary. It's important to note that there is no right or wrong answer here; it is purely up to your personal preference what you decide: Would you like to receive less money sooner, or more money later?

0m vs. 3m: We will now start the task. In this next group of decisions, you will make decisions between getting Ksh 200 in 3 months, or a smaller amount today. You will make 6 decisions, and the smaller amount that you can get today will be different in each decision. You can go through the decisions at your own pace. Remember that there is no right or wrong answer, your preference is the only thing that counts. Please raise your hand if you have questions.

0m vs. 6m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in SIX months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace.

0m vs. 9m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in NINE months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace. 0m vs. 12m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in TWELVE months, or a smaller amount TODAY. When you are ready please press OK and go through the questions at your own pace.

6m vs. 9m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in NINE months, or a smaller amount in SIX months. When you are ready please press OK and go through the questions at your own pace.

6m vs. 12m: Ok, thank you. In this next group of decisions, you can choose between getting Ksh 200 in TWELVE months, or a smaller amount in SIX months. When you are ready please press OK and go through the questions at your own pace.

Risk Preference

In this next task, you will see a number of boxes on the screen. All boxes will contain 1 Ksh coins, except for one which contains a red "X". You don't know initially which box contains the X and which boxes contain coins. You can choose to open as many of the boxes as you like; e.g., if there are 3 boxes, you can open 1 box, 2 boxes, or 3 boxes. You always have to open boxes from the lowest number up; e.g. if you open one box, you must open box number 1; if you open two boxes, you have to open boxes number 1 and 2. If all the boxes that you open contain only coins, you will earn that money; it will be added to your account.

However, if one of the boxes that you open contains the X, you will not earn any money on this trial, even from the other boxes that you opened that contain coins. For instance, say there are 3 boxes, and you decide to open the first 2 boxes. You do this by putting your finger on the box with the number "2", because you want to open 2 boxes. After you do this, the computer will open boxes 1 and 2. Now suppose they both contain coins. Then you have earned Ksh 2, and you move on to the next trial. However, suppose box 1 contains a coin, and box 2 contains the red X. Then you earn Ksh 0 on this trial, and move on to the next trial. If you uncover the X, you don't make money on the current trial, but you keep all money that you made on previous trials and in the previous games, and you can earn more money in the subsequent trials.

Remember that the red X will be contained in exactly one box; it will not occur in more than one box, but it also will not occur in less than one box. Which box contains the red X is chosen at random by the computer at the beginning of each trial. Each box has the same probability of containing the red X. On each trial, you have a new chance to decide how many boxes you want to open. There is no correct answer; we are only interested in your preference. If you open more boxes, you may make more money, but you also have a higher chance of uncovering the X and therefore not earning any money on this trial. If you open fewer boxes, you earn less money, but you have a lower chance of uncovering the X and therefore losing all the money. Note, however, that you will not lose all the money you earned in earlier trials and tasks; you only lose the money contained in the other boxes on that particular screen.

You will play 10 trials of this game.

If you have questions, please raise your hand. Ok, so let's start; please move through the trials at your own pace, i.e. just decide on each screen how many boxes you want to open, put your finger on the corresponding box, and confirm your answer with "OK". You will see whether you earned any money and how much, and then move on to the next trial.

Chapter 3

PUTTING THE 'VICE' IN SAVINGS DEVICE: AN EXPERIMENT ON PRIZE-LINKED SAVINGS

Chaning Jang and Karl Jandoc[1]

3.1 Introduction

Saving is vital to the lives of the poor. Regular savings allows for smoothing of consumption, purchases of durable goods, investments in human and physical capital, and mitigation of personal and financial shocks. Moreover, since the poor are more vulnerable to a disaster or a shock, even a modest amount of savings will obviate the need for them to engage in detrimental methods (for instance, taking children out of school) to

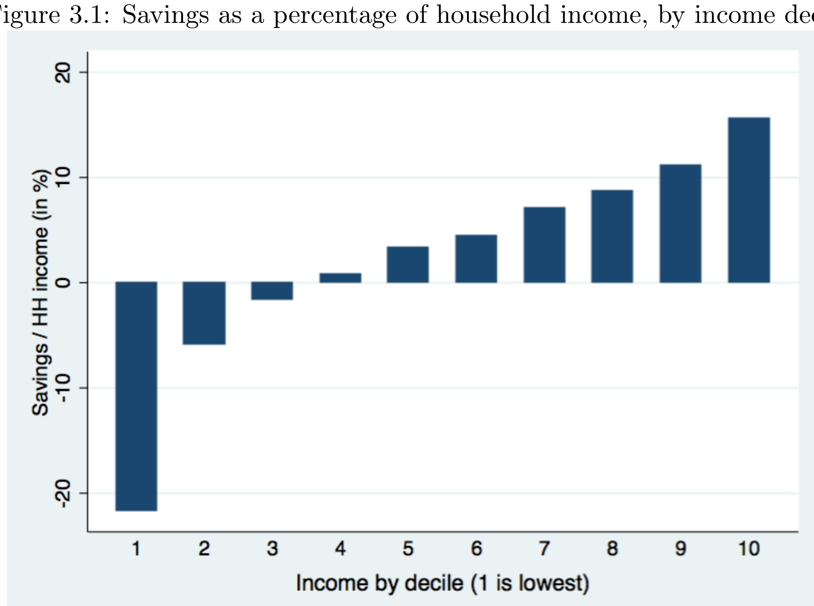
[1]Karl Jandoc, University of Hawai'i at Manoa, Economics Department. We thank Timothy Halliday, Katerina Sherstyuk, Nori Tarui, Majah Ravago and Jeff Ducanes and students from the University of Hawai'i at Manoa and the University of the Philippines for helpful comments. Thank you to the Opel community association, especially Edith Perin, for allowing us to run our study. We are indebted to Colton Jang for his invaluable assistance in conducting some aspects of field work, data management and organization. All errors are our own.

avoid large consumption drops (Chetty and Szeidl, 2007). Thus, encouraging the poor to save may have large social and private benefits and recent studies have focused on how to develop this behavior.

Despite the plethora of benefits that access to savings provides, and evidence that it increases welfare (Bruhn and Love, 2014), it is often the case that the poor do not act as *homo economicus* in response to extensions of traditional savings accounts. Karlan and Zinman (2012) find that demand for savings accounts is unaffected by offered interest rates, in contrast to a similar study that showed a negative relationship between demand for microcredit and price (Karlan and Zinman, 2005). Neither is demand completely driven by account availability or opening cost; Dupas et al. (2012) find that 40% of individuals offered a *free* bank account refused, and that even among those that did open a free account, over 80% did not actively use it[2].

In order to stimulate demand for savings, we then, must turn our efforts away from financial incentives to behavioral incentives. Can we identify a channel that encourages savings not because of financial incentives, but in spite of them? To this end, we focus on a mechanism seen as anathema to savers, gambling.

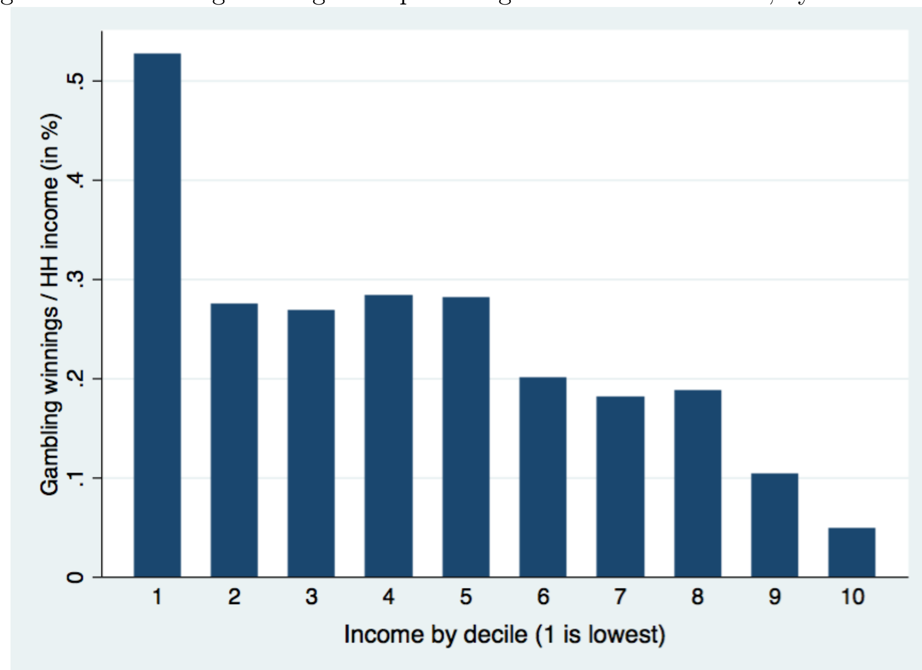
Figure 3.1: Savings as a percentage of household income, by income decile



The horizontal axis represent household income deciles. The bars indicate the average savings as a proportion of total household income for each decile. *Source:* Authors' estimates based on the 2012 Philippine Family Income and Expenditure Survey.

[2]The authors define "active use" as at least 2 deposits within a 12 month period.

Figure 3.2: Gambling winnings as a percentage of household income, by income decile



The horizontal axis represent household income deciles. The bars indicate the average proportion of gambling winnings to total household income for each decile. *Source:* Authors' estimates based on the 2012 Philippine Family Income and Expenditure Survey.

We are motivated by two stylized facts in the Philippines. First, as Figure 3.1 shows, poorer households save less (in fact it is negative for the poorest 20%) than their richer counterparts. Moreover, the proportion saved increases monotonically as we move to richer households. Second, gambling winnings constitute a larger proportion of income for poorer households, as evidenced by Figure 3.2. One of the most popular gambling game is *Jueteng*[3], which is an illegal numbers game in the Philippines. One survey estimates that 14% of Filipinos play this game, and most of them come from the poor Mangahas (2010). Moreover, annual per capita spending on *Jueteng* is estimated to be Php 1,600 (≈USD 40)[4] (which is predominantly played by the poor), almost double the annual per capita spending (Php 875) on the legal state lottery *Lotto* (Desierto et al., 2011). We attempt to implement a savings mechanism based on a game similar to *Jueteng* and ask whether we could exploit the poor's cultural or behavioral disposition towards gambling to make them save more.

[3]The basic mechanism of this game will be discussed in a later section.

[4]At the time of our study $1USD \approx Php40$

This paper contributes to the burgeoning literature on savings behavior in developing countries. We use a randomized controlled trial to test the effects of a prize-linked commitment savings device. Prize-linked savings (PLS) is a mechanism that distributes collective interest in lump-sum payments via a lottery system rather than offering certain, small, individual payments. This scheme dates back hundreds of years, and although it has shown promise in generating funds, it has never been rigorously evaluated as a potential incentive for poor individuals to consistently save.

This RCT is designed not as an impact evaluation *per se*, but as an *intensive mechanism experiment*. An intensive mechanism experiment is one that focuses on interventions which are more highly incentivized than would be feasible to implement at scale. Our main focus was to understand the channel, not the financial sustainability or scaleability. Ludwig et al. (2011) espouse the use of these experiments. The benefits are many; the authors write,

> "Ruling out entire classes of policy interventions is easier when our experiments test interventions that are as intensive as (or even more intensive than) that could be accomplished by actual policies. Testing unrealistically intensive treatment arms also has the benefit of letting us forecast the effects of a wide range of more realistic policy options when... our policy experiments do identify successful interventions." (pg. 26)

We find that prize-linked savings accounts offer high take-up rates and low rates of attrition compared to the existing literature on savings mechanisms. Second, individuals preferred prize-linked savings to traditional savings accounts, *despite a lower rate of return.* Most importantly, those offered prize-linked savings accounts saved a significantly higher amount than those in the control group. We also find effects of time and risk preference and one's social network on savings behavior. Our results show the promise of creating novel savings devices to encourage pro-saving behavior.

The rest of our paper proceeds as follows. In section 3.2, we review the related literature pertaining to prize-linked savings and savings devices aimed at the poor. Section 3.3 discusses the background, population and experimental methodology, section 3.4 explains the results. Section 3.5 offers discussion on the promise of our study, as well as the limitations, while section 3.6 concludes.

3.2 Literature review

Our study aims to contribute to the existing literature in two ways. First, this study is, to the best of our knowledge, the first randomized controlled trial to investigate the effects of prize-linked savings (PLS)[5] on savings behavior. Generally, we refer to PLS as a savings device that bundles accrued interest among savers and redistributes them in a lottery-like fashion. Prize-linked savers earn little or no interest on their deposits, but have the opportunity to earn a larger lump sum instead. PLS dates back to the the "Million Adventure" in the 1690's, where the United Kingdom raised nearly seven million pounds to pay back debts from its Nine Years War (Murphy, 2005). It is currently available in countries around the world, spanning 5 continents. The largest example stems from Great Britain, where their Premium Savings bonds have accumulated over $40 billion of savings. Bond holders are eligible for a monthly drawing where one could win a prize of Gbp 1,000,000 ($1.6 million). Other countries have more modest balances and prizes. Prizes range from cash, to cars, to DVDs with drawings held as infrequently as twice in five years (India Premium Prize Bonds) to daily (Brazil HiperFundo account). See Kearney et al. (2010) and Guillen and Tschoegl (2002) for a more in-depth overview of recent PLS offers. PLS-like accounts are also offered within our country of study, the Philippines (Diaz et al., 2011).

PLS is a popular tool for savings generation, in one case, a South African bank was able to open 1.1 million accounts and collect 1.4 billion Rand in a matter of 3 years (Kearney et al., 2010). There is also evidence that PLS is a popular tool for gamblers (Filiz-Ozbay et al., 2013), and those who are poor at saving through traditional channels Cole et al. (2014).[6] Kearney et al. (2010) report that the South African bank reached 1.1% of the previously unbanked population.

Drawing from two recent papers in the experimental literature, Atalay et al. (2012) find that PLS increases

[5]Also referred to as lottery-linked deposit accounts (LLDA).

[6]Lower income households gamble a higher proportion of their wealth in the US (Kearney et al., 2010) and in the Philippines (see Figure 3.2). See Tufano et al. (2011) for survey evidence that shows PLS appeals to non-savers.

savings at the expense of gambling, *especially among relatively poorer individuals*. Filiz-Ozbay et al. (2013) find that, for a given rate of return, subjects save more with PLS compared to a certain interest payment. Although focused on one-shot portfolio allocation decisions among US citizens, these studies shows the promise that PLS holds in attracting savings among the poor.

To understand the behavioral motivation behind the demand for PLS, we turn to the theoretical literature on gambling. Kwang (1965) offers the seminal treatment on this topic and develops a theoretical model that shows that gambling behavior can be consistent with utility maximization when expenditures are indivisible, even while maintaining the assumption of diminishing marginal utility of consumption. Subsequent models further explore the indivisibility of expenditure and show that larger lump sum payouts offer agents the ability to cross the purchasing threshold on expensive goods. Gambling, or lottery behavior, can be justified by an agent's desire to invest in a high-return, indivisible capital good (Kedir et al., 2011), or to convexify their budget set (Crossley et al., 2011). Other models, backed by empirical data, show that, rather than the effective ticket price (i.e., expected return), the absolute size of the jackpot, standard deviation and skewness all contribute to the demand for lottery devices (Forrest et al., 2002; Wang et al., 2006). Filiz-Ozbay et al. (2013) find evidence that overweighting of small probability events may be an explanatory factor driving the attractiveness of lottery payments.

Second, our study contributes to the growing literature on effects of commitment savings devices on saving behavior in developing countries. Commitment savings devices are used to "force" individuals to create and maintain savings by making withdraw difficult unless certain goals are met. Randomized controlled trials have studied a multitude of commitment savings devices, including lockboxes, accounts that restrict withdraw until a certain time or savings goal is met, costly deposit collection service, and costly withdraw fees.[7] These devices incur an explicit - in fees - or implicit - in time value - cost of holding money, which rational consumers should avoid if a costless option is available. Despite this, take up rates range in the

[7] Ashraf et al. (2006b) provide the seminal treatment on commitment savings; savers in the Philippines were given lockboxes and withdrawal restrictions until a certain date, or until a certain savings goal was met. Ashraf et al. (2006a) offer savers the option to subscribe to a costly deposit collector, who would come door-to-door to collect savings. Dupas and Robinson (Forthcoming) also offer simple lockboxes to Kenyan savers. In South America, Karlan et al. (2010) offer text message reminders and puzzle pieces (with the finished puzzle containing a picture of their savings goal) as an incentive to save. Dupas and Robinson (2013) provide minimum balances and account opening fees for previously unbanked Kenyans.

25%-40%, and treatment groups see significant increases in savings compared to control groups.

Our device stands at the nexus of two mechanisms that are shown to increase savings: a probabilistic device (PLS) and commitment savings. Prize-linked savings should, in theory, allow for the best of both worlds; the ability to commit to longer-term savings as well as the opportunity for a big "pay day". Furthermore, in contrast to traditional PLS accounts[8], we offer individuals the chance to pick numbers, which has shown to be valuable to consumers (Farrell et al., 2000). Thus, compared to costly commitment savings devices, or no savings accounts at all, we should expect that our savings device should lead to both higher take-up rates and higher savings levels. Indeed, our results indicate that they do. As a preview of our results, we find that take-up rates exceed 80% and intent-to-treat effects average Php 92 per person over our 15-day trial.

3.3 Background and methodology

3.3.1 Background and Target Population

Our study took place in July, 2012. Our population of interest is the urban poor in Quezon City, Philippines, one of the most populous cities in Metro Manila. The participants in our study are informal settlers (squatters) who come from the province of Leyte in the Visayas region and are members of the Waray ethno-linguistic group. There are some 60 families in a distinct community area[9], all of whom participated in our study. Our sample population comprises of 66 heads-of-households. Among them, reported daily family income is Php 466, which is above the official poverty line of 271 Php for a family of similar size.[10] Only 12% of households have a formal bank account and 97% find it difficult to save. Sixy percent of households have access to piped water in their homes and the average outstanding informal debt is Php 4,800. See Table 3.1 for more background information.

[8] See Guillen and Tschoegl (2002) for a comprehensive overview of PLS accounts around the world.

[9] The area is bordered by a river along three sides, and a row of houses on the last side. All settlers in the area are from the same ethnic group and migration comes via word of mouth from family and friends back in their home province.

[10] Poverty data from $http : //www.nscb.gov.ph/poverty/2009/Presentation_RAVirola.pdf$, Shows Php 271 for a family of 5, while our study population had an average income of Php 466 and an average family size of 4.9.

Table 3.1: Baseline Characteristics

	Averages			Mann-Whitney
	Overall	Control	Treatment	z
Years in Community	10.87	11.48	10.36	0.48
Daily Income	465.79	447.40	481.11	-0.18
Monthly Savings	148.48	83.33	202.78	-1.22
Household Size	4.88	4.93	4.83	-0.11
% No Savings	0.88	0.93	0.83	1.23
ROSCA Member	0.49	0.41	0.56	-1.13
ROSCA Weekly Savings	244.08	247.83	240.77	-0.77
MFI Member	0.15	0.13	0.17	-0.37
5/6 Borrower	0.74	0.80	0.69	0.97
Informal Loan Amount	4803.79	4056.67	5426.39	0.41
Piped Water	0.58	0.60	0.56	0.36
% Difficulty Saving	0.97	0.93	1.00	-1.56
% Who Gamble	0.91	0.97	0.86	1.47
N	66	30	36	

*, **, ***, denote significance at the 10%, 5%, and 1% level, respectively.

3.3.2 Experimental Timeline

Our experimental timeline was as follows: first we interviewed each head-of-household to ask them questions about their income, savings behavior and family situation as well as elicit risk and time preferences. Next, we randomly divided the groups into a treatment ($n = 36$) and control ($n = 30$). Mann-Whitney Rank-sum test shows that baseline characteristics in the treatment and control groups are not significantly different from one another (Table 3.1). Those in the treatment group were offered a choice between two savings devices: a PLS-like commitment device (PLS) and a commitment based, interest-bearing savings device (COMIT). They also had the option of declining to participate. Those in the control group were not offered any devices; they were interviewed in the baseline and end-line survey only. The treatment period lasted 15 days, after which we conducted the end-line survey, which included questions on savings behavior and one's social network.

3.3.3 *Lo-Teng*: The Genesis of our PLS Device

Our prize-linked savings device is based on two gambling regimes which are prevalent in the Philippines; *Lotto*, and *Jueteng*. Lotto is a government run daily lottery with multiple lotteries within the day and multiple prizes. Individuals go to sanctioned locations (kiosks, or stores) to purchase lottery tickets. A particular Lotto variant we are interested in is the 'EZ-2' lotto where the bettor chooses two numbers, 1-31 inclusive, where a Php 10 bet wins Php 4,000[11]. The 'EZ-2' was designed by the government to be an alternative for the illegal *Jueteng*. However, in most communities in the Philippines, the numbers drawn in the 'EZ-2' lotto are used as winning numbers by *Jueteng* gambling lords (perhaps to signal that draws are not manipulated), thus giving rise to the portmanteau *Lo-Teng* from "Lotto" and "Jueteng". In our target community, *Lo-Teng* is played by 91% of the families. Gambling lords send bet collectors, or *kubradors*, into the community to collect bets door-to-door. The bets are kept by, and the winnings paid out by, the gambling lords. The winning numbers are based on the 9 pm 'EZ-2' lotto which are publicly announced live on TV and newsprint the next day. Because the odds offered are the same, the convenience of having a bet collector come to you, instead of having to travel to place your bet, means that most informal settlers prefer *Lo-Teng* to the official 'EZ-2' lotto.

3.3.4 Description of our PLS device

Our prize-linked savings device (henceforth PLS) works as follows: Each day for 15 days, an enumerator visits a participant and collects Php 10. In return, she offers participants who save the opportunity to play a simple lottery game based on *Lo-Teng*. In our game, players choose 2 numbers, 1 through 31 inclusive. If they match the numbers to those of the official daily drawing (in the correct order) they win Php 300, paid to them the next day[12]. If not, they receive nothing.[13] After 15 days all of the money collected is returned to them (Php 150 in the case that they participate every day).[14] There is no interest earned and participants

[11] Numbers must be chosen in the same order as those drawn.
[12] Prizes were paid for out of research funds.
[13] Results of the drawing are available daily in all major newspapers and on live TV. We did not find a situation where it would be costly for a participant to find this information.
[14] All money is held by the community association.

who do not win incur an implicit cost in losing access to their money during the 15 day time period.

3.3.5 Description of our Commitment device

The commitment savings device (henceforth COMIT) is administered in a similar fashion, without the opportunity to "gamble". Each day for 15 days, a collector visits a participant and collects Php 10. The participant is not eligible to play the *Lo-Teng* game. However, at the end of 15 days, all money is returned to him plus a Php 10 interest payment (Php 160 total in the case that they participate every day). Thus, the difference between PLS and COMIT is the choice of playing *Lo-Teng* at the expense of Php 10 of foregone interest.

Back-of-the-envelope calculations show that PLS offers an expected internal rate of return of around 3.3% while COMIT yields 6.7% *per 15 days*. If participants are risk neutral or risk averse, we should expect no one to choose to adopt the PLS device, which offers less return at a higher variance. However, we remind readers of earlier theoretical models that predict that the absolute size of the payout, rather than the effective return, affects the demand for lottos. The lotto aspect of PLS should predict a positive take-up.

In contrast to some other studies on savings devices[15], we do not encourage savings in either the treatment or control. Choices of treatment were framed neutrally in terms of returns and probabilities.[16]

[15] Most of the studies on savings devices encourage savings in both treatment and control groups. Ashraf et al. (2006a) and Ashraf et al. (2006b) are two notable examples. They do this because their treatment and control groups are both members of banks; ostensibly the very fact that one group is approached with a savings device gives that group education about the importance of savings and may confound the effect of the device alone. Since neither of our groups are encouraged to saved, and the device we proposed is not framed as a method of saving, we can avoid the confounding effects of education.

[16] Full experimental instructions available from authors upon request.

3.4 Results

3.4.1 Risk and Time Preference and Social Network Integration

Risk and Time Preference

We elicited risk and time preferences during our baseline survey by having participants make decisions for real money. Our methodology was based largely on that used in Bauer et al. (2012).[17] To measure risk preference, individuals chose between six sets of gambles, each gamble yielding a high or low payoff with equal probability. The variance of the gambles increased jointly with the expected value. We measured time preference two times: between now and one month from now, and between one month from now and two months from now. In each case, participants selected between a constant amount now (one month from now), and an amount in the future which increases in over six steps. Unlike Bauer et al. (2012), we did not introduce a "front-end delay".[18] After making decisions for risk preference and two time preferences, we randomly paid individuals based on one of their decisions.

Results of risk preference is reported in Table 3.2.

Table 3.2: Baseline Risk Preferences

	Overall	Control	Treatment
Risk Averse	20/66	13/30	7/36
Risk Loving	11/66	5/30	6/36
	Overall	Control	Treatment
Risk Averse	30%	43%	19%
Risk Loving	17%	17%	17%

Individuals are classified as Risk Averse if they choose, of the 6 choices, the gamble with the lowest expected value. Individuals are classified as Risk Loving if they choose the gamble with the highest expected value.

We classified individuals as risk averse if they chose the lowest expected value gamble, and risk loving if they chose the highest expected value. Overall, we see that individuals are more risk averse than risk loving.

[17] See the appendix for the actual decision options.

[18] Bauer et al. (2012) use a "front-end delay" to control for credibility concerns and transaction costs. However, this comes at the cost of eliciting their discount rate with respect to *now*. Because we were with a trusted community member, and future money would be delivered, not picked-up, we decided to forego the front-end delay.

Results of time preference reveal a departure from the literature. First of all, we see strong evidence of minimal short term time discount rates. Nearly half (30/66) of the participants preferred Php 50 one month from now to Php 50 *immediately*. Interestingly, of those 30 who were very patient in the short term, nearly half (14/30) proved to be very impatient in the longer term, preferring Php 50 in one month to Php 100 in two months. Ashraf et al. (2006b) call this behavior “patient now and impatient later”. They find that nearly 20% of their subject pool displayed these tendencies. We show similar results when considering those who were maximally patient in the short term, and maximally impatient in the longer term. Considering the entire sample, over 40% (28/66) of individuals are “patient now and impatient later”. Ashraf et al. (2006b) classify those who are more patient in the future than the present as “hyperbolic”. We classify only 7% (5/66) of our participants as this type in contrast to the 27.5% reported by Ashraf et al.. See Table 3.3 for a full complement of time-preference types.[19]

Table 3.3: Baseline Time Preferences

		Indifference Between 50 Pesos in 1 Month vs. X Pesos in 2 Months			
		Patient	Somewhat Patient	Impatient	Total
Indifference Between	Patient	19	3	19	41
50 Pesos Now vs.	Somewhat Patient	1	2	1	4
X Pesos in 1 Month	Impatient	1	1	19	21
	Total	21	6	39	66

		Indifference Between 50 Pesos in 1 Month vs. X Pesos in 2 Months			
		Patient	Somewhat Patient	Impatient	Total
Indifference Between	Patient	28.8%	4.5%	28.8%	62.1%
50 Pesos Now vs.	Somewhat Patient	1.5%	3.0%	1.5%	6.1%
X Pesos in 1 Month	Impatient	1.5%	1.5%	28.8%	31.8%
	Total	31.8%	9.1%	59.1%	100.0%

Joint distribution of short-term and longer-term time preference. Individuals are classified by their ‘switching point’ in preference of shorter or longer horizon payout. For each individual, there is a point at which time they would prefer to receive money in the short horizon (now or in one month) than in the long horizon (in one month, or in two months). Maximally patient individuals switch immediately, that is, they prefer the longer horizon payment for all decisions. Maximally impatient individuals never switch, that is, they always prefer the short horizon payoff. We classify individuals as *Patient* if they switch immediately, or at 60 pesos. *Somewhat Impatient* are those who switch at 70, 80 or 90 pesos, while *Impatient* individuals switch at 100 pesos or not at all.

[19]Furthermore Bauer et al. (2012) find that 9.6% of individuals were “patient now and impatient later”, while 33.1% were “hyperbolic”.

Social Network Integration

In addition to risk and time preference, we elicit an individual's social network within the community. From a full household roster, we ask each individual to name up to 5 people who they consider to be their closest friends. From this, we analyze the data along three measures: in-degree, out-degree and betweenness centrality. In lay terms, for any given individual, in-degree refers to the number of others in the community who chose him/her as a friend. Out-degree is the number of friends (maximum of 5) which he/she has identified. Betweenness centrality accounts for an individuals importance in providing a 'link' any two individuals.[20]

We find a concentrated social hierarchy in the community; not surprising considering immigration into the community is done through personal connection and word of mouth. Table 3.4 show summary statistics for in-degree, out-degree and betweenness centrality.

Table 3.4: Social Network Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
In-Degree	4.53	3.25	0	13
Out-Degree	4.53	1.166	0	6
Betweenness Centrality	126.697	102.39	0	470.301
N		66		

Overall summary statistics. Mann Whitney Rank-sum test show no significant difference between treatment and control groups (not reported).

We see that the mode out-degree is five, the maximum allowed. However, the mode in-degree is just two, suggesting a top-heavy structure of friendships. To the extent that gaining approval of influential community members is important to effectively administer interventions, it is of the utmost importance that our PLS device appeal to these well-connected community members.

The primary motivator of measuring an individual's social network and risk and time preferences was to use them as explanatory variables in determinants of treatment choice (PLS, COMIT, opt out) and savings

[20]Strictly speaking, in this directed social network, each individual is considered a *node* in the network. Without loss of generality, for two people, A and B, if person A chooses person B as a 'friend' in our survey, this represents a directed *link* from node A to node B. The *in-degree* of node i is the sum of the directed links from other nodes to i. The *out-degree* of node i is the sum of directed links from i to other nodes. Shortest-path betweenness centrality (Freeman (1977)), or simply *betweenness centrality*, is a measure of network centrality which calculates the shortest-paths between each pair of nodes and determines which fraction of all shortest-paths lie on the node of interest.

behavior. We discuss these results in the next section.

3.4.2 Overall Take-up and savings rates

Our intuitive hypothesis is that the dual nature of PLS, which offers lottery-like winning combined with commitment savings should make it a more attractive mechanism than commitment savings alone, despite offering a smaller rate of return. We find strong support for this hypothesis. Among the 36 participants in our treatment group, 6 chose not to participate, while the remaining 30 all chose the PLS treatment. This is our first result.

> ***Result 1: Individuals prefer prize-linked savings to traditional savings even though returns are lower in expectation, and more uncertain.***

This finding is stylized; neither PLS nor COMIT accounts would be economically feasible to implement broadly at the tested rates of return. However, as an intensive mechanism experiment, the results are telling. The data show that individuals are willing to take a substantial rate-of-return discount in order to participate in prize-linked savings. Reinforcing the attractiveness of PLS, all risk-averse individuals in the treatment group opted into PLS.

In terms of savings, we found that our intent-to-treat effects were Php 92 over 15 days. Overall treatment savings of Php 196 is an economically meaningful sum equal to approximately one-half of the average daily wage. This leads to our second result.

> ***Result 2: Individuals in the treatment group saved an average of Php 92 more than those in the control group.***

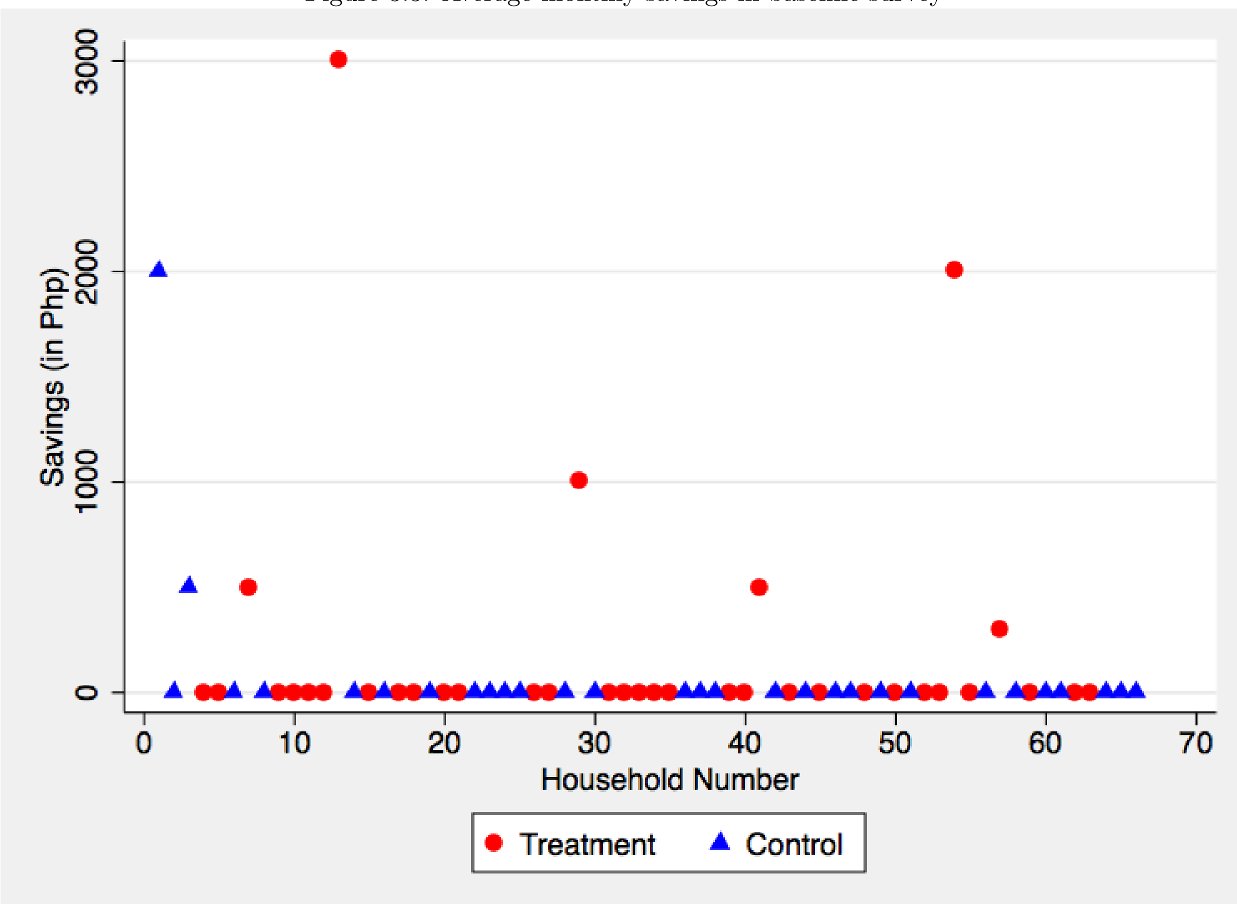
The results are significant at the 1% level using the Mann Whitney Rank-sum test. Figures 3.3 and 3.4 show the before and after scatter plot of savings for each head of household in our study.

Table 3.5: Results of 15-Day Treatment

	Averages		Mann-Whitney
	Control	Treatment	z
Savings in 15 days	103.93	85.71	0.60
Lo-Teng Savings in 15 days	0.00	113.06	-6.547***
Total Savings in 15 days	103.93	196.39	-4.825***
N	30	36	

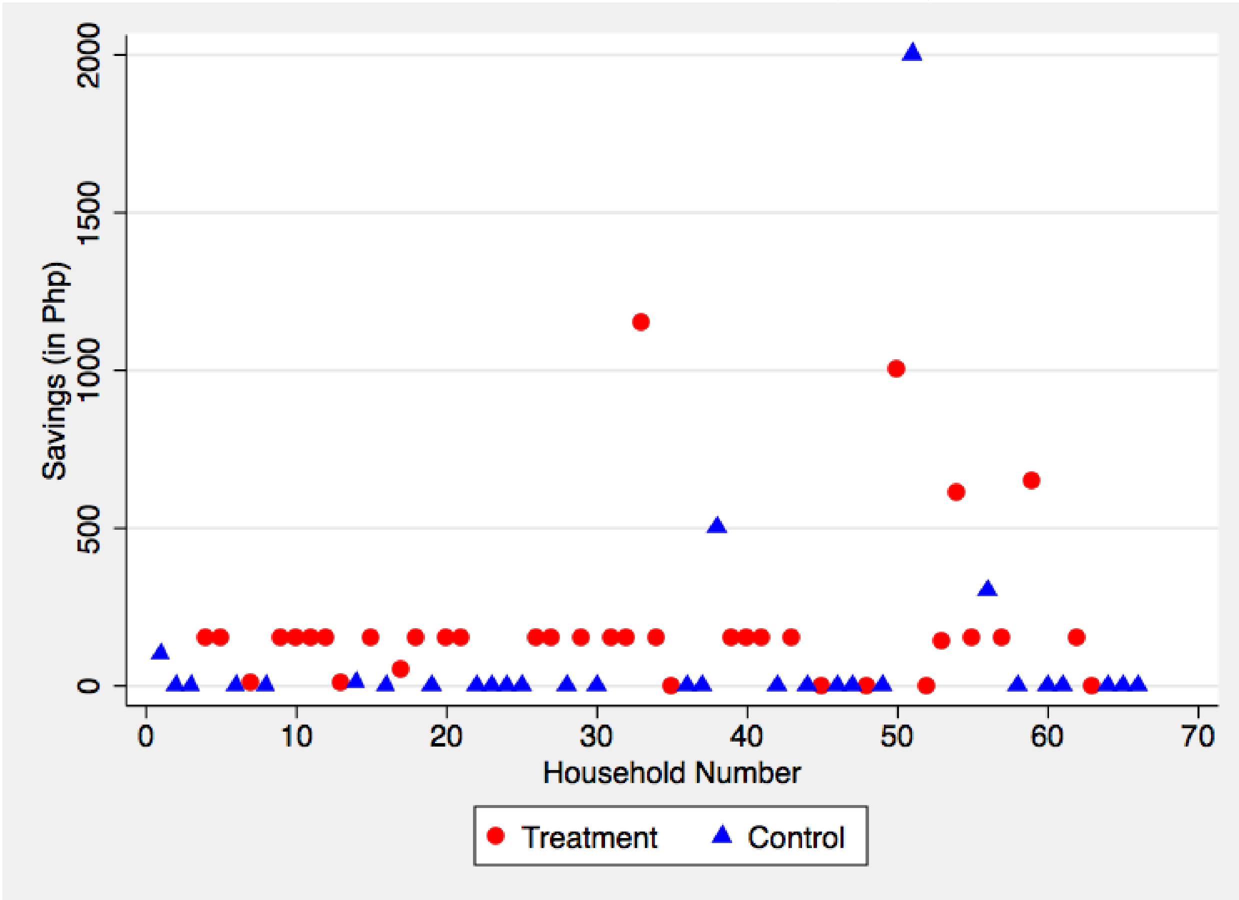
'Savings in 15 days' refers to savings *outside* of the treatment, in other words, money individuals saved on their own. 'Loteng Savings in 15 days' refers to savings contributed to our PLS device. Note that this is zero for the control group by design. *, **, ***, denote significance at the 10%, 5%, and 1% level, respectively.

Figure 3.3: Average monthly savings in baseline survey



Scatter plot of average monthly savings in baseline survey. Red dots indicate those in the treatment group, while blue triangles indicates those in the control group. Y axis is average monthly savings, while X axis is the survey household number

Figure 3.4: Post-Treatment average savings (15 days)



Scatter plot of total savings over the 15 day treatment. Red dots indicate those in the treatment group, while blue triangles indicates those in the control group. Note that savings in the treatment group include money collected with the PLS mechanism, as well as personal out-of-treatment savings. Y axis is total 15 day savings, while X axis is the survey household number

The treatment group saved an average of Php 113 *in treatment* and an average of Php 86 *out of treatment*. By comparison, the control group saved nothing in treatment (by design) and an average of Php 104 *out of treatment*. Note that the Mann Whitney rank-sum test shows that the out-of-treatment savings in each group are not statistically different from one another.

The results are driven by the high compliance rate among PLS adopters. Of the 30 participants in PLS, 25 completed the full treatment, saving Php 150. Of the remaining five who did not fully complete the treatment for 15 days, one individual moved away from the community and was unable to be reached. The other four saved Php 10, Php 50, Php 110, and Php 140; in other words, participated for 1, 5, 11 and 14 days, respectively. By analyzing the daily collection data from the enumerator logbook, we obtain a fuller picture. The 1-day and 5-day participants can be categorized under attrition; they complied until a certain day and then stopped participation completely. The other two could not be located during some collection days in the middle of the treatment period, but otherwise fully complied with the daily collection of savings.

Effect of risk & time preferences and social network integration on take-up and savings

We now take a closer look at how risk and time preference and social network integration affect take-up rates and savings in our PLS savings device. We estimate the effect of these characteristics on take-up rates using a logit regression. Our dependent variable is an indicator variable that equals unity if an individual in the treatment group agrees to participate, and zero otherwise. Table 3.6 shows no robust evidence that take-up is affected by risk preference, time preference or social network integration. This non-result is due in part to limited observations, and limited variation due to high overall take-up rates.

Next we examine how individual characteristics affect in-treatment savings. We estimate the effect using OLS. The general form is $y_i = \beta_0 + \beta_1 X_i^{'} + \beta_2 Z_i^{'} + \epsilon_i$ where y is the 15-day savings from the PLS device (in Php), X_i is a vector of individual characteristics and Z_i is a vector of household controls. Because we measure intent-to-treat effects, $y = 0$ for those in the treatment group who rejected the PLS device.

Table 3.7 shows that various individual characteristics have a statistically significant relationship with in-treatment savings. We see in model 6 that individuals classified as risk loving saved 49 Php more, and that more socially integrated individuals also saved more (for each additional 'friend' an individual has in the community, he/she saves 7 Php more). These results are robust to a host of controls including for household size and income.[21] We also see that informal borrowers are more likely to save more with PLS. Thus we see evidence, not only that PLS is an attractive and useful savings device overall, but also that PLS appeals to risk loving individuals and those currently engaged in expensive informal borrowing; subsets of the population who are at especially high risk for falling deeper into poverty through debt and gambling.

[21] Adding additional controls do not materially change the results. (Regressions not reported)

Table 3.6: Effect on Take-Up

	(1)	(2)	(3)	(4)	(5)
Patient Now,	1.609			1.455	0.705
Impatient Later	(1.39)			(1.09)	(0.46)
In-Degree		0.590**	0.527	0.365	0.995
		(2.01)	(1.51)	(1.03)	(1.24)
Betweeness			0.00289	0.00813	-0.00178
Centrality			(0.31)	(0.74)	(-0.14)
Daily Income					-0.000439
					(-0.13)
Num of Livestock					1.151
					(0.98)
Years in Community					-0.242
					(-1.44)
HH Size					0.198
					(0.28)
Constant	1.099**	-0.475	-0.559	-0.990	-0.549
	(2.13)	(-0.51)	(-0.57)	(-0.89)	(-0.32)
Observations	36	36	36	36	36
Pseudo R^2	0.076	0.212	0.215	0.256	0.385

t statistics in parentheses

Logit Regression.

Effect of Risk & Time Preference and Social network integration on Take-Up. Dependent variable is an indicator equal to 1 if the offer was accepted.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.7: Effect on In-Treatment Savings

	(1)	(2)	(3)	(4)	(5)	(6)
Hyperbolic	-96.32		-85.73		-47.79	-61.34
	(-1.65)		(-1.51)		(-0.85)	(-1.12)
Patient Now,	43.68**		34.23*		22.79	32.26
Impatient Later	(2.26)		(1.75)		(1.10)	(1.67)
Risk Loving		49.42*	40.48		43.91*	49.14*
		(1.84)	(1.58)		(1.77)	(1.94)
Risk Averse		56.09**	39.81		43.68*	31.00
		(2.22)	(1.60)		(1.80)	(1.33)
In-Degree				8.224**	5.399	7.727**
				(2.15)	(1.33)	(2.28)
Out-Degree				19.23*	9.026	
				(1.79)	(0.84)	
Betweeness				-0.0726	0.0562	
Centrality				(-0.59)	(0.44)	
Informal Borrower						45.65**
						(2.22)
Daily Income						-0.0239
						(-0.75)
Num of Livestock						1.554
						(0.53)
Years in Community						-1.338
						(-0.84)
HH Size						7.674
						(1.07)
Constant	96.32***	93.91***	85.73***	-7.990	12.03	2.466
	(7.37)	(7.69)	(6.23)	(-0.17)	(0.25)	(0.07)
Observations	36	36	36	36	36	36
R^2	0.217	0.172	0.308	0.276	0.446	0.558
Adjusted R^2	0.170	0.122	0.219	0.208	0.307	0.382

t statistics in parentheses

OLS Regression.

Effect of Risk & Time Preference and Social network integration on In-Treatment Savings. Dependent variable is 15-day savings from the PLS device.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.5 Discussion

Besides our particular mechanism, our experiment differs from the existing literature in its small sample size and small time frame. There are a two main reasons for this. First, was our intention to trial an intensive mechanism experiment. If we had found little demand for our product in spite of the attractive interest rate and short term, it would have made little practical sense to extend the experiment. Thus, by creating an idealized environment, we can test to see if the *channel* rather than the *policy* is effective. The results of our experiment has demonstrated a significant demand for commitment based prize-linked savings accounts.

Second, there are several socio-political constraints in reaching our target population and offering them a substitute to an illegal lotto they regularly participate in. The small informal settlements in the area are close-knit ethnically and socially. We sought to be minimally invasive - necessitating a small study period. Another looming problem was the fact that our PLS mechanism could be seen as direct competition to the existing *Jueteng* operation.[22] Although we were assured it would not lead to problems, we sought to minimize any potential social conflicts.[23] These socio-political factors are more than justification for a small sample, they are important implications that must be considered before scaling. Mirroring comments by Dupas et al. (2012), we found that trust is, at the same time, a significant barrier to entry, and a gateway to success. Despite the success of the initial experiment, there must be close ties with the community, local government and *powers that be* before proceeding with any scale.

In spite of these potential setbacks, further study into the demand for prize-linked savings accounts hold promise. We caution over-extrapolating our results, but take-up rates (83%), compliance (69%) and increases in savings (91%) are as large or larger than that seen in the previous literature. Furthermore, in absolute magnitude, the Php 113 saved in the PLS treatment compares favorably (if not superior) to the existing literature and was obtained in a fraction of the time. Moreover, all the commitment devices proposed in the literature involved some form of subsidy (whether through provision of lock boxes or costly text messages).

[22] In fact, we designed the mechanism to be as similar to *Jueteng* or *Lo-Teng* as possible to facilitate comprehension. We even calibrated the daily payment to roughly coincide with a settler's average daily bet.

[23] In the end, there were no problems with the gambling lords, and anecdotally, there was little evidence that PLS crowded out gambling.

It is an open question how the substantial increase in savings that we observed in our mechanism balanced by the potential subsidies needed to implement it (prizes, payment to "kubradors", etc.) compare to those offered in the literature. To envision a policy appropriate PLS device, consider charging a 5 peso 'fee' to participate; in other words, returning 145 Php after 15 days. This would reduce the effective annualized rate of return to 3%, in line with current Philippine interest rates.

The key to unlocking the potential in "intensive mechanism experiments" is finding the right parameter values (interest rate, commitment term) to balance demand and feasibility. In an exit survey, 80% of those who were in the PLS treatment said they would be interested in participating again, and over longer commitment lengths. However, when asked what they would use the proceeds of the PLS for, no one mentioned paying down debt, and only two mentioned that they would continue to save the money. Anecdotally, the *kubrador* saw no noticeable decline in informal gambling takings over the treatment period, suggesting that, unlike Atalay et al. (2012), PLS did not crowd out lotto spending. Encouraging habitual savings and good investments remain open challenges.

3.6 Conclusion

Can we transform the proclivity for gambling into virtuous savings behavior? The results of our study show that the answer is yes. We conducted what was, to the best of our knowledge, the first experimental evaluation of prize-linked savings among poor in developing countries, with promising results. We find that those in the treatment group preferred prize-linked savings accounts to traditional savings accounts, foregoing a substantial rate of return in the process. Furthermore, take-up rates of those offered accounts was high (83%) and attrition low; of those who chose to participate, 69% diligently saved throughout the entire study period.

We found that PLS appealed to individuals who are risk-loving, informal borrowers, and socially well connected. This demonstrates that PLS can appeal to those at risk for falling deeper into poverty, at the same time attracting influential community members. Most importantly, over our 15 day study those in the treatment group saved, on average, Php 92 more than those in the control group, a statistically and economically significant amount. For a community with an average informal debt of over Php 4,500, encouraging saving behavior will be crucial to lifting the veil of poverty and allowing for consumption smoothing (without resorting to drastic measures), high return investments, and mitigation of shocks.

Our results hold promise as an "intensive mechanism experiment" but more work needs to be done to pin down the right parameters to best incentivize saving, while allowing for project sustainability. Adjusting the length of commitment, implied interest rates and size of contribution to maximize total saving is the next step in developing a mechanism that can help lift many out of poverty. Going hand-in-hand is understanding how the poor make purchasing decisions and how to encourage savers to spend their accumulated savings in financially prudent ways.

3.7 Appendix

3.7.1 Risk and Time Preference Instructions

Risk Preference Instructions

In this scenario, we will flip a fair coin. Depending on whether the coin lands on heads or tails you will receive the Heads payout or the Tails payout. You will be presented with 6 combinations of payouts. Please choose the option that you prefer:

1. Heads 50, Tails 50

2. Heads 95, Tails 45

3. Heads 120, Tails 40

4. Heads 150, Tails 30

5. Heads 195, Tails 5

6. Heads 200, Tails 0

(Payouts are in Philippine Pesos)

Time Preference 1 Instructions

In this scenario we will ask you to choose between money received now, or money received one month from now. We will ask you six questions, please tell me your preference for each of the six questions. If this scenario is implemented, we will roll a dice. The number on the dice will correspond to one of the six questions you answer. This will determine your payout. For example, if the die rolls a 3, then your answer to question 3 will determine your payout. Please tell me which you would prefer:

1. 50 pesos now or 50 pesos 1 month from now

2. 50 pesos now or 60 pesos 1 month from now

3. 50 pesos now or 70 pesos 1 month from now

4. 50 pesos now or 80 pesos 1 month from now

5. 50 pesos now or 90 pesos 1 month from now

6. 50 pesos now or 100 pesos 1 month from now

(Payouts are in Philippine Pesos)

Time Preference 2 Instructions

This scenario is exactly like the last scenario, except that you will choose to receive money either 1 month from now, or 2 months from now. Please tell me which you would prefer:

1. 50 pesos 1 month from now or 50 pesos 2 months from now

2. 50 pesos 1 month from now or 60 pesos 2 months from now

3. 50 pesos 1 month from now or 70 pesos 2 months from now

4. 50 pesos 1 month from now or 80 pesos 2 months from now

5. 50 pesos 1 month from now or 90 pesos 2 months from now

6. 50 pesos 1 month from now or 100 pesos 2 months from now

(Payouts are in Philippine Pesos)

CONCLUDING REMARKS

This dissertation presents three essays on the intersection of behavioral economics, psychology, and development. My future research attempts to make bigger strides out of the small steps that I have taken so far. On the psychology of poverty, I have completed a third lab experiment that creates what I like to call a scarcity-induced stress. In this project, participants struggle to manage a common-pool resource, where individual profit-maximizing behavior is at direct odds with group-level social optima. After managing this resource in a stressful or non-stressful way, I measure risk and time preference. I expect the results of this experiment in early 2015. I am also developing a project that looks at how direct manipulation of the psychological state can affect economic decision-making and overall well-being. I will be borrowing interventions from positive psychology to test whether they have a direct effect on the psychological state of the poor and a secondary effect on their economic choice. This project will run through 2015.

Regarding poverty alleviation, I am finishing a follow-up randomized field experiment in Nairobi that investigates prize-linked savings with a larger sample and longer time frame. Here I design a mobile phone savings product that tests for the effectiveness of prize-linked savings accounts on overall savings behavior. A rich baseline and end-line survey will also allow me to understand heterogeneous treatment effects for those that are especially prone to gambling. Data collection on this experiment has just completed and will be analyzed in 2015. Another field experiment that is in progress investigates how different welfare/workfare schemes affect the psychology of the poor (affective state) as well as their behavior. Using store vouchers as either unconditional transfers, conditional transfers, or payment for work, I am attempting to understand how different transfer schemes affect both how the poor feel, and how they use the resultant money. Critically, I am working closely with a grocery store to track the purchases that each participant makes. This should help us unpack how spending behavior may be shaped by psychology and ultimately, the way to design transfer schemes to optimize both subjective and material wellbeing. Finally, an emerging interest of mine is how social networks are formed, cultivated, and capitalized on in development. Without the formal institutions that many in the western world are privy to, those in developing countries, especially the poor, rely on informal social networks and social capital to save, share risk, borrow, and invest. I am currently involved in two projects that aim to quantify the effect of social networks on business outcomes among informal micro-entrepreneurs. In the first, I am partnering with Kiva Zip, a peer-to-peer micro-lending platform to understand the effect of social underwriting on loan repayment and business outcomes. We have just completed a baseline survey to characterize the social networks of the borrowers and trustees (who recommend borrowers for loans) and will begin an experimental phase that will quantify the impact of loan recommendations on social capital. The second project is a complete network mapping of a second-hand clothes market to understand how familial and business networks intersect and what correlation exists between network position and business outcomes.

I hope that this line of research tackles one of the most widely known, but least understood problem that faces us today. It is clear that psychological and behavioral changes can be both symptoms and causes of poverty. They can serve as stumbling blocks to poverty alleviation and create poverty traps that are difficult to escape. On the other hand, we see that leveraging behavior can have large effects on poverty alleviation and designing products and services that cater to the specific psychology and behavior of those that are experiencing poverty can be cost-effective solutions for ending this global problem. To this end, I continue to learn as much as I can about poverty, in the hopes that one day we will not have to learn about it anymore.

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