Stress and Temporal Discounting: Do Domains Matter?*

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Abstract

Recent work in behavioral economics and psychology has asked whether stress affects economic choice. Here we focus on the effects of stress on temporal discounting, for which previous studies have produced inconsistent results. We hypothesize that different types of stress may differentially affect discounting. To test this hypothesis, we conducted laboratory experiments in Nairobi, Kenya, in which we induced stress in three domains: social (Trier Social Stress test), physical (Cold Pressor Task), and economic (Centipede Game). We find that neither the social stressor nor the physical stressor affected discounting, but the economic stressor increased temporal discounting. These effects track those of the stressors on self-reported stress and negative affect: the economic stressor increased stress, while the social and physical stressors had no effect. Together, these results suggest that different stress induction protocols may be differentially effective in inducing stress, but that different types of stress may affect discounting in the same way.

Keywords: stress, temporal discounting, laboratory experiment

JEL codes: D03, C91, D9,

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1 Introduction

Many important decisions, including economic choices, are made under stress. As a result, economists and psychologists have recently taken an interest in understanding the effects of stress on such choices (see Haushofer and Fehr, 2014, for a review). However, the precise effects of stress on economic choice remain incompletely understood. Here we focus on the effects of acute stress on temporal discounting by comparing the results of three laboratory experiments that manipulated acute stress along three domains: social, physical, and economic. In studying this question, we make two main contributions. The first is to extend the study of the effects of stress on economic choice beyond Western laboratory settings to a laboratory in a developing country. The effect of stress on economic choice has almost exclusively been studied using "WEIRD" (Western, Educated, Industrialized, Rich, and Democratic) participants (Henrich, Heine, and Norenzayan, 2010), and it is therefore of interest to ask whether the effects found in these populations extend to other settings. In our view, these effects are of particular interest in developing countries, where individuals are exposed to high degrees of stress, and where individual choices may have more dramatic consequences because individuals have less "slack" (Mullainathan and Shafir, 2013).

The second contribution is that we directly compare the effect of different stress induction methods on temporal discounting. Specifically, we aimed to test the relative effects on temporal discounting of social stress, physical stress, and economic stress. To induce social stress, we use the Trier Social Stress Test for Groups (TSST-G) (Kirschbaum, Pirke, and Hellhammer, 1993; von Dawans, Kirschbaum, and Heinrichs, 2011). To induce physical stress, we use the Cold Pressor Task (CPT), which involves immersion of a participant's hand in ice-cold water (0–4° C) for 2 minutes (Porcelli and Delgado, 2009). Like the TSST-G, the CPT has been shown to reliably raise levels of subjective stress, as well as levels of the stress hormone cortisol (Schoofs, Preuss, and Wolf, 2008). Finally, to induce economic stress, we employ a real-time version of the Centipede Game, in which four players alternately get a chance to take a portion of an increasing amount of money (Rosenthal, 1981). At each turn players can either pass, or end the game by taking the money. The four players are thus constantly trading off the motivation to wait until the available amount of money grows larger over time, and the risk that one of the opponents will take first and thus leave them with nothing; this tension is likely stressful. After stress induction in one of the three domains listed above, we measure stress and other negative affective states via self reports on a visual analog scale. Finally, our outcome of interest, temporal discounting, is measured by offering incentivized choices between immediate and delayed payments, made through the Kenyan mobile money system M-Pesa.

The motivation to compare the relative effect of these different methods of stress induction on temporal discounting is twofold. First, existing studies on the effect of stress on discounting have produced inconclusive results, and part of these existing discrepancies could be explained by a different choice of methods. Delaney, Fink, and Harmon (2014) and Koppel et al. (2017) find increases in temporal discounting after exposure to the Cold Pressor task and thermal stimulation. Similarly, Riis-Vestergaard et al. (2018) find that oral administration of hydrocortisone – which raises cortisol levels – led to an increase in temporal discounting. In contrast, Haushofer et al. (2013) find that the Trier Social Stress Test does not affect temporal discounting. One possibility for these discrepant findings is that social stress does not affect temporal discounting, while physiological stress and direct pharmacological manipulation of stress hormones do affect it.[1]

Second, stress is a type of negative affect, and it has previously been shown that different types of negative affect differentially affect economic choice. For instance, Lerner and Keltner (2001) show that fear and anger, two affective states that are often thought to be similar, have differential effects on risk perception: fear, which is associated with lack of control, increases risk aversion, while anger, which is associated with control, increases risk-seeking. We might thus expect that different types of stress have different effects on economic choice as well. In the context of the tasks described above, we might hypothesize that economic stress affects economic choice because the domain in which the stress is induced matches that in which the decision-making tasks takes place. Physical stress could affect economic choice by inducing a feeling of lack of control and physical pain. In line with this view, Koppel et al. (2017) recently showed that physical pain increases discount rates. The effect of social stress is likely to depend on the degree to which the social interaction in question is stressful, and what behavioral motives arise from it; e.g., it has been argued that social stressors induce a "tend-and-befriend" motive (von Dawans et al., 2012), which might lead to more prosocial behavior, but might not affect individual behaviors such as risk and time preference.

We report two main findings. First, we find differential effects of the three stress induction methods on temporal discounting. In particular, the economic stressor leads to an increase in temporal discounting; in contrast, we find no such effect for the social or physical stressors.

Second, this pattern of results tracks precisely the effect of the stress induction methods on stress. The different stress induction methods affect stress levels differentially, and in ways that differ from Western settings. In particular, we find no evidence of an increase in subjective stress levels through our social stressor, the TSST-G, in Kenya. This finding might be due to the fact that public speaking is less stressful to Kenyans than to Western undergraduates, who are traditionally tested on this task and for whom it was mainly developed. In contrast, the physical and economic stressors – the Cold Pressor Task and Centipede Game – produce strong increases in subjectively experienced stress in our setting, suggesting that physical and economic stressors may more universally induce stress than social

[1] A number of other papers study the effect of stress on other economic outcomes; e.g. Angelucci and Córdova (2014). There exists a body of work on the effect of stress on risk attitudes, the results are similarly inconclusive. For instance, Kandasamy et al. (2014) find an increase in risk aversion following repeated hydrocortisone administration. Porcelli and Delgado (2009) find that the Cold Pressor Task increases risk aversion in the gains domain; in contrast, Delaney, Fink, and Harmon (2014) find no effect using the same task.

ones. However, the effect of the Cold Pressor Task dissipates quickly over time and has declined back to baseline by the time participants perform the temporal discounting task, while the effect of the Centipede Game is longer-lasting.

Together, these results suggest that different participant populations may be differentially affected by different stressors, and that therefore the effect of stress on economic choice may differ across settings. In particular, findings with Western participants may not apply to developing country contexts, and researchers should therefore be wary of generalizations from one participant population to another.

The remainder of this paper is structured as follows. Section 2 details the design, procedure, and outcome variables, Section 3 discusses the data and econometric approach, Section 4 presents the results, and Section 5 concludes.

2 Design and Methods

2.1 Sample and Data Collection

Using the participant pool of the Busara Center for Behavioral Economics, we recruited 705 participants from Kibera, Viwandani and Kawangware, informal settlements in Nairobi, Kenya to participate in the study.[2] Recruitment was restricted to males (to minimize fluctuations in cortisol levels) who had not previously attended a study which induced stress. No participant attended more than one experimental session. For each stressor, a participant was assigned to the stress condition or the control condition, never both. Experimental sessions took place between February 2013 and October 2015.

Upon arriving at the Busara Center, participants waited in a room where they gave informed consent. After this participants entered the computer lab and sat at a computer that was randomly assigned to them. Generally the tasks within the experiment proceeded as follows. First, participants were given a set of examples to acquaint them with using touchscreen computers. Next, the first measurement of subjective stress was taken. Next, participants underwent the stressor or control condition. The assignment was not known to participants *ex ante* and no reference was made to the idea that the task might be stressful. After the administration of the stressor, we again measured self-reported stress. The primary tasks related to temporal discounting followed. Next, endline self-reported stress was measured, followed by a demographic questionnaire. Finally, participants were made aware of the earnings from the experiment that they would be receiving.

2.2 Stress induction tasks

Our primary question is how stress in different domains affects temporal discounting. We therefore purposely chose paradigms designed to induce three types of stress: social, physical, and economic. Each

[2] Haushofer et al. (2014) provide an overview of the infrastructure and processes of the laboratory, and detailed recruitment and study protocols.

method is described in greater detail below:

1. **The Trier Social Stress Test for Groups (TSST-G):** The Trier Social Stress Test for Groups (TSST-G) (von Dawans, Kirschbaum, and Heinrichs, 2011) is based on the single-participant Trier Social Stress Test (TSST) (Kirschbaum, Pirke, and Hellhammer, 1993). The test involved 5 minutes of preparation for a mock job interview, which was followed by a 2-minute question and answer round where participants were quizzed about their suitability for the hypothetical job. Next, participants underwent a 2-minute mental arithmetic task, in which they performed serial subtractions of 16 from a four digit number, while being recorded by a video camera and evaluated by project staff who refrained from socially-supportive facial expressions. In the stress condition, at most five participants were tested at once. The control group exercise involved a 4-minute period of reading a magazine, in lieu of preparation. Instead of a job interview, control group participants spoke freely about the qualities of a friend; during this exercise, all respondents in the group spoke at the same time. The arithmetic task was the same as in the treatment group, but again participants performed it at the same time and were told that performance was not rated. In the control condition up to twenty participants were tested simultaneously. We randomly assigned sessions to receive the stressor or control during the invitation process. Performance in the task was not incentivized.

2. **The Cold Pressor Test (CPT):** The Cold Pressor Test (Porcelli and Delgado, 2009) consisted of immersing one's left 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 containing 6 kg of ice cubes, and another in which participants immersed their hand in water up to their wrist with outstretched fingers. A waterproof RS-2001 electrical filter pump was used to circulate the water to avoid local heat build up around the hand (Mitchell, MacDonald, and Brodie, 2004). Commercial-grade submersible aquarium thermometers were used to monitor and measure water temperature. Random assignment of the stressor was conducted at the individual level via a double-blind procedure.[3] Participants received KES 100 for completing the 60 second immersion.

3. **The Centipede Game (CENT):** We used a modified real-time version of the Centipede Game first introduced by Rosenthal (1981). In our case, the game lasted for 15 rounds of 21 seconds

[3] Upon arrival at the lab, participants were randomly assigned seat numbers (between 1 and 8) by a research assistant who was not involved in the administration of the experimental session. Before each session, a different research assistant, who was also not involved in administration, randomly drew seat numbers from an envelope to assign respondents to seats. After positioning the containers at their respective seats, the containers were covered such that neither the research assistant(s) administering the session, nor the participants, could determine which seat was associated with which condition.

each. We generated two versions of the game: a "regular" and a "reverse" version. In the "regular" version, in each round of the game, a resource started at a low amount and doubled every three seconds. Player(s) were faced with a decision to "pass" or "take" the resource. The fact that the resource grows over time creates an incentive to "take" in the last three second interval and "pass" in all others. However, when the game is played with others, the player who takes first ends the game, thus creating an incentive to take early. We used two versions of the game: a 1-player and a 4-player condition. Participants assigned to the 1-player condition played for themselves without partners, and their payoff depended only on when they themselves decided to "take". The starting resource was KES 1 (at the time of the study the KES/USD rate was between 85/1 and 100/1), resulting in a maximum resource of KES 128. If a player did not make a decision within the decision period of 21 seconds, the default decision was to pass and the player received KES 128 for that round. If the player did not take in any of the 15 rounds, they received the maximum payout. Thus, the optimal strategy was simply to wait out the game. Participants in the 4-player condition competed with 3 other players. The starting resource was KES 4, resulting in a maximum resource of KES 512. Players decided simultaneously to pass or take within each three second interval. The default decision was to pass. If all players passed, the resource remained intact. If a player took, the round ended, and that player earned all of the resource. If more than one player took in the same 3-second interval, those players split the resource amongst themselves. If no player collected before the time ran out, everyone in the group split the maximum resource equally. After each round, participants were alerted of the resource they had collected, but not the resource levels of anyone else. At the end of the study, the computer randomly chose one of the 15 rounds to pay out to the participants. By backward induction, there exists a unique sub-game perfect equilibrium in the 4-player condition where each player takes in the first three second interval. We hypothesized that this unraveling would lead to stress. In contrast, in the one-player condition, no unraveling is predicted to take place, and as a result, stress levels should be lower. We therefore manipulated stress by randomly assigning, at the session level, some participants to the 4-player game as a stress inducer, and others to the 1-player game as the control. It is important to note that total payoffs were carefully calibrated across the two conditions, ruling out the possibility that any differences in discounting behavior resulted from the income effect during titration.

In the "regular" version of Centipede Game described above, the equilibrium strategy is to act immediately. This fact could generate a general belief that acting immediately is advantageous, and therefore spill over into the discounting task and induce participants to select the "sooner" option. We therefore generated a "reverse" version of the Centipede Game to control for this possibility. In the reverse version, each round began with a large common-pool resource that decreased over time (KES 128 for the 1-player and KES 512 for the 4-player game). Participants assigned to the 1-player condition individually played the game and decided how much to collect. If the player did not collect when the timer ran out, they received the minimum amount for that round (1). Thus, the profit maximizing strategy for an individual in the 1-player condition was to collect the resource immediately. Players in the 4-player condition competed with 3 other players. The incentives were now such that it was individually optimal to take as late as possible: players who collected before the three second interval in which the *last* person collected received zero points. Players who collected in the same three second interval split the points among themselves. If no player collected before the time ran out, everyone in the group received the minimum number of points (1). In the 4-player version of this game, if each person collected immediately, the group would equally split the maximum resource (KES 512). But if three people took in the first interval and the fourth player took in the second three second interval, the fourth player would receive the resource of 256, and everyone else would receive nothing. The computer randomly chose one of the rounds to pay out to the participants at a conversion rate to KES of 1:1. In this version, as in the previous, the 4-player game was randomly assigned at the session level. Our main results present pooled data for the regular and reverse versions; disaggregated results are shown in the Appendix.

2.3 Outcome variables

2.3.1 Self-reported stress

Our main outcome measure of self-reporeted stress is a single question asking participants how stressed they feel at the moment, using a visual analog scale from 1–100. This measure was taken immediately after stress induction, but before the temporal discounting task. In the CPT and CENT conditions, it was additionally measured at endline, i.e. after the tepmoral discounting task. In the TSST-G and CENT conditions, we also measured negative affect using the PANAS scale; we do not focus on these outcomes because they were not collected for TSST participants.

2.3.2 Temporal Discounting

We measure temporal discounting using a titration paradigm. On each trial of the task, participants are asked to choose between a larger amount of money available later, and a smaller amount available sooner. The delay combinations are "today vs. 3 months", "today vs. 6 months", "today vs. 12 months", and "6 months vs. 12 months".[4] For each delay, each participant made five decisions between smaller, sooner and larger, later rewards. The larger, later reward was fixed at USD 5.10 for TSST-G and CPT and at USD 25.30 for CENT. The smaller, sooner amount was systematically adjusted by means of a bisection algorithm based on the choices made by each participant. For each larger, later reward chosen,

[4]These delay combinations are shared across all conditions; the CENT condition also had other delay combinations, but we exclude these here for comparability.

the smaller, sooner reward was increased by half the difference between it and the fixed larger, later reward. For each smaller, sooner reward chosen, the smaller, sooner reward was decreased by half the distance between it and the previously offered smaller, sooner award.

At the end of the experiment, the computer randomly selected one of the choices and paid that amount to the respondent; in the Centipede experiment payouts were realized with 20% probability. All payments in our experiment were made using the M-Pesa mobile money technology. M-Pesa is a money transfer service operated by Kenya's largest mobile phone company, Safaricom. Users can send and receive transfers and make direct payments to firms using their phones, and they can also withdraw cash from their M- Pesa accounts at over 80,000 M-Pesa agents throughout the country. All subjects in our experiment have active M-Pesa accounts. This system allowed us to offer intertemporal choices that can be realized in the future and as soon as the same day, while holding the transaction costs of receiving payment constant. Because Busara enjoys a high level of trust in the community, we believe that the promise of payment in the future was credible. [5]

Note that we assume quasi-linear utility in inferring discount rates from choices in this task. This approach differs from approaches that jointly estimate utility function curvature and time preference parameters (Andersen et al., 2008; Andreoni and Sprenger, 2012). We nevertheless chose this assumption, for three reasons. First, the use of binary choices greatly simplifies the task, which is important especially in the context in which we work, which has low familiarity with questions of this type. Second, with moderate stakes, utility is likely well-approximated by quasi-linearity, and as a result, the most recent work in intertemporal choice has made this assumption (Augenblick and Rabin, 2017). Finally, in our previous work in the same context, found high correlations between time preference parameters when utility function curvature was taken into account and when it was not (Balakrishnan, Haushofer, and Jakiela, 2015).

Temporal Discounting Variables For each delay, the titration exercise determines an indifferent point for the larger, later relative to the smaller, sooner payment. We can calculate the following measures of temporal discounting.

1. **Proportion of patient choices:** For each decision in each titration exercise, an individual could choose the larger, later reward or the smaller, sooner reward. This variable measures the proportion of times an individual opted for the larger, later payment.

2. **Average indifference point:** We calculate the indifference points implied by the titration exercise is the as midpoints of the interval that the decisions of the participant identify as containing the true indifference point for each delay combination. The average indifference point is an individual-level outcome which takes the simple average of the indifference points elicited with different delays.

[5]For more information on M-Pesa, we refer readers to Jack and Suri (2011) and Mbiti and Weil (2011).

3. **Average exponential decay ($\bar{\delta}$):** To calculate an exponential decay for each participant i and each delay combination($t_1 = 0, t_2 = 3$), ($t_1 = 0, t_2 = 6$), ($t_1 = 0, t_2 = 12$), and ($t_1 = 6, t_2 = 12$), we write:

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

This implies:

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

The average exponential decay is the participant's average δ over all delay combinations.

4. **Area under the curve:** For each participant, we calculate the area under the curve described by their indifference points with the trapezoidal formula.

5. **Decreasing impatience:** Given δ, we can compute an index for decreasing impatience as an average of two differences:

$$\Delta_{DI_{03}} = \delta_{0,3} - \delta_{0,6},$$

$$\Delta_{DI_{06}} = \delta_{0,6} - \delta_{0,12}.$$

Each difference captures the extent to which impatience decreases as delay increases. A low index for decreasing impatience (> 0) implies that discount rates do not vary with delay; a large index implies that an individual's discount rate falls as delay increases.

6. **Departures from stationarity:** We also compute an index for departures from stationarity (Halevy, 2015):

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

Thus, departure from stationarity measures the extent to which δ changes with a front-end delay. This index can be thought of as a measure of "static reversals" or time inconsistency, i.e. the extent to which decisions differ when front-end delays are added.

3 Empirical Strategy

To test the effect of the stressors on our outcomes and to compare effects across different stressors, we estimate the following linear model.

$$y_i = \beta_0 + \beta_1 \text{Treat}_i + \beta_2(\text{Treat}_i \times \text{TSST}_i) + \beta_3(\text{Treat}_i \times \text{CPT}_i) + \gamma_0 \text{TSST}_i + \gamma_1 \text{CPT}_i + \mathbf{X}_i + \varepsilon_i \quad (1)$$

Here, y_i is the outcome variable of interest for individual i, Treat_i is a dummy for the stress treatment, TSST_i is a dummy for the TSST-G experiment, CPT_i is a dummy for the CPT experiment, ε_i is the residual, and $\mathbf{X}_i$ is a pre-specified vector of baseline covariates.[6] The omitted category in this model is the control group of the CENT experiment. We pool regular and reverse Centipede Game under this group. Standard errors are clustered at the session level, our highest level of randomization.

Including stressor dummy variables and their treatment interactions allows us to test for effects within and across experiments. We test null hypotheses of no treatment effect in the CENT, TSST-G, and CPT conditions with $\beta_1 = 0$, $\beta_1 + \beta_2 = 0$, and $\beta_1 + \beta_3 = 0$, respectively. Testing $\beta_2 = 0$, $\beta_3 = 0$, and $\beta_2 = \beta_3$ compares the stress effect for TSST-G against CENT, CPT against CENT, and TSST-G against CPT, respectively.

We first estimate Equation 1 with self-reported stress as the outcome to determine whether the treatment successfully induced stress. We then estimate the treatment effect on our primary temporal discounting outcomes detailed in Section 2.3.2. We additionally conduct a test of joint significance over the temporal discounting outcomes using SUR.

Given that we analyze several outcomes related to temporal discounting, we calculate sharpened q-values over each set of outcomes to control the false discovery rate (Benjamini, Krieger, and Yekutieli, 2006). Rather than specifying a single q, we report the minimum q-value at which each hypothesis is rejected (Anderson, 2008). We apply the correction over the six outcomes, separately for each hypothesis we test. We report both standard p-values and minimum q-values in our analysis.

The econometric approach was pre-specified and registered prior to analysis (Haushofer et al., 2015). Minor discrepancies between the present analyses and those specified in the pre-analysis plan are summarized in Table A1 in the Appendix.

4 Results

4.1 Effect of Stress Induction on Self-Reported Stress

Table 1 summarizes the treatment effect of the stressors on self-reported stress, measured immediately after stress induction ("midline") using our single visual-analog scale question, separately for the individual stressors. Column headers denote the stressor type (TSST-G, CPT, CENT). Each cell in the table represents the treatment effect of a particular stressor on self-reported stress. Because the outcome is standardized to its control group mean, the coefficients can be interpreted as the difference in standard deviations from the control group mean.

Surprisingly given its effectiveness in Western contexts, the TSST-G stressor does not strongly affect stress, with a 0.09 SD difference between treatment and control conditions, not significant at the 5% level. In contrast, the CPT significantly increased self-reported stress (1.69 SD, $p < 0.01$). We also find a treatment effect of the Centipede Game (pooled regular and reverse) on self-reported stress (0.49 SD),

[6] This vector includes a dummy variable for whether the participant completed standard 8, participant age, number of children, a dummy variable for being married, a dummy variable for unemployment, BMI, monthly income, and a dummy variable for holding debt.

Table 1: Treatment effects across domains – Stress

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Self-reported stress (SD)	-0.09	1.69***	0.49***	1.78***	0.58***	-1.20***
	(0.17)	(0.20)	(0.12)	(0.27)	(0.21)	(0.23)

Notes: This table displays coefficients and hypothesis tests for the effects of treatment on self-reported stress, measured immediately after stress induction and before the temporal discounting task. Columns 1-3 report treatment effect estimates for self-reported stress for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across conditions. Standard errors are in parentheses. Asterisks indicate significance with naive p-values. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

significant at the 0.01 level. Thus, the CPT and CENT induce a strong stress response and, in contrast to many experiments run in Western settings, the TSST-G failed to induce any changes in stress.

Note, however, that the effect of the CPT on self-reported stress dissipated quickly, and was no longer different from control when measured at "endline", i.e. after the discounting task, as shown in Table A3. In contrast, the stress induced by CENT was still different from control at endline.

Columns 4-6 in Table 1 test differences in the treatment effect on stress across conditions. Stress is significantly elevated in the Cold Pressor (1.78 SD) and Centipede Game (0.58 SD) conditions relative to TSST-G, both significant at the 1% level. Furthermore, we observe a 1.20 SD difference in stress between the Cold Pressor and the Centipede Game ($p < 0.01$), suggesting that the Cold Pressor induces a stronger stress response than the Centipede Game.

4.2 Effect of Stress on Temporal Discounting

We now discuss the effect of the three stressors on temporal discounting. Table 2 shows the results of this analysis.

The TSST-G and CPT conditions show limited evidence of a stress effect on temporal discounting; most of the individual estimates are close to zero, and none of them are significant. In contrast, we find that temporal discounting is also strongly affected in the CENT condition, with participants in the treatment condition being less patient than those in the control condition. Specifically, they are 6% less likely to choose the "patient" option ($p < 0.05$), have indifference points that are on average USD 0.07 lower ($p < 0.05$); and an area under the curve lower by 0.09 units ($p < 0.01$). Interestingly, the effect appears to be driven less by changes in the exponential discount rate and decreasing impatience, and mostly by departures from stationarity. Recall that decreasing impatience measures how discount rates vary with delay in decisions between the present and the future (e.g. 0–6 months vs. 0–12 months), while departures from stationarity measure how discount rates change as front-end delays are added to decisions between two options with a fixed time difference (e.g. 0–6 months vs. 6–12 months). Most of

Table 2: Treatment effects across domains – Temporal discounting

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Prop. of patient choice	0.03	-0.01	-0.06**	-0.04	-0.09*	-0.05
	(0.04)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)
	[1.00]	[1.00]	[0.01**]	[0.75]	[0.34]	[0.24]
Avg. indifference point	-0.01	0.00	-0.07**	0.01	-0.06	-0.07*
	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)	(0.04)
	[1.00]	[1.00]	[0.01**]	[1.00]	[0.34]	[0.12]
Avg. exponential decay	-0.02	0.02	0.04*	0.04	0.06	0.02
	(0.04)	(0.02)	(0.02)	(0.04)	(0.04)	(0.03)
	[1.00]	[1.00]	[0.02**]	[0.75]	[0.34]	[0.49]
Area under the curve	-0.03	0.02	-0.09***	0.05	-0.06	-0.11**
	(0.05)	(0.04)	(0.03)	(0.06)	(0.06)	(0.05)
	[1.00]	[1.00]	[0.01**]	[0.75]	[0.34]	[0.05*]
Decreasing impatience	0.03	-0.03	-0.03	-0.06	-0.06	0.00
	(0.04)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)
	[1.00]	[1.00]	[0.06*]	[0.75]	[0.34]	[0.63]
Dept. from stationarity	-0.02	0.02	-0.05***	0.04*	-0.03	-0.08***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
	[1.00]	[1.00]	[0.00***]	[0.51]	[0.34]	[0.00***]
Joint test p-value	0.06*	0.56	0.00***	0.14	0.19	0.01**

Notes: This table displays coefficients and hypothesis tests for the effect of treatment on discounting. Columns 1-3 report treatment effect estimates on each row variable for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across conditions. Standard errors are in parentheses and FDR-adjusted minimum q-values are in brackets. Stars on the coefficient estimates indicate significance with naïve p-values. The bottom row reports p-values of a joint test across row variables. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

the estimates for CENT remain significant at the 5% level when using FDR-adjusted q-values. We further reject the null hypothesis for the joint test of CENT ($p < 0.01$). Table A6 shows that the coefficients are almost identical when we disaggregate the "regular" and "reverse" versions of the centipede game.

Comparing the treatment effect across experiments, we do not observe differences between TSST-G and the other stress induction methods; the joint tests do not reject. We find some significant differences when comparing CENT and CPT; the negative effect of the Centipede Game on AUC is 0.11 units greater than the Cold Pressor ($p < 0.05$) and the effect on departures from stationarity greater by 0.08 ($p < 0.01$). The joint test comparing CENT and CPT is significant at the 5% level. Thus, CENT affects discounting more strongly than CPT, but neither CENT nor CPT differ significantly from TSST.

4.3 Robustness to Finite Sample Bias

One potential concern with the results reported above is that they might be caused by finite sample bias in estimates of the standard errors. Recall that for our primary specification, we estimate cluster-robust standard errors (CRSE) at the session level—our highest level of randomization—to account for intracluster correlation. Use of this estimator is justified asymptotically, but with a small number of clusters the CRSE is known to be downwardly biased, leading to invalid inference (Cameron and Miller, 2015). The present study relies on a total of 81 clusters. Finite sample bias is further exacerbated with variance in cluster sizes (Mackinnon and Webb, 2017). The number of participants in each session ranges broadly from 5 in the TSST-G stress condition to 20 in the control condition and in the remaining experiments. Thus, there is a concern that our tests are over-rejecting the null of no treatment effect.

To address this issue, we conduct randomization inference to test the Fisherian sharp null hypothesis of no treatment effect for every participant (Fisher, 1935).[7] The basis for this inferential framework is that the distribution of test statistics comes from random treatment assignment rather than from drawing a finite sample from a super-population. We perform Monte Carlo approximations of the exact p-values using $M = 10,000$ permutations of the treatment assignment. We then estimate our primary specification within each m^{th} permutation and calculate the standard Wald statistics for each of our six hypothesis tests. We compare the Wald statistics from the original sample with the distribution of permuted statistics to produce approximations of the exact p-values:

$$\hat{p}_{\beta} = \frac{1}{10,000} \sum_{m=1}^{10,000} \mathbf{1}\left[\hat{\boldsymbol{\beta}}'_m \hat{V}(\hat{\boldsymbol{\beta}}_m)^{-1} \hat{\boldsymbol{\beta}}_m \geq \hat{\boldsymbol{\beta}}'_{obs.} \hat{V}(\hat{\boldsymbol{\beta}}_{obs.})^{-1} \hat{\boldsymbol{\beta}}_{obs.}\right]$$

Following Young (2015), we permute the data and calculate the regressions for all outcomes within each draw. We estimate SUR for each permutation over the family of outcomes to obtain p-values for the test of joint significance.

Results from randomization inference are shown in Tables A4 and A5 in the Appendix. The individual and joint tests of the Cold Pressor and Centipede Game on stress remain significant at the 1% level, while the effect of TSST-G on stress remains insignificant. Comparing the sample-based and randomization-based tests of our main results on temporal discounting, we find the pattern of results remain consistent with what we find in the prior analysis. Thus, the conventional large-sample tests used for our main results are robust to potential finite sample bias.

5 Conclusion

There exists a growing literature on the effects of stress on temporal discounting, but previous studies have reported inconsistent effects, with some finding no effects (Haushofer et al., 2013) and others finding increases in discounting under stress (Delaney, Fink, and Harmon, 2014; Riis-Vestergaard et al., 2018; Koppel et al., 2017). In this paper, we attempt to resolve this contradictory pattern of evidence by asking whether different types of stressors differentially affect temporal discounting. We use a physical (Cold Pressor Task), social (Trier Social Stress Test), and economic stressor (Centipede Game) to assess how these stressors affect both temporal discounting and self-reported stress and affect. Our study is

[7] Note that this is more restrictive than the null hypothesis of zero average treatment effect.

conducted with residents of informal settlements in Nairobi, Kenya, increasing external validity and contributing to moving behavioral economics away from student participant pools.

We find that the physical stressor (CPT) induces a strong but quickly dissipating increase in stress, while the economic stressor produces a milder but longer-lasting increase in negative affect. Surprisingly, the TSST-G does not affect stress or affect, contradicting previous evidence establishing it as an effective stress induction protocol. In fact, we find evidence that the TSST-G *reduced* stress in our sample, a result possibly explained by the difference in social context and in particular different attitudes towards public speaking in Kenya.

The differential effects of the manipulations on stress and affect are reflected in their effects on temporal discounting. We find strong evidence that the economic stressor increases temporal discounting. In contrast, the stress induction of the CPT and TSST-G have no robust effects on temporal discounting. Thus, our finding suggest that the domain in which stress is induced matters only inasmuch as different stress induction protocols may have different effects on stress, and these effects may differ across settings: in Western settings, the TSST-G produces robust increases in stress, while in our setting it does not produce the same effect. In contrast, CENT game increased stress as expected, as did the CPT; however, the transitory stress increase generated by the CPT resulted in no effect on discounting. Together, these findings are consistent with a unitary effect of stress on discounting: it appears that increased stress increases discounting, and decreased stress decreases it, regardless of how the stress was induced.

We note that the effects we observe here may be specific to discounting with money. Recent work has suggested that people discount effort differently than money (Augenblick, Niederle, and Sprenger, 2015), and specifically that they exhibit present bias only for effort, but not for money. We focus on discounting of monetary outcomes because people frequently do make savings and investment decisions involving money. Future work might test whether and to what extent stress affects effort discounting as well.

Our evidence demonstrates the importance of context in studies of stress and economic choice, and the usefulness of going beyond "WEIRD" samples to study non-standard populations. It further highlights the importance of manipulation checks in assessing whether stress induction protocols work as intended for different populations. Future work might test systematically which stressors work in which contexts, and which other economic behaviors are affected by stress.

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A Appendix: Randomization Check

We test for differences in sociodemographic characteristics between treatment and control groups using the following specification.

$$y_{ij} = \beta_{0j} + \beta_{1j}\text{Treat}_{ij} + \varepsilon_{ij} \tag{2}$$

We estimate this model separately for each stressor j at the individual level i. y_{ij} are the following dependent variables: a dummy variable for whether the participant completed standard 8, participant age, number of children, a dummy variable for being married, and a dummy variable for unemployment. Treat_{ij} is the treatment indicator and ε_{ij} is the idiosyncratic error term. Standard errors are clustered by session—the level of randomization. We test for balance on participant characteristics within each experiment with a test of joint significance across outcomes using seemingly unrelated regression (SUR).

Table A2 shows baseline characteristics for demographic variables and the baseline affective state inventory. There are no significant differences in any of the experiments between treatment and control groups on baseline measures of stress and negative affect. Unexpectedly, we observe significant differences between treatment and control individuals in the Cold Pressor experiment for age, marital status, and number of children and in the TSST experiment for income and debt status. We reject the null hypothesis of no joint differences at the 5% level for TSST and CPT. Our pre-specified analysis includes control variables for these outcomes; we thus proceed following the pre-analysis plan, and include all possible control variables.

Table A1: Discrepancies with the pre-analysis plan

Pre-analysis plan	Modification	Reason for modification	Locations
Initially specified analysis for only CENT experiment.	Combined CENT data with TSST-G and CPT and compared treatment effects across stressors.	Analyzing data from all three stressors allows comparison between stress induction methods.	Tables 1 and 2
Specified item-level saturated regression for manipulation checks and choice-level regression with delay combination interaction terms for patient choice, indifference point, and exponential discounting.	Highlighted effect estimates from individual level regressions. Outcomes for AUC, decreasing impatience, and departure from stationarity were originally specified at the individual-level.	Linear models were simplified for parsimony and expositional clarity. Parameter estimates are similar in magnitude and identical in statistical significance between models.	Tables 1 and 2
Specified a test of the overall effect of stress on negative affect and temporal discounting.	Tested only within-experiment and across-experiment effects.	There is little theoretical interest in the average effect across the three experiments.	Tables 1 and 2
Specified geometric discounting parameter as an outcome variable.	Omitted geometric discountin‘g parameter as an outcome variable.	Parameter estimates will only be unbiased assuming linear utility. We reject linearity with data from the risk elicitation task.	Table 2
Specified risk aversion as outcome.	Effects on coefficient of relative risk aversion from multiple price list method reported in appendix.	Data only available in CPT and CENT experiments.	Table A7

Notes: This table itemizes discrepancies between the present analyses and the pre-analysis plan.

Table A2: Randomization check – Baseline demographics and affective state

	TSST-G		CPT		CENT	
	Control mean (SD)	Difference	Control mean (SD)	Difference	Control mean (SD)	Difference
Age	30.56	3.27	31.10	-3.51**	30.15	0.02
	(10.10)	(2.34)	(11.04)	(1.49)	(10.57)	(1.48)
Married or co-habitating	0.42	0.03	0.50	-0.19***	0.40	0.06
	(0.50)	(0.07)	(0.50)	(0.06)	(0.49)	(0.05)
Children	1.18	0.42	1.52	-0.62**	1.28	-0.10
	(1.69)	(0.34)	(2.01)	(0.25)	(1.99)	(0.20)
Completed std. 8	1.00		0.88	0.06	0.95	-0.00
	(0.00)		(0.33)	(0.04)	(0.21)	(0.03)
Unemployed	0.22	0.01	0.34	0.07	0.29	0.03
	(0.42)	(0.07)	(0.48)	(0.06)	(0.46)	(0.08)
Monthly income	166.18	-108.07***	146.46	-19.12	160.71	4.74
	(201.78)	(30.50)	(271.77)	(31.35)	(143.19)	(17.62)
Disposable income	62.46	-41.35***	36.06	34.37	72.50	-10.90
	(120.57)	(14.00)	(81.93)	(22.04)	(200.27)	(18.88)
Indebted	0.66	0.74***	0.66	-0.03	0.72	0.03
	(0.48)	(0.26)	(0.48)	(0.06)	(0.45)	(0.06)
Body mass index	27.20	1.84	23.04	0.78	23.26	0.16
	(7.56)	(4.23)	(3.43)	(0.61)	(3.36)	(0.39)
Self-reported stress	40.84	-7.65	30.57	5.66	27.91	-4.56
	(34.52)	(6.21)	(30.03)	(3.81)	(30.54)	(4.39)
Negative affect (SD)	0.20	-0.27	-0.00	0.17	-0.05	-0.08
	(1.11)	(0.22)	(0.96)	(0.13)	(0.99)	(0.15)
Joint p-value		0.00***		0.01***		0.33

Notes: This table compares treatment and control means of each row variable using Equation 1. Columns 1, 3, and 5 report control group means for each experiment with SD in parentheses. Columns 2, 4, and 6 report difference of means with the treatment group with standard errors in parentheses. The bottom row reports p-values of a joint test across row variables. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

Table A3: Treatment effects across domains – Stress measured at endline

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Self-reported stress (SD)		0.20	0.42***			0.22
		(0.13)	(0.11)			(0.17)

Notes: This table displays coefficients and hypothesis tests for the effects of treatment on self-reported stress. Columns 1-3 report treatment effect estimates for self-reported stress for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across conditions. Standard errors are in parentheses. Asterisks indicate significance with naive p-values. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

Table A4: Treatment effects with randomization inference – Stress

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Self-reported stress (SD)	-0.09	1.69***	0.49***	1.78***	0.58***	-1.20***
	(0.17)	(0.20)	(0.12)	(0.27)	(0.21)	(0.23)
	[0.64]	[0.00***]	[0.00***]	[0.00***]	[0.02**]	[0.00***]

Notes: Columns 1-3 report treatment effect estimates on each row variable for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across experiments. Analytic cluster-robust standard errors are in parentheses. Exact p-values obtained from permutation tests are in brackets. Stars on the coefficient estimates indicate significance with conventional p-values. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

Table A5: Treatment effects with randomization inference – Temporal discounting

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Prop. of patient choice	0.03	-0.01	-0.06**	-0.04	-0.09*	-0.05
	(0.04)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)
	[0.56]	[0.66]	[0.02**]	[0.46]	[0.13]	[0.28]
Avg. indifference point	-0.01	0.00	-0.07**	0.01	-0.06	-0.07*
	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)	(0.04)
	[0.89]	[0.90]	[0.02**]	[0.85]	[0.26]	[0.10]
Avg. exponential decay	-0.02	0.02	0.04*	0.04	0.06	0.02
	(0.04)	(0.02)	(0.02)	(0.04)	(0.04)	(0.03)
	[0.61]	[0.41]	[0.07*]	[0.38]	[0.21]	[0.57]
Area under the curve	-0.03	0.02	-0.09***	0.05	-0.06	-0.11**
	(0.05)	(0.04)	(0.03)	(0.06)	(0.06)	(0.05)
	[0.59]	[0.53]	[0.01**]	[0.41]	[0.38]	[0.03**]
Decreasing impatience	0.03	-0.03	-0.03	-0.06	-0.06	0.00
	(0.04)	(0.03)	(0.02)	(0.05)	(0.05)	(0.04)
	[0.56]	[0.21]	[0.19]	[0.24]	[0.26]	[0.97]
Dept. from stationarity	-0.02	0.02	-0.05***	0.04*	-0.03	-0.08***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
	[0.30]	[0.15]	[0.00***]	[0.08*]	[0.14]	[0.00***]
Joint test exact p-value	0.52	0.67	0.00***	0.38	0.49	0.04**

Notes: Columns 1-3 report treatment effect estimates on each row variable for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across experiments. Analytic cluster-robust standard errors are in parentheses. Exact p-values obtained from permutation tests are in brackets. Stars on the coefficient estimates indicate significance with conventional p-values. The bottom row reports exact p-values of a joint permutation test across row variables. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

Table A6: Treatment effects for regular and reversed Centipede Game

	(1) Pooled CENT	(2) Regular CENT	(3) Reversed CENT
Self-reported stress (SD)	0.40***	0.65***	0.07
	(0.12)	(0.15)	(0.13)
	[0.00***]	[0.00***]	[0.26]
Prop. of patient choice	-0.06**	-0.06*	-0.06
	(0.03)	(0.03)	(0.04)
	[0.04**]	[0.10*]	[0.17]
Avg. indifference point	-0.07**	-0.07*	-0.07*
	(0.03)	(0.04)	(0.04)
	[0.02**]	[0.10*]	[0.17]
Avg. exponential decay	0.04*	0.03	0.04
	(0.02)	(0.03)	(0.02)
	[0.05*]	[0.14]	[0.17]
Area under the curve	-0.09***	-0.08*	-0.09**
	(0.03)	(0.04)	(0.04)
	[0.01**]	[0.10*]	[0.15]
Decreasing impatience	-0.03	-0.04	-0.01
	(0.02)	(0.02)	(0.03)
	[0.07*]	[0.10*]	[0.28]
Dept. from stationarity	-0.05***	-0.05***	-0.05***
	(0.01)	(0.02)	(0.02)
	[0.00***]	[0.01**]	[0.05**]

Notes: Column 1 reports the treatment effect on the pooled Centipede Game. Column 2 reports treatment effect estimates on each row variable for the regular Centipede Game. Column 3 reports treatment effects for the reversed Centipede Game. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

Table A7: Treatment effects across domains – Risk aversion

	Within experiments			Across experiments		
	(1)	(2)	(3)	(4)	(5)	(6)
	TSST-G	CPT	CENT	CPT vs. TSST-G	CENT vs. TSST-G	CENT vs. CPT
Coefficient of relative risk aversion		0.18	-0.26**			-0.44*
		(0.18)	(0.13)			(0.23)

Notes: This table displays coefficients and hypothesis tests conducted with Equation 2. The dependent variable is the coefficient of relative risk aversion measured using the multiple price list method and assuming constant relative risk aversion. Columns 1-3 report treatment effect estimates on each row variable for TSST-G, CPT, and CENT, respectively. Columns 4-6 report differences in the treatment effect across experiments. Standard errors are in parentheses . Stars on the coefficient estimates indicate significance with naive p-values. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct.

B Appendix: TSST-G Participant Instructions

Treatment (TSST-G) Instructions:
The task we ask you to do is a training for job interviews. Imagine that you are invited to a job interview where you are asked to present yourself. You can freely chose for what kind of job you will be applying, however, your presentation will be held in front of a jury which consists of two persons. **Please note this is not a real job interview, and you will not be offered a job at the end of this study.** It is only intended as training.

You will get 5 minutes to prepare yourself for this fictional job interview. You are allowed to make notes during the preparation phase. However, you will not be allowed to use the notes during the fictional job interview.

During the job interview you should talk about your positive characteristics. Especially, emphasize the characteristics that differentiate you from other candidates. You can assume that the jury has your application, and is well informed about your educational level. Thus you should not talk about this.

The job interview will be recorded with a video camera. Therefore it is important to pay attention to your mimics, gestures and language. The jury is educated in observing and analyzing behavior and will take notes on your appearance. <u>It is possible that the jury asks you questions at each point in time during the study, even when it is someone else's turn.</u>

After presenting yourself there will be a second task, which will be explained to you in more detail after your speech. <u>You will be called randomly, and it is possible to be called at each point in time during this task.</u>
These two tasks will take approximately 20 minutes.
During both tasks you will be called by the number which has been assigned to you at the beginning of the experiment.
If you have any questions, please let me know.
You now have 5 minutes to prepare for the job interview training. You may take notes, but you may not use these later during the interview. Please begin.
Stop for 5 minutes.
You'll now have two minutes' time to present yourself. You will be called by your number. The whole job interview will be video-recorded for later analysis. Please pay attention to your facial expressions, gestures and language. The panel is trained in behavioural observation and will make notes about your behaviour. You may be asked questions at any time, even when it is another person's turn. After the free speach, you will be given another task, which will be explained to you in more detail later. You will always be called randomly. Do you have questions?

Control (TSST-Control) Instructions:
In this task you are asked to talk about one of your close friends. Please imagine that you tell someone you know about your best or a really close friend (not your partner). Talk about the positive characteristics of your best friend, what you like about him or her and why and how you became friends with him or her. You may also want to talk about positive experiences such as common trips, which you had with your best friend.

You will get 5 minutes to prepare the description of your best friend. After the preparation you will have 2 minutes to orally describe your friend. You will be asked to do this at the same time as the other participants are doing this. This means you will be talking at the same tame as the other participants. **Please note, your description of your best friend will not be recorded, nor observed or evaluated.**
Please make sure you speak audibly. However, you do not need to talk loud nor need your talking be understandable to anyone.
Someone will be sitting in the room while you do this, but this person will not evaluate your performance, she or he will only give you instructions about what to do.
After you described your friend there will be another short task. The person in the room will explain the task to you in detail. **Your performance in this task will not be evaluated as well.**
These two tasks will take about 20 minutes. If you have any questions please raise your hands.
Ok, you now have 5 minutes to prepare to tell about your best friend. At the end, this telling will be done orally at the same time as the other participants. This is not about performance, and you'll neither be observed nor graded.
Stop for 5 minutes.
We will now ask you to deliver your talk about your good friend. You'll all speak at the same time, this is not about performance or originality, and you'll neither be observed nor rated. My colleague will tell you when you should begin talking; remember you do not need to talk very loud nor fully understandable. Do you have any questions?

<u>TSST TREATMENT CONDITION</u>

TSST TREATMENT 1: JOB INTERVIEW

FROM HERE, THE ACTIVE STRESSOR WILL SPEAK. The researcher leaves the room.
Active and passive stressor: DO NOT SMILE, DO NOT ENGAGE IN SMALL TALK, DO NOT BE OVERLY FRIENDLY. BE STERN AND SERIOUS.

A participant will be called randomly by their number and asked to begin the talk.

Number XY: Please begin! **TIME: 0:00**
Second (passive) stressor starts the stopwatch for that participant.
First let the participant speak freely for as long as possible.

If the participants stop talking before 2 minutes are up, advise them that they still have some time:
(0) You still have time; please go on.

If the participant is speaking too fluently:
(1a) Thanks, that's of little interest to us. Please talk about to <u>your greatest strengths.</u>
(1b) Thanks, that's of little interest to us. Please talk about your <u>problem-solving strengths</u>.
(1c) Thanks, that's of little interest to us. Which <u>weaknesses</u> do you see in yourself?

If a participant does not know what to say before the two minutes are up you may ask some of the following questions. You do not need to ask all the questions, these question should just help the participant to start his speech. All participants should be asked different questions.

(2) Why do you consider yourself qualified for this job?

(3) Why do you think that you are more qualified than the other applicants?

(4) What do your family and your friends particularly appreciate about you?

(5) You told us that you are very good in .... . What other special qualities do you have?

(6) You have just expressed your special qualities with regard to… What do you find special about (a) Opportunism in the job (b) ... ?

(7) You have just expressed you special qualities with regard to… . What other qualities make you the best candidate for this job?

(8) You just spoke about.... What do you think of... ?

(9) Complete the sentence: I am the best at…

(10) Which leadership qualities do you possess?

(11) What are your career goals?

(12) What do you think of teamwork?

(13) Are you vain?

(14) What do you think of job interviews?

(15) Please talk about your non-academic qualities.

(16) Is there a mistake you did from which you learnt something? And what was your key learning?

(17) In which area have you recently improved yourself the most?

(18) How much would you sacrifice for our company?

(19) How important is work life balance to you?

(20) In your first week of work, you observe that your supervisor does not comply with the rules of the company. How do you react?

As soon as the first two minutes are over, the volunteer will be interrupted and the next one randomly called in by number. In total, the 10 minutes (5 x 2) should not be exceeded!

- Many thanks. That will do. **Time: 10:00**

SALIVETTE 3: BLUE (TSST-Treatment)

TSST TREATMENT 2: ARITHMETICS

Active stressor: We will now explain you the second exercise. It is an arithmetic task. Please count backwards from a particular number in steps of sixteen. Do this as fast and as error-free as it is possible for you. Again, we will call you by your number. If you make a mistake, we will notify you, and then you or another participant will have to start again from the beginning.
Number X, please start now; start at the number...:

1 4878	4862	4846	4830	4814	4798	6 4782
4766	2 4750	4734	4718	4702	5 4686	4670
4654	4638	3 4622	4606	4 4590	4574	4558
4542	4526	4510	4494	4478	4462	4446
4430	4414	4398	4382	4366	4350	4334
4318	4302	4286	4270	4254	4238	4222
4206	4190	4174	4158	4142	4126	4110
4094	4078	4062	4046	4030	4014	3998
3982	3966	3950	3934	3918	3902	3886
3870	3854	3838	3822	3806	3790	3774
3758	3742	3726	3710	3694	3678	3662
3646	3630	3614	3598	3582	3566	3550
3534	3518	3502	3486	3470	3454	3438
3422	3406	3390	3374	3358	3342	3326
3310	3294	3278	3262	3246	3230	3214
3198	3182	3166	3150	3134	3118	3102
3086	3070	3054	3038	3022	3006	2990
2974	2958	2942	2926	2910	2894	2878
2862	2846	2830	2814	2798	2782	2766

Each participant does this for a total of ~1:30 min. The passive stressor stops the time.

- Thanks, that will do. **TIME: 20:00**

The active stressor opens the doors → The researcher comes back into the room, the stressors leave the room.

<u>TSST CONTROL CONDITION</u>

FROM HERE, THE ACTIVE STRESSOR WILL SPEAK. The reasercher leaves the room

→ **No CAMERA, no white lab coats**

TSST CONTROL 1: TALKING ABOUT YOUR FRIEND

- Good day. We will now wait for 5 minutes, before you begin with your talk. During this time, you may read the magazine, which is lying in front of your computer. However, I'd ask you, to stand while waiting or reading.
- Wait 5 minutes.
- After 5 minutes: all of you should now begin with the talk about your friend. While you do this, you will not be observed and evaluated. (Every participant should now be speaking – they do not need to speak too loudly. A general "babbel" should be audible. During this time, the panel will read something and not observe the participants. Should one of the participants not talk at all, then requask them to start talking again.)
- Wait 2 Minutes
- At Minute 7 (that is, after 2 minutes): Many thanks, this is enough. We'll now wait for a few minutes; if you'd like, you can read a bit more, but again you need to stand while you do this.
- Wait 3 minutes
- At Minute 10 (that is, after 3 minutes):

SALIVETTE 3: BLUE (TSST-Control)

TSST CONTROL 2: ARITHMETIC

- We now come to the second task. You are asked to count backwards f**rom 4750 in steps of 16.** Please speak at the same volume as during the previous task. We will let you know when you can begin counting backwards. Again, this exercise is <u>not about your performance, this means you will not be rated</u>.
- We will now wait for 3 minutes first, before we begin with the task. During this time, you may read the magazine, which is lying in front of your computer. However, I'd ask you, to stand while waiting or reading.
- Wait 3 minutes
- After 3 minutes: please begin, all at the same time, with counting backwards from 4750. We are not interested in your performance. (Every participant should now be speaking – they do not need to speak too loudly. A general "babbel" should be audible. During this time, the panel will read something and not observe the participants. Should one of the participants not talk at all, then requask them to start talking again.)
- Wait ~1:30 minutes
- At Minute 4:30 (that is, after 1:30 minutes): many thanks, this is enough. We will now wait for a few minutes. You can, if you like, read a bit more, but I would like to ask you to stand while doing this.
- Wait until 20:00 minutes have elapsed from beginning of task: Thanks, that's enough.

The active stressors opens the doors → the researcher comes back into the room, the stressors leave the room.

C Appendix: CPT Participant Instructions

30 Second Cold Pressor Procedure with Short PANAS/VAS 2

Put hand in ice water – You will get if you hold your hand in for 30 seconds.

- The water must reach up to your wrist (everyone put their hands up and show me where your wrist is). You must keep your hand open, not in a fist, and you must not touch the sides of the container or the metal divider. Towards the end of the 30 second period you will be asked to answer the questions on the screen in front of you. To answer the questions, use your free hand, which is not in the water. For each question indiciate how you feel right now with your hand in the water.
- There is no risk of electrocution when putting your hand in water.
- The water you put your hand in may be cold. You do not have to keep your hand in the water if you do not want to, please pull your hand out slowly if you feel uncomfortable.
- Are you ready to begin? Please wait for my signal to start

60 Second Cold Pressor Procedure with Time Preference Questions

Put hand in ice water – You will get 100 KES if you hold your hand in for 60 seconds.

- The water must reach up to your wrist (everyone put their hands up and show me where your wrist is). You must keep your hand open, not in a fist, and you must not touch the sides of the container or the metal divider.
- There is no risk of electrocution when putting your hand, in water.
- While your hand is in water, you will be asked a series of questions asking you to choose between two amounts of money. There are no right or wrong answers, just choose which amount of money you prefer. The computer will randomly select one of your answers and this answer may be paid. So you should think about each question carefully.

The water you put your hand in may be cold. You do not have to keep your hand in the water if you do not want to, please pull your hand out slowly if you feel uncomfortable. If you pull your hand out before 60 seconds, you will not earn the 100 shilling bonus, but your other earnings will still be sent to you.

1

D Appendix: CENT Participant Instructions

Common Pool Resource (CPR) Game Introduction

Now you will complete a task for real money. In this next task, there will be several rounds, and in each round you will try to collect as many points as possible.

NO RULES: You are doing this task individually.
RULES: You will be randomly paired in groups of 4, (with 3 others) that are trying to collect points from the same pool of points as you.

Each round will last 21 seconds, and the points that are available will double every 3 seconds. We will now watch a demonstration. This is only for practice, do not push any buttons.

Run CPR Demonstration – The green bar shows how many points are available for you to collect. The number on the right shows how much time is left for you to collect points. Notice how the next round starts immediately after the first round ends.

Run CPR Comprehension - Now we will answer some basic questions about how the task works. This will not affect your earnings in any way, we just want to make sure that everyone understands how everything works.

RULES: Are there any questions? You can see that if you wait until the round ends *without* pressing any button, you earn 128 points. If you press "Collect" when the resource is at 128, you earn 128 points. The outcomes are the same.

Run CPR Practice (There will be a screenshot of the task for 60 seconds)

Now we will play a practice round, but this time you can collect points by pushing buttons. You will do this two times. Try once to press "Collect" before the round ends. The second time, do not press "Collect" at all and see how your points differ.

RULES	No Rules
To collect points, press the YELLOW button that says "Collect". You will receive the amount of points on your screen when you hit the "Collect" button. If you do not hit the Collect button before the round ends, you will earn the amount on your screen.	There are two different ways for you to collect points. If you push the BLUE button that says "Collect All", you will collect all of the available points and the round will end. If you push the YELLOW button that says "Collect and split" then you will share the points evenly with the other people in your group and the round will end.

If neither person pushes a button before the end of a round, both will receive zero points. At the end of the round you will be shown how many points you earned and why you earned that many points.

We will now play a few practice rounds so you can practice collecting points. This is not for real money and you will not be in a group.

Did everybody try pushing the buttons and collecting points?
(If necessary, run another round of the practice)

The next several rounds of the task will be for real money. Each point is worth one shilling. At the conclusion of the task, the computer will randomly select one round, count the number of points you collected, and pay you one shilling per point.

RULES: Remember you are playing by yourself and trying to earn the most points possible.
NO RULES: You will not have the same group for the entire task. You may be re-matched into a different, randomly selected group. We will notify you when this occurs.

Finally, to ensure your privacy and concentration, we would like you to put on the headphones as you complete this task. The headphones will play a static sound – do not be alarmed by it. **Try listening to the headphones now – put them on and take them off again, and if you do not hear a static sound, please raise your hand.**

When instructed by the computer, please remove your headphones.

**********************Run CPR Round 1**********************

When I say go, put the headphones on and click OK. Once everybody clicks OK, the task will begin.

(Announce the first time that there is a change in partners and tell them to press OK)

E Appendix: CENT (Reverse) Participant Instructions

Common Pool Resource (CPR) Game Introduction

Now you will complete a task for real money. In this next task, there will be several rounds, and in each round you will try to collect as many points as possible.

NO RULES: You are doing this task individually.
RULES: You will be randomly paired in groups of 4, (with 3 others) that are trying to collect points from the same pool of points as you.

Each round will last 21 seconds, and the points that are available will halve every 3 seconds. We will now watch a demonstration. This is only for practice, do not push any buttons.

****Run CPR Demonstration**** – The green bar shows how many points are available for you to collect. The number on the right shows how much time is left for you to collect points. Notice how the next round starts immediately after the first round ends.

****Run CPR Comprehension**** - Now we will answer some basic questions about how the task works. This will not affect your earnings in any way, we just want to make sure that everyone understands how everything works.

RULES: Are there any questions? You can see that if you wait until the round ends *without* pressing any button, you earn 0 points. If you press "Collect" when the resource is at 0, you earn 0 points. The outcomes are the same.

****Run CPR Practice**** (There will be a screenshot of the task for 60 seconds)

Now we will play a practice round, but this time you can collect points by pushing buttons. You will do this two times. Try once to press "Collect" before the round ends. The second time, do not press "Collect" at all and see how your points differ.

F Appendix: Temporal Discounting Task Instructions

Titration Short

Now we will ask you a more questions about your preferences between two amounts at two given time periods. For example, would you prefer 100 Ksh today or 200 Ksh 3 months from now? After you select your preference, the amounts will change and you will be asked to select your preference between the two new amounts. At the end, the computer will select ONE choice out of all the choices you will make, and then you have a 1/20 chance that the choice you made will actually be paid. The choice is random, so you should think carefully about each choice you make.

Titration Long

Now we will ask you a more questions about your preferences between two amounts at two given time periods. For example, would you prefer 100 Ksh today or 200 Ksh 3 months from now? After you select your preference, the amounts will change and you will be asked to select your preference between the two new amounts. At the end, the computer will select ONE choice out of all the choices you have made so far, and then you have a 1/20 chance that the choice you made will actually be paid. The choice is random, so you should think carefully about each choice you make.