Acute Stress Decreases Competitiveness Among Men*

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Abstract

An increased willingness to compete among men relative to women is thought to contribute to the overrepresentation of men in positions of leadership. One possible explanation for this increased competitiveness among men is that it is caused by the stress of high-stakes environments. In this paper we present evidence against this hypothesis. We exposed 434 men to a standard laboratory stress task in which they submerged their hand in cold water, and then measured their preferences for entering a competition relative to a piece-rate payment scheme. We find an 8 percentage point decrease in their willingness to enter the competition under stress relative to a control condition. The effect is a change in pure taste for competition, and cannot be explained by changes in beliefs about the choices of others, social preferences, risk preferences, overconfidence, or productivity. We conduct a meta-analysis in which we compare our findings to existing literature. We show that previous studies found effects of almost identical magnitude, but were not powered to detect them statistically. Together, our results suggest that stress decreases competitiveness among men, and that therefore the stress of high-stakes environments is unlikely to account for men's high taste for competition.

Keywords: stress, competitiveness, laboratory experiment, gender

JEL codes: C90, C91, D9, J16

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1. Introduction

Men are significantly overrepresented relative to women in positions of leadership and responsibility. This overrepresentation partly stems from an increased desire to compete among men: men are more likely than women to engage in competition in laboratory settings (Gneezy, Niederle, and Rustichini 2003; Niederle and Vesterlund 2007; Niederle and Vesterlund 2011), and high male competitiveness has been found to predict several important real economic outcomes in stressful environments, such as whether high school students choose prestigious, math-focused, study profiles (Buser, Niederle, and Oosterbeek 2014) and whether they make successful labor market decisions (e.g. Berge et al. 2015).

A wide range of social environmental factors have been proposed to explain the high taste for competitiveness in males, including societal structure (Gneezy, Leonard, and List 2009), socio-economic status (Almås et al. 2015), and parental decision-making (Tungodden 2018).

Another possible source of higher male competitiveness is stress: positions of leadership and responsibility, and the selection procedures that lead to them, such as interviews, presentations, auditions, and pitch competitions, are stressful environments (Buser, Dreber, and Möllerström 2017; Buckert et al. 2017; Zhong et al. 2018). If stress causes men to be competitive, this mechanism could partly account for the observed overrepresentation of men in leadership positions.[1]

In this paper, we present evidence against this account: We show that men compete *less* under stress compared to when they are not stressed. In our study, 434 men underwent a standard laboratory stress induction protocol, the Cold Pressor Task (CPT; Hines and Brown 1932). This task consists of submerging one's hand in ice water and reliably raises levels of stress and related hormones (Schwabe, Haddad, and Schachinger 2008). In a control condition, participants submerge their hands in lukewarm water. Participants then per-

[1]Of course, another possible account is that women compete less under stress. This question is not the focus of the present study.

formed a version of the well-known competitiveness paradigm pioneered by Niederle and Vesterlund (2007). They first performed a real effort task, which consisted of counting the number of zeros in tables of zeros and ones, under both a piece-rate and a tournament scheme. In the piece-rate scheme, they were paid a fixed amount for each correctly counted table. In the tournament scheme, they received a higher payment if they counted the most tables in an experimental group of 6–8 members, and no payment otherwise. In the crucial third task, they then decided whether to participate in another round under a piece-rate or a tournament scheme.

Our core finding is that compared to the control condition, the willingness of participants in the stress condition to enter the tournament is reduced by 8 percentage points. This effect is a change in pure taste for competition, for several reasons. First, if participants choose the tournament, they compete against the *prior* tournament performance of other players, in a round in which there was no choice but to perform under tournament incentives. This rules out beliefs about which other players select into the tournament as a driver of the decision, as well as mechanisms related to social preferences (e.g. a hesitation to impose externalities on others). Second, in a further task in which participants can decide whether to enter their previous piece-rate performance into a tournament, we observe no treatment effect, suggesting that the reduction in competitiveness is specific to the prospect of competing under tournament incentives. Third, we observe no treatment effects on overconfidence (beliefs about one's performance relative to others), or on productivity. Finally, in a separate lottery task, we observe no treatment effect on risk preferences, ruling out risk as a mechanism. Our finding is also robust to alternative regression specifications (probit vs. OLS), and the inclusion vs. omission of control variables.

We next conduct a meta-analysis to relate our treatment effect to previous findings. The causal effect of stress on competitiveness in men has been examined in three papers, using the same Niederle & Vesterlund competitiveness paradigm as we. One other study also uses the CPT to induce stress (Buser, Dreber, and Möllerström 2017), and two use the Trier Social Stress

Test, a social stressor in which participants complete public speaking and mental arithmetic tasks in front of an audience (Cahlíková, Cingl, and Levely 2017; Zhong et al. 2018). None of these studies reports a significant decrease in competitiveness under stress among men: Cahlíková, Cingl, and Levely (2017) find a negative effect when combining data from men and women, which is statistically significant for the entire sample, but not for men alone. Buser, Dreber, and Möllerström (2017) also find no significant effect for men, and Zhong et al. (2018) find no effect for a mixed sample and do not analyze men and women separately. We contacted the authors of these papers to obtain the frequencies of competition entry for men and women in their samples. We could thus reconstruct their datasets and enter them in a meta-analysis. When we standardize the treatment effects and compare them to ours, we find that they are very similar across these four studies (-0.12, -0.26, -0.27, and -0.28 standard deviations). When we enter them in a meta-analysis, we find a highly significant overall reduction of competitiveness among men under stress of 0.16 standard deviations, significant at the 5 percent level. Together, these findings suggest that previous studies observed similar treatment effects, but were not powered to detect them statistically. Since the other studies investigate both men and women, they necessarily compromise on gender-specific sample sizes; for men, the sample sizes are 46 (Buser, Dreber, and Möllerström 2017), 44 (Zhong et al. 2018), and 95 (Cahlíková, Cingl, and Levely 2017). With 434 men, our sample is thus more than four times larger than the largest existing study, and allows us to study treatment effects which other studies could not detect.

Why does stress reduce competitiveness? One possible explanation is homeostasis: if competitiveness and stress were simply mutually reinforcing, this could lead to ever-increasing stress-competitiveness loops, which would eventually become unbearably stressful for the individual. An adaptation to prevent this spiral would be a negative feedback loop in which competition may cause stress, which then decreases competitiveness to restore manageable stress levels. This interpretation dovetails with findings in von Dawans et al. (2012), who find that stress increases prosocial behavior and interpret this as a “tend-and-befriend” strategy to reduce stress.

This paper contributes to a larger economic literature that studies the effect of stress on economic behavior. Existing studies have shown effects on time preferences (Riis-Vestergaard et al. 2018; Koppel et al. 2017; but see Haushofer et al. 2013), risk preferences (Kandasamy et al. 2014; Porcelli and Delgado 2009; Cahlíková and Cingl 2017; Koppel et al. 2017; see Kluen et al. 2017 for an overview), and social preferences (von Dawans et al. 2012). Together with the three papers that contribute to our meta-analysis, we expand this literature by showing that stress decreases competitiveness in men. We do not study the effect of stress on competitiveness in women, although all three of the papers in our meta-analysis have done so. The results are somewhat inconsistent, with some studies showing an increase and others a decrease. It remains for future work to reconcile the existing evidence.

The rest of the paper is organized as follows: Section 2 describes the sample, recruitment, and experimental procedure. Section 3 describes the econometric strategy. Section 4 outlines our results. Section 5 concludes.

2. Methodology

2.1 Setting and sample

The experiment was with participants from informal settlements in Nairobi, Kenya, at the facilities of the Busara Center for Behavioral Economics. Busara is a laboratory facility located in the Kilimani area of Nairobi, adjacent to the city’s largest informal settlement, Kibera. A total of 434 men participated in the experiment, of which 53% came from Kibera and 47% from another informal settlement, Viwandani. The majority spoke Kikuyu, Luhya, Luo, or Kisii as their mother tongue. In addition, all participants either spoke English, Kiswahili, or both. Thus, the experiment was primarily conducted in English, and translation was provided into Kiswahili as needed. To be eligible for participation, individuals needed to have completed at least six out of eight years of primary school education to ensure literacy. Individuals were excluded from the experiment if they had participated in previous research on stress at the lab facilities; if they were obviously intoxicated during the study; or if they had an open wound on their dominant hand or arm.

2.2 Recruitment

Participants were recruited from the Busara Center for Behavioral Economics subject pool, composed of individuals from informal settlements in Nairobi, as well as the University of Nairobi. Permission for recruitment into the subject pool was granted by the relevant District Commissioners in Nairobi, and all activities of the experimental research center were covered by Institutional Review Board approvals at the Massachusetts Institute of Technology and the Ethics Review Committee of Maseno University.

Two days prior to the experiment, participants who met the eligibility criteria were called via mobile phone and invited for participation by staff members using a standardized call-in script. An agreement to participation was followed by requests to refrain from activities that affect the hypothalamic-pituitary-adrenocortical (HPA) axis (McEwen 2000): alcoholic beverages, smoking, or other intoxicating substances the day prior to the experiment and on the day of the experiment itself. They were also asked to refrain from eating and from drinking coffee two hours before arriving at the lab.

2.3 Experimental procedure and measures

The experiment had four treatment conditions: stress treatment and control was crossed with an easy and a difficult effort task. Each participant was randomly assigned to one of these four conditions through random seat assignment in the lab: *treatment easy* ($n = 116$), *control easy* ($n = 113$), *treatment difficult* ($n = 102$), and *control difficult* ($n = 103$). Each session had between 6 and 8 participants. Participants were instructed not to talk to each other during the experiment. Sessions started at 10 am at the earliest and finished at 5 pm at the latest, and each session lasted approximately 85 minutes in total.

On the day of the experiment, participants reported to the gate of the research center, where staff members welcomed them and verified their identity with a fingerprint scanner that was connected to a netbook with stored personal information and fingerprint records. Upon verification of their identity, each subject was randomly assigned to a computer cubicle and was handed a place card with the corresponding computer number. Before entering the lab, participants were seated in a waiting room, where they received a short introduction to the experiment (with the exception of the Cold Pressor Task or the control task, to avoid anticipatory stress), the monetary compensation and payment modality, and were asked not to communicate with others during the experiment. When participants entered the lab, they were seated in their randomly assigned cubicles and, having read and signed the consent form, had an opportunity to ask questions. Staff members answered questions in all sessions in Kiswahili or English. A similar debriefing session with a question-and-answer session was conducted after the experiment was completed. All participants received a fixed participation fee (KES 200 for participants from Kibera, KES 400 for Viwandani) in addition to their earnings, and those who turned up on time received an "on-time" bonus of KES 50. For an overview of the experiment timeline, see Figure 1.

2.4 Control variables

We collected data on a number of economic variables and stressors to use as control variables, including the individual's economic circumstances (monthly income and spending, number of dependents, an indicator for depending entirely on others economically, an indicator for being employed, and an indicator for being in debt), age, education, and variables that modulate the effect of stress on physiological and behavioral outcomes (height, weight, indicators for smoking and drinking today, and wake-up time). The full questionnaire is shown in the appendix, and summary statistics are shown in Table 1. An additional control variable is a measure of working memory, included as a proxy for IQ and elicited with a computerized version of a digit span task. Over 8 rounds, participants were shown series of digits to be remembered, starting with a series of 4 digits and ending with a series of 11 digits (e.g. in round 1: 6, 4, 3, 2; in round 2: 3, 5, 6, 8, 2), thereby increasing working memory load by one digit in each round. One series was presented on the touch screen at a time and was located above a touch pad, into which participants entered their answers. Simultaneously, the series of digits to be remembered was read out aloud by a staff member. Afterwards, a memory phase of 5 seconds followed, during which the screen went blank. Then, participants were asked to recall and enter the remembered sequence into the touch pad. To make the technology familiar, the touch pad resembled that of a mobile phone. Cheating, e.g. by writing down the series of digits to be remembered on a piece of paper, was sanctioned by deducting KES 200 from the total amount paid. The digit span task was scored by adding up the number of series recalled correctly. A final control variable is the order of the effort tasks (piece-rate first or tournament first), detailed below.

2.5 Cold pressor task

Stress was induced using the Cold Pressor Task (CPT), first described by Hines and Brown (1932). It is one of the most common stress treatments used in laboratory experiments, and a well-documented method of activating the HPA axis. The HPA axis is a neuroendocrine system regulating the stress response, and its activation leads to release of the stress hormone cortisol (Schwabe, Haddad, and Schachinger 2008). The CPT prompted participants in the treatment condition to immerse one hand in a cooler box filled with ice-cold water (0–4 °C) up to the wrist with stretched-out fingers for a certain duration. Those in the control condition immersed their hand in a container with water at a temperature between 35–37° C. Inside the container of the treatment group, two compartments were created by means of a custom-built permeable iron partitioner. One compartment was filled with 6 kg of ice cubes to cool the water down to a temperature between 0–4°C, and the other compartment was filled with water, in which participants were to immerse their hand up to the wrist with stretched-out fingers. To avoid heat build-up around the hand in this task (Mitchell, MacDonald, and Brodie 2004), an electrical filter pump was placed in the compartment of the cooler containing the ice cubes to circulate the water. Waterproof, commercially submersible thermometers were used to measure water temperature.

There were two immersions: the CPT began with a short immersion of 30 seconds, followed by a second immersion of 60 seconds. In the second immersion, participants were paid KES 100 if they kept their hand immersed in water up to the wrist for the whole duration. The goal of the two immersions was to induce cumulative stress, and add an element of "dread" during the period between immersions which would add additional stress. In all cases, participants were informed that they were free to pull out their hand at any point should the procedure become too painful.

As a manipulation check for the CPT, we collected subjective stress and pain ratings on visual-analog scales from 0–100 at the start of the experiment; between the two immersions of the CPT; and at the end of the experiment.

2.6 Effort and competitiveness task

The rest of our experimental design closely follows the well established setup of Niederle and Vesterlund (2007). Participants completed three rounds of a real effort task, with each round lasting two minutes. The effort task was to count the numbers of zeros in a 7×5 table of zeros and ones, adapted from Abeler et al. (2011). We chose this effort task over the original effort task in the Niederle & Vesterlund paradigm due to the potentially lower levels of mathematical training of our participants compared to previous studies. Tables were displayed on the left hand-side of the screen, and responses were entered into a numerical touchpad displayed on the right hand-side of the screen. Right and wrong answers were displayed underneath the tables and updated in real-time. We also manipulated task difficulty in two difficulty levels: "easy" tables had between 4 and 7 zeros, and "difficult" matrices between 14 and 21 zeros, with the exact number chosen from a uniform random distribution for each table.

In the first two rounds, participants were paid under two different incentive schemes, piece-rate and tournament pay. In piece-rate pay, participants were paid KES 1 per correctly solved effort task. In tournament pay, the most productive participant earned $1 \times n$ shillings per correct answer, where n was the number of participants in the session (n =6, 7, or 8). Those who did not win the tournament earned zero. In case of a tie in productivity, the winner was randomly drawn. While participants in the Niederle & Vesterlund paradigm were exposed to the piece-rate scheme first and the tournament second, we extended their paradigm by randomizing the order of the incentive schemes, allowing us to balance for order effects. A treatment overview is shown in Table 2, with the incentive scheme order in italics.

In the third and final effort round, participants were asked to choose an incentive scheme, piece-rate or tournament pay. Competitiveness was measured as whether or not the participant chose to enter the tournament. If they chose piece-rate payment, they were rewarded with KES 1 per correctly solved task, as before. To win the tournament, a participant's performance in round 3 of the effort task had to beat the *previous* tournament round's top score. The advantage of this approach is that beliefs about which other players select into the tournament are ruled out as a driver of the decision. In addition, social preferences (e.g. a hesitation to impose externalities on others) cannot play a role.

Following Niederle & Vesterlund's original design, we also elicited a measure of "backward-looking" competitiveness: in this task, participants were given the choice of submitting their first piece-rate performance to tournament compensation, competing against the set of initial piece-rate performances of the other participants. This task serves as a control condition that contains all elements of the decision in round 3, except for the prospect of competing in a tournament. It is therefore that we term this decision a measure of "backward-looking" competitiveness.

Productivity in each round was measured as the number of successfully completed effort tasks within the two minutes. In our regressions, the impact of stress on productivity is analyzed separately for piece-rate and tournament rounds, as well as for a combined binary measure that takes value one if the participant was overconfident in both rounds.

After each of the two first effort rounds, we asked participants to guess their performance in that round relative to the other participants in the same group. Specifically, they were paid with KES 22 if they correctly guessed their rank within the group. We measured overconfidence as the difference between a participant's guess of their performance rank and their actual rank. In our regressions, overconfidence is analyzed as the difference in guessed and actual rank for the piece-rate and tournament rounds, as well as a combined measure, where the two overconfidence measures are added together.

2.7 Risk Task

We elicited risk preferences using the investment measure developed in Gneezy and Potters (1997). Participants received an endowment of KES 50, and could choose to invest a fraction between zero and one into a risky asset. The risky asset paid zero with a fifty percent chance, and four times the investment with a fifty percent chance. Our first measure of risk aversion is the share of the endowment invested in the risky asset. The second measure is an individual-level constant relative risk aversion (CRRA) parameter. Using CRRA utility, the expected utility of the lottery is given by

$$EU_i = p \times \frac{(B(1-\alpha_i) + k\alpha_i B)}{1-\gamma_i}^{1-\gamma_i} + (1-p) \times \frac{(B(1-\alpha_i))}{1-\gamma_i}^{1-\gamma_i},$$

where α_i is individual i's share invested in the risky asset, B is the total endowment (KES 50), $p = 0.5$ is the probability of winning the lottery, and $k = 4$ is the lottery technology. We find the CRRA risk aversion parameter γ for each individual i by taking the first-order condition and rearranging to solve for γ_i:

$$\gamma_i = \frac{\log\left({}^{(1-p)}/_{p(k-1)}\right)}{\log(1-\alpha_i) - \log(1-\alpha_i(k-1))}$$

The parameter is increasing in risk aversion. Since the expression is undefined when the individual invests either nothing or everything, we re-code these observations using the lowest and highest observed empirical values from the interior of the interval.

3. Econometric Specifications

We first check for balance between our treatment and control groups using the following specification:

$$Y_i = \beta_0 + \beta_1 T_i + \varepsilon_i,$$

where Y_i is a demographic characteristic and T_i is a treatment indicator. We test for joint significance across all demographics using seemingly unrelated regression (SUR).

We then conduct a manipulation check of the effect of the CPT, testing for significant differences in stress and pain at baseline, midline (during the CPT task), and endline:

$$Y_{it} = \beta_0 + \beta_1 T_i + \gamma' \mathbf{X}_i + \varepsilon_{it} \qquad t \in \{Baseline, Midline, Endline\},$$

Here, the outcomes are the self-reported measures of stress and pain. The vector of control variables $\mathbf{X}_i$ is as described in Section 2.4.

Our main specification is a probit regression testing the effect of the CPT on tournament entry:

$$Pr(Y_i = 1) = \Phi(\beta_0 + \beta_1 T_i + \beta_2 D_i + \beta_3 D_i \times T_i + \gamma' \mathbf{X}_i)$$

Here, D_i indicates the difficulty level of the matrix task (Difficult, Easy). In reporting results from probit models we show marginal effects. Standard errors are clustered at the session level.

The next specification serves two purposes. First, it is a robustness check for the effect of stress on competitiveness, using an OLS linear probability framework instead of probit. Second, it also serves as the main specification to test the effect of stress and task difficulty on our non-binary other outcomes of interest, such as productivity, overconfidence, and risk preferences.

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 D_i + \beta_3 D_i \times T_i + \gamma' \mathbf{X}_i + \varepsilon_i$$

Standard errors are again clustered at the session level.

As a robustness check, we also run all regressions described above without demographic and cortisol control variables, but with controls for order effects; these results are shown in the appendix. Further, we also run restricted regressions of the main specifications for the two levels of task difficulty, i.e. restricting the sample to only the "easy" or "difficult" conditions.

Note that all specifications are intent-to-treat (ITT), i.e. they treat an individual as "stressed" as long as they were assigned to the CPT, regardless of whether they actually were stressed by the task.

It might seem natural to run a treatment-on-the-treated (TOT) analysis, i.e. to instrument a measure of stress, such as self-reported stress or cortisol levels, with treatment assignment. However, such an analysis would fail the exclusion restriction: the CPT affects a large number of physiological variables, including heart rate, blood pressure, adrenaline, noradrenaline, cortisol, as well as subjective feelings of stress and pain. A TOT approach is therefore not justifiable.

4. Results

4.1 Baseline characteristics

Table 1 displays means and treatment group differences for the demographic characteristics of our sample that are later used as control variables. None of the coefficients on the treatment indicator is individually statistically significant, nor are they jointly significant using SUR.

4.2 Effect of the cold pressor task on stress and pain

Table 3 shows the effect of the CPT on self-reported measures of stress and pain. We find no differences in average self-reported stress or pain between the treatment and control groups at baseline (Column 1). Column 2 shows that the CPT increased self-reported stress by 39 points on the 0–100 scale relative to the control group, significant at the 1 percent level. We see similar results in Panel 2, which shows an increase in self-reported pain of 49 points, also significant at the 1 percent level. Both effects have returned to baseline at the end of the experiment; the endline measures, shown in Column 3 of the table, are not different between treatment and control groups. These results are robust to the omission of controls, as shown in Table S.1. Thus, the CPT was successful in increasing levels of stress and pain.

4.3 Is there a causal effect of stress on competitiveness?

Table 4 examines the effect of the CPT on competitiveness, measured as the choice of the tournament over piece-rate in round 3 and analyzed using our logit model with control variables. Column 1 shows that we find an 8 percentage point reduction in entering the tournament in the treatment group, relative to a control group mean of 80 percent (i.e. a 10 percent reduction). This effect is significant at the 5 percent level. The effect is driven by a reduction in tournament entry among the group exposed to the difficult effort task, as shown in Column 2; we observe no significant change in competitiveness for the easy effort task (Column 3). However, the interaction term is not significant, as shown in Column 4. These results are robust to the omission of the control variables (Table S.2), and to estimation with OLS instead of probit (Table S.3). Thus, our core result is that cold-pressor task reduces competitiveness.

4.4 Is there a causal effect of stress on backward-looking competitiveness?

We next report a number of tests to understand if our effect on competitiveness is truly driven by a change in the desire to perform in a tournament, or changes in other preferences. The first test is the task measuring "backward-looking" competitiveness, which captures all elements of the round 3 task except for the prospect of performing in a tournament. Results for this task are reported in Table 5. We find no reduction in competitiveness overall, nor separately for the easy or difficult task, and no significant interaction. In fact, the average effect of the CPT on competitiveness in this task is slightly positive. Thus, our treatment effect appears to be limited to the setting in which participants decide whether to perform in a tournament in the future, suggesting a change in the pure taste for performance under competition. This finding also lends further credence to the hypothesis that the reduction in competitiveness after stress may serve to restore homeostasis: if this was the case, opting out of future competitions would serve this purpose, while engaging in backward-looking competitiveness would not.

4.5 Is there a causal effect of stress on overconfidence?

Another possible mechanism for our core effect is that the CPT may have altered overconfidence, measured as the difference between subjective relative rank and actual relative rank in the effort task. Table 6 shows results for this variable. In Columns 1 and 2, overall overconfidence is a dummy, where a value of 1 corresponds to being overconfident in both the piece-rate and tournament rounds of the effort task. We find that the treatment effect on overall overconfidence is small and non-significant on the whole, with a coefficient on the CPT dummy of 0.02 (Column 1). The same is true when considering the easy and difficult condition separately (Column 2). In Columns 3-6, we repeat the same analysis separately for the piece-rate and tournament rounds of the effort task. Again we find no statistically significant impacts, although some of the coefficients are somewhat larger. These results are robust to the omission of control variables (Table S.4). Overall, we find little evidence for a causal relationship between the CPT and overconfidence. This finding resonates with that of the only other study which reports causal effects of acute stress on overconfidence: Cahlíková, Cingl, and Levely (2017) use the same paradigm and find no effect of the TSST on overconfidence.

4.6 Is there a causal effect of stress on productivity?

A further potential mechanism for the effect of the CPT on competitiveness is that stress may affect productivity directly; if participants are aware of such an effect, they might behave differently in the effort task. Table 7 shows regressions of productivity, as measured by the number of successfully completed trials in each round of the effort task, on a treatment dummy. In Columns 1 and 2, overall productivity is the sum of correct responses in the piece-rate, tournament, and choice rounds of the effort task. We find no significant effects of our treatments on productivity measured in this fashion. In Columns 3–8, we repeat the same analysis separately for the piece-rate, tournament, and choice rounds of the effort tasks. Again we find no evidence for an impact of the CPT on productivity. This result also holds when control variables are omitted (Table S.5), and when distinguishing between choices of the piece-rate vs. the tournament regime in round 3 (Table S.6). This finding also resonates with those of previous studies: While there is some evidence that stressful environments are associated with high performance, previous studies using the same paradigm as ours find no impact of stress on productivity for men (Cahlíková, Cingl, and Levely 2017; Zhong et al. 2018; Buser, Dreber, and Möllerström 2017)

4.7 Is there a causal effect of stress on risk aversion?

Finally, we turn to risk aversion as a possible mechanism behind our core result. Table 8 shows how risk aversion is affected by the CPT. Columns 1 and 2 show the overall treatment effect on risk aversion, measured as the share invested in the 50/50 lottery. Columns 3 and 4 repeat the same analysis for the CRRA risk aversion parameter. We find no evidence for an effect of our treatment on risk aversion. This result presents an interesting contrast to existing studies on stress and risk preferences, which often find an increase in risk aversion under stress (see Kluen et al. (2017) for an overview). For instance, Porcelli and Delgado (2009) find that the cold pressor task increases risk aversion in the gains domain, and this result is confirmed by Cahlíková and Cingl (2017). Kandasamy et al. (2014) find a similar result for chronic administration of hydrocortisone. However, other studies find an increase in risk-seeking under stress (Koppel et al. 2017). Future work will need to resolve this conflicting set of results. However, in our study, we are mainly interested in whether risk could be a driver of the competitiveness effect, and we find no evidence for this.

4.8 Meta-analysis

To integrate our results into the existing literature on stress and competitiveness, we next conduct a meta-analysis on the standardized effect of stress on tournament entry, separately for men and women. Three previous studies have used the Niederle & Vesterlund paradigm to investigate the effect of stress on competitiveness: Buser, Dreber, and Möllerström (2017) also use the CPT, and Cahlíková, Cingl, and Levely (2017) and Zhong et al. (2018) use the Trier Social Stress Test. None of these studies report a statistically significant change in competitiveness among men under stress.

We began by collecting the raw treatment effects of stress on tournament entry from each study. For the Buser, Dreber, and Möllerström (2017) and Zhong et al. (2018) studies, we contacted the authors to obtain the frequencies of competition entry for men and women in their samples. We then used a probit model to regress tournament entry in round 3 of the Niederle & Vesterlund paradigm on a treatment dummy, using the frequencies of tournament by treatment status provided by the authors, separately for men and women. The Cahlíková, Cingl, and Levely (2017) experiment assesses tournament entry using a continuous measure of points invested in a tournament, rather than a binary measure. The treatment effect of stress on points invested in the tournament is given in Column 3 of Table 4 in their paper, and the coefficient for women in Column 4 of Table 4. In our experiment, the coefficient comes from the regression of tournament entry on the treatment dummy in Column 1 of Table 4. We summarize the raw treatment coefficients from all studies, including ours, in Column 2 of Table 9. Confirming the results reported by the original authors, the effects of stress on tournament entry in men are not statistically significant in any of the other studies. However, all point estimates are negative.

To make these estimates comparable, we next calculated standardized treatment effect estimates for each study. To this end, we divide each treatment coefficient by the associated control group standard deviation, thus expressing the effect size in control group standard deviation units. We impute the control group standard deviation from the standard error of the constant term β_0 (expressed in marginal effects) in the regressions: because $SE(\beta_0) = SD(\beta_0)/\sqrt{n_0}$, where $SE(\beta_0)$ is the standard error of the constant term and n_0 is the number of participants in the control group, we have $SD(\beta_0) = SE(\beta_0) \times \sqrt{n_0}$. We then compute the standardized treatment coefficient, $\beta_{T_{st}} = \beta_T/SD(\beta_0)$, where β_T is the raw treatment coefficient from each study. We derive the standard error of the standardized treatment effect analogously, $SE(\beta_{T_{st}}) = SE_{\beta_T}/SD(\beta_0)$, where SE_{β_T} is the standard error of the raw treatment coefficient.

The resulting standardized treatment effects and standard errors are shown in Column 3 of Table 9. Strikingly, the effect sizes for men are almost identical in three out of the four studies, and very similar in the fourth: $-0.27\,SD$ in our study, $-0.28\,SD$ in (Buser, Dreber, and Möllerström 2017), $-0.26\,SD$ in (Zhong et al. 2018), and $-0.12\,SD$ in (Cahlíková, Cingl, and Levely 2017).[2] Thus, previous studies did identify a negative effect of stress on competitiveness in men; they were simply not powered for these effects to be statistically

[2] Interestingly, the effects of stress on tournament entry among women are much less consistent, with standardized effects of $0.52\,SD$ (Buser, Dreber, and Möllerström 2017), $-0.13\,SD$ (Zhong et al. 2018), and $0.02\,SD$ (Cahlíková, Cingl, and Levely 2017). In the meta-analysis, it is close to zero ($+0.02\,SD$), and not statistically significant.

significant, owing to sample sizes of 46 (Buser, Dreber, and Möllerström 2017), 44 (Zhong et al. 2018), and 95 (Cahlíková, Cingl, and Levely 2017) men. In comparison, the sample size of 434 men in our study allows us to detect such effects. We hasten to add that the other experiments studied both men and women, and therefore the smaller sample sizes for men are natural. The trade-off is that our study cannot compare between men and women.

We next enter all studies in a random-effects meta-analysis. This model allows the true underlying effect to vary across the studies, and minimizes the impact of our large sample size relative to the other studies. The meta-analysis finds an average effect of stress on competitiveness of $-0.16\,SD$ among men, statistically significant at the 5 percent level. Thus, both the individual effects in the existing literature, as well as our meta-analysis, confirms the results of our experiment.

5. Conclusion

In this paper, we study the effect of acute physical stress on competitiveness in men. Previous research has established a robust gender difference in competitiveness between men and women, with men much more likely to enter competitive environments (Niederle and Vesterlund 2007). If the stress induced by such environments leads men to be particularly competitive, this effect might partly account for the gender difference. We find no evidence for this effect: in fact, we demonstrate a sizable and robust reduction in competitiveness in men under stress. This result reflects a change in the "pure" taste for competitiveness because we rule out several possible alternative mechanisms, using both design elements of the task measuring competitiveness, and control tasks. In particular, the effect cannot be explained by changes in beliefs about the choices of others, social preferences, risk preferences, overconfidence, or productivity. We further confirm this finding in a meta-analysis, which reveals that the negative effect of stress on competitiveness is very similar in magnitude relative to other studies, which were not individually powered to detect the effect statistically. The meta-analytic effect is negative and highly significant. The similarity of effect sizes across studies is particularly compelling given the variation in stressors, including physical and psychosocial, and study populations, which ranged from Harvard undergraduates to residents of informal settlements in Nairobi. One possible explanation for these highly similar effect sizes is that physiological responses to stress are fairly stable across populations.

A potential confound to the differential impact of the stress intervention in the "backward-looking" and "forward-looking" task, as well as the risk task, is that the main competitiveness task was completed before these other tasks. Thus, it is possible that the stress induced by the CPT had already worn off by the time the control tasks were administered. However, two factors make this possibility unlikely. First, the "backward-looking" competitiveness and risk tasks were completed extremely close in time to the main competitiveness task. Second, they were completed about 25 minutes after the stressor, at a time when stress-induced cortisol levels are at their peak (Riis-Vestergaard et al. 2018; Haushofer et al. 2013; Cahlíková and Cingl 2017). Thus, we do not deem timing a significant threat to the interpretation of our results.

In sum, our results suggest that acute physical stress markedly lowers competitiveness in men. These results suggest that the gender difference in competitiveness is not easily explained through an increased propensity for men to choose competition under stress. Instead, it is possible that stress actually reduces the gender gap in competitiveness. Of course, this would require that the effect of stress on competitiveness in women is smaller than that in men. Indeed, in our meta-analysis, the average effect size of stress on competitiveness in women is half as large as that among men. This result suggests that stress may indeed reduce the gender gap in competitiveness. It is also consistent with our homeostasis hypothesis: if men are more competitive than women on average, the homeostatic pressure to reduce competitiveness induced by stress may be larger. Future studies might use large mixed samples to confirm this conjecture directly.

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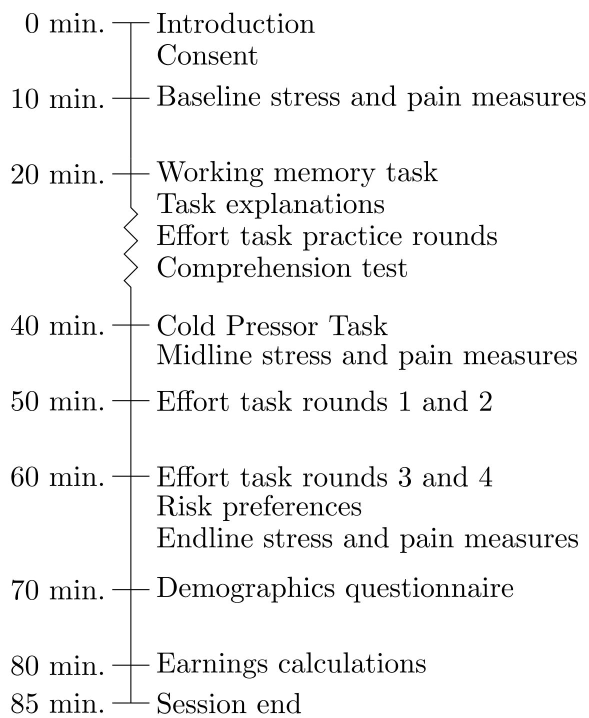

Figure 1: Timeline of Experiment

Table 1: Sample Characteristics and Balance

	Control Mean (SE)	Treatment difference (SE)
Age (years)	30.17	−0.94
	(0.76)	(1.00)
Education	13.01	0.23
	(0.22)	(0.30)
Height(cm)	165.81	1.13
	(0.57)	(0.87)
Weight (kg)	69.07	−5.54
	(4.36)	(4.40)
Monthly Income (KES)	4583.94	1646.35
	(379.64)	(1459.45)
Spending (KES)	1979.09	−383.59
	(504.93)	(539.92)
Dependents (#)	3.13	2.14
	(0.44)	(2.59)
Depend Entirely on Others	0.45	−0.03
	(0.03)	(0.05)
Employed	0.26	−0.02
	(0.03)	(0.04)
Debt	0.67	−0.01
	(0.03)	(0.05)
Smoke Today	0.11	0.00
	(0.02)	(0.03)
Drink Today	0.51	0.01
	(0.03)	(0.05)
Wake Up	6.42	0.04
	(0.09)	(0.13)
Working Memory	2.74	0.18
	(0.10)	(0.14)
Joint test (p-value)		0.81

Notes: OLS estimates of differences in control variables between treatment and control groups. *Age* is the stated age of the participant in years. *Education* is the stated level of education in years. *Height* is the stated height of the participant in centimeters. *Weight* is the stated weight of the participant in kilograms. *Monthly income* is the stated monthly income of the participant in response to the question, "How much money do you earn per month?". *Spending* is the stated spending of the participant in response to the question, "How much spending money do you normally have per month after rent, taxes, bills, etc?". *Dependents* is the stated number of people who depend entirely on the participant's income. *Supported by others* is a binary variable taking value 1 if the participant reports that they are entirely supported by others financially, without earning their own money. *Employed* is a binary variable taking value 1 if the participant reports that they are employed in a regular job. *Debt* is a binary variable taking value 1 if the participant reports that they are currently in debt. *Smoke today* is a binary variable taking value 1 if the participant reports having smoked on the day of the experiment. *Drink today* is a binary variable taking value 1 if the participant reports having drunk alcohol, tea, or coffee on the day of the experiment. *Wake up time* is the stated time that the participant woke up on the day of the experiment. *Working memory* is the number of series in the digit span task recalled correctly. For each control variable, we report the control group mean and standard error in Column (1), and the difference between the treatment and control groups and the associated standard error in Column (2). The last row shows the p-value for joint significance of all variables using SUR.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 2: Overview of Treatments

		Task difficulty			
		Easy		Difficult	
Treatment	Control	*Reverse*	*Standard*	*Reverse*	*Standard*
	Stress	*Reverse*	*Standard*	*Reverse*	*Standard*

Notes: Overview of treatments. Participants in the stress treatment were exposed to the Cold Pressor Task, whereas participants in the control condition were exposed to a room-temperature version of the task. Effort task difficulty is either Easy or Difficult. The incentive schemes, Piece-rate and Tournament, are either played in standard order (first piece-rate, then tournament), or in reversed order (first tournament, then piece-rate).

Table 3: Treatment Effect on Self-Reported Stress and Pain

	Stress		
	Baseline	After CPT	Endline
Treatment	−4.33	39.15***	−2.90
	(2.75)	(3.13)	(2.68)
Constant	3.88	29.41	−8.25
	(27.84)	(31.89)	(27.53)
Adjusted R^2	0.02	0.30	0.02
Individual Controls	Yes	Yes	Yes
Order Control	Yes	Yes	Yes
N	434	434	434
	Pain		
	Baseline	After CPT	Endline
Treatment	−1.64	48.56***	2.65
	(2.81)	(2.76)	(2.45)
Constant	30.80	11.67	6.35
	(25.57)	(28.89)	(24.53)
Adjusted R^2	0.02	0.45	0.02
Individual Controls	Yes	Yes	Yes
Order Control	Yes	Yes	Yes
N	434	434	434

Notes: OLS estimates of the treatment effect on self-reported stress and pain, controlling for order of the effort task and the standard set of individual-level control variables. Column (1) shows the treatment effect on baseline stress and pain. Column (2) shows the treatment effect on stress and pain after performing the CPT task. Column (3) shows the treatment effect on stress and pain at endline, after completing the effort task. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 4: Treatment Effect on Tournament Entry (Probit)

	Tournament Entry			
	Overall	Difficult	Easy	Overall
Treatment	-0.08^{**}	-0.10^{**}	-0.06	-0.06
	(0.04)	(0.05)	(0.05)	(0.05)
Difficult				-0.00
				(0.05)
Treatment × Difficult				-0.05
				(0.07)
Control group mean	0.80	0.81	0.79	0.80
Individual Controls	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes
N	434	205	229	434

Notes: Marginal effect of stress treatment on choosing to enter the tournament, controlling for order of the effort task and the standard set of individual-level control variables, using a probit model. Column (1) shows the overall treatment effect on tournament entry. Columns (2) and (3) show the treatment effect on tournament entry for the subsets of participants who completed the difficult or easy task, respectively. Column (4) shows the fully interacted model with the interaction term. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 5: Treatment Effect on Backward-Looking Tournament Entry (Probit)

	Overall	Difficult	Easy	Overall
Treatment	0.02	0.03	0.02	0.02
	(0.04)	(0.07)	(0.05)	(0.06)
Difficult				−0.11
				(0.07)
Treatment × Difficult				−0.01
				(0.09)
Control group mean	0.60	0.55	0.64	0.60
Individual Controls	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes
N	434	205	229	434

Notes: Marginal effect of stress treatment on choosing to enter the first piece-rate performance into a tournament, controlling for order of the effort task and the standard set of individual-level control variables, using a probit model. Column (1) shows the overall treatment effect on tournament entry. Columns (2) and (3) show the treatment effect on backward-looking tournament entry for the subsets of participants who completed the difficult or easy task, respectively. Column (4) shows the fully interacted model with the interaction term. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 6: Treatment Effect on Overconfidence (OLS)

	Overconfidence					
	Overall	Overall	Piece-rate	Piece-rate	Tournament	Tournament
Treatment	−0.02	−0.10	−0.06	−0.37	−0.12	−0.32
	(0.05)	(0.06)	(0.21)	(0.31)	(0.23)	(0.31)
Difficult		−0.20**		−0.78**		−0.72**
		(0.06)		(0.26)		(0.28)
Treatment × Difficult		0.17*		0.64		0.41
		(0.10)		(0.40)		(0.44)
Constant	0.22	0.31	−1.83	−1.47	−1.63	−1.31
	(0.50)	(0.50)	(1.70)	(1.69)	(1.80)	(1.76)
Treatment + Interaction β		0.07		0.28		0.10
Treatment + Interaction β SE		0.08		0.27		0.33
Adjusted R^2	0.02	0.04	0.06	0.07	0.04	0.05
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on overconfidence, controlling for order of the effort task and the standard set of individual-level control variables. Column (1) shows the overall treatment effect on overconfidence. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the piece-rate round, and Columns (5) and (6) for the tournament round. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 7: Treatment Effect on Productivity (OLS)

	Productivity							
	Overall	Overall	Piece-rate	Piece-rate	Tournament	Tournament	Choice	Choice
Treatment	0.33	−0.16	−0.08	−0.01	0.28	0.02	0.14	−0.16
	(1.55)	(2.17)	(0.51)	(0.72)	(0.57)	(0.85)	(0.60)	(0.86)
Difficult		−37.41***		−11.55***		−12.23***		−13.63***
		(1.53)		(0.59)		(0.60)		(0.54)
Treatment × Difficult		0.45		−0.34		0.37		0.42
		(2.43)		(0.85)		(0.93)		(0.97)
Constant	38.99	53.45***	11.12	15.54***	12.62	17.37***	15.25*	20.54***
	(24.70)	(11.22)	(8.27)	(4.17)	(8.50)	(4.63)	(8.62)	(3.87)
Treatment + Interaction β		0.30		−0.35		0.39		0.26
Treatment + Interaction β SE		1.13		0.46		0.41		0.45
Adjusted R^2	0.08	0.76	0.08	0.68	0.09	0.71	0.06	0.74
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	434	434	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on productivity, controlling for order of the effort task and the standard set of individual-level control variables. Column (1) shows the overall treatment effect on productivity. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the piece-rate round; Columns (5) and (6) for the tournament round; and Columns (7) and (8) for the choice round. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 8: Treatment Effect on Risk Aversion (OLS)

	Risk Aversion			
	Share invested in risky asset	Share invested in risky asset	CRRA risk parameter	CRRA risk parameter
Treatment	−0.03	−0.03	0.11	0.08
	(−1.07)	(−0.70)	(0.86)	(0.39)
Difficult		0.02		−0.25
		(0.54)		(−1.60)
Treatment × Difficult		−0.00		0.05
		(−0.03)		(0.21)
Constant	0.87***	0.86**	−0.77	−0.67
	(3.49)	(3.39)	(−0.73)	(−0.62)
Treatment + Interaction β		−0.03		0.13
Treatment + Interaction β SE		0.03		0.13
Adjusted R^2	0.03	0.03	0.08	0.08
Individual Controls	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes
N	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on risk aversion, controlling for order of the effort task and the standard set of individual-level control variables. Column (1) shows the overall treatment effect on the share of the endowment invested in the risky asset. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the CRRA rik aversion parameter. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 9: Meta-analysis: Effect of Stress on Tournament Entry

	Stress paradigm	Raw treatment coefficient (SE)	Standardized effect size (SE)	95% CI	N
Men					
Current experiment	CPT	-0.08^{**}	-0.27^{**}	$[-0.54, -0.01]$	434
		(0.04)	(0.14)		
Buser et al., 2017	CPT	-0.09	-0.28	$[-1.10, 0.55]$	46
		(0.15)	(0.42)		
Cahlíková et al., 2017	TSST	-7.99	-0.12	$[-0.27, 0.03]$	95
		(5.00)	(0.08)		
Zhong et al., 2018	TSST	-0.09	-0.26	$[-1.08, 0.57]$	44
		(0.15)	(0.42)		
Random-effects meta-analysis			-0.16^{**}	$[-0.29, -0.04]$	619
Women					
Buser et al., 2017	CPT	0.17	0.52	$[-0.19, 1.23]$	57
		(0.12)	(0.36)		
Cahlíková et al., 2017	TSST	-7.31	-0.13	$[-0.29, 0.03]$	95
		(4.58)	(0.08)		
Zhong et al., 2018	TSST	0.01	0.02	$[-0.91, 0.95]$	40
		(0.14)	(0.47)		
Random-effects meta-analysis			0.02	$[-0.35, 0.39]$	192

Notes: Random-effects meta-analysis of the effect of stress on competitiveness. Column (1) lists the stress paradigm used in each experiment. Columns (2) and (3) show the raw treatment coefficient, derived from the original experiment, and the standardized effect size for each individual experiment. Column (3) also shows the meta-analytic effect for all studies. Column (4) shows the confidence interval for each individual study, derived from the meta-analysis, and the confidence interval for the meta-analytic estimate itself. Column (5) shows the number of observations in each experiment. Standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Appendix

Table S.1: Treatment Effect on Self-Reported Stress and Pain (OLS without individual-level controls)

	Stress		
	Baseline	After CPT	Endline
Treatment	−3.79	38.42***	−2.43
	(2.64)	(3.09)	(2.66)
Constant	36.65***	21.43***	29.18***
	(2.47)	(1.95)	(2.15)
Adjusted R^2	0.00	0.30	−0.00
Individual Controls	No	No	No
Order Control	Yes	Yes	Yes
N	434	434	434
	Pain		
	Baseline	After CPT	Endline
Treatment	−2.43	47.78***	2.28
	(2.77)	(2.80)	(2.47)
Constant	15.92***	14.34***	12.31***
	(2.03)	(1.60)	(1.49)
Adjusted R^2	0.00	0.44	−0.00
Individual Controls	No	No	No
Order Control	Yes	Yes	Yes
N	434	434	434

Notes: OLS estimates of the treatment effect on self-reported stress and pain, controlling for order of the effort task but not for the standard set of individual-level control variables. Column (1) shows the treatment effect on baseline stress and pain. Column (2) shows the treatment effect on stress and pain after performing the CPT task. Column (3) shows the treatment effect on stress and pain at endline, after completing the effort task. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.2: Treatment Effect on Tournament Entry (Probit without individual-level controls)

	Tournament Entry			
	Overall	Difficult	Easy	Overall
Treatment	-0.07^{*}	-0.09^{*}	-0.05	-0.05
	(0.04)	(0.05)	(0.06)	(0.06)
Difficult				0.02
				(0.06)
Treatment × Difficult				-0.04
				(0.08)
Control group mean	0.80	0.81	0.79	0.80
Individual Controls	No	No	No	No
Order Control	Yes	Yes	Yes	Yes
N	434	205	229	434

Notes: Marginal effect of stress treatment on choosing to enter the tournament, controlling for order of the effort task but not for the standard set of individual-level control variables, using a probit model. Column (1) shows the overall treatment effect on tournament entry. Columns (2) and (3) show the treatment effect on tournament entry for the subsets of participants who completed the difficult or easy task, respectively. Column (4) shows the fully interacted model with the interaction term. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.3: Treatment Effect on Tournament Entry (OLS)

	Tournament Entry - Controls			
	Overall	Difficult	Easy	Overall
Treatment	-0.08^{**}	-0.10^{**}	-0.06	-0.06
	(0.04)	(0.05)	(0.05)	(0.05)
Difficult				0.00
				(0.05)
Treatment × Difficult				-0.05
				(0.07)
Constant	0.95^{**}	0.54	1.10^{**}	0.95^{**}
	(0.40)	(0.64)	(0.54)	(0.40)
Adjusted R^2	0.03	-0.02	0.08	0.03
Individual Controls	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes
N	434	205	229	434

	Tournament Entry - No Controls			
	Overall	Difficult	Easy	Overall
Treatment	-0.07^{*}	-0.09^{*}	-0.05	-0.05
	(0.04)	(0.05)	(0.06)	(0.06)
Difficult				0.02
				(0.06)
Treatment × Difficult				-0.04
				(0.08)
Constant	0.81^{***}	0.87^{***}	0.76^{***}	0.80^{***}
	(0.07)	(0.09)	(0.11)	(0.08)
Adjusted R^2	0.00	0.00	-0.01	-0.00
Individual Controls	No	No	No	No
Order Control	Yes	Yes	Yes	Yes
N	434	205	229	434

Notes: OLS estimates of the effect of stress treatment on choosing to enter the tournament, controlling for order of the effort task and either including (top panel) or not including (bottom panel) the standard set of individual-level control variabes. Column (1) shows the overall treatment effect on tournament entry. Columns (2) and (3) show the treatment effect on tournament entry for the subsets of participants who completed the difficult or easy task, respectively. Column (4) shows the fully interacted model with the interaction term. Robust standard errors, clustered at the session level, in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.4: Treatment Effect on Overconfidence (OLS without individual-level controls)

	Overconfidence					
	Overall	Overall	Piece-rate	Piece-rate	Tournament	Tournament
Treatment	−0.02	−0.11*	−0.10	−0.42	−0.14	−0.36
	(0.05)	(0.06)	(0.22)	(0.33)	(0.22)	(0.31)
Difficult		−0.22***		−0.88***		−0.81**
		(0.06)		(0.24)		(0.27)
Treatment × Difficult		0.19*		0.65		0.46
		(0.10)		(0.42)		(0.45)
Constant	0.58***	0.69***	1.47***	1.92***	1.97***	2.38***
	(0.07)	(0.07)	(0.30)	(0.28)	(0.26)	(0.25)
Treatment + Interaction β		0.07		0.24		0.10
Treatment + Interaction β SE		0.08		0.27		0.33
Adjusted R^2	−0.00	0.02	−0.00	0.01	−0.00	0.02
Individual Controls	No	No	No	No	No	No
Order Control	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on overconfidence, controlling for order of the effort task but not for the standard set of individual-level control variables. Column (1) shows the overall treatment effect on overconfidence. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the piece-rate round, and Columns (5) and (6) for the tournament round. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.5: Treatment Effect on Productivity (OLS without individual-level controls)

	Productivity							
	Overall	Overall	Piece-rate	Piece-rate	Tournament	Tournament	Choice	Choice
Treatment	1.24	0.99	0.23	0.37	0.59	0.40	0.42	0.22
	(1.58)	(2.50)	(0.51)	(0.82)	(0.59)	(0.96)	(0.60)	(0.94)
Difficult		−36.31***		−11.19***		−11.90***		−13.21***
		(1.96)		(0.71)		(0.74)		(0.66)
Treatment × Difficult		−0.16		−0.52		0.18		0.19
		(2.75)		(0.91)		(1.06)		(1.05)
Constant	43.49***	62.54***	12.79***	18.67***	15.21***	21.46***	15.48***	22.41***
	(8.18)	(2.45)	(2.57)	(0.96)	(2.75)	(0.92)	(2.91)	(0.73)
Treatment + Interaction β		0.83		−0.15		0.57		0.40
Treatment + Interaction β SE		1.16		0.38		0.46		0.47
Adjusted R^2	−0.00	0.66	0.00	0.58	−0.00	0.61	−0.00	0.66
Individual Controls	No	No	No	No	No	No	No	No
Order Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	434	434	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on productivity, controlling for order of the effort task but not for the standard set of individual-level control variables. Column (1) shows the overall treatment effect on productivity. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the piece-rate round; Columns (5) and (6) for the tournament round; and Columns (7) and (8) for the choice round. Robust standard errors, clustered at the session level, in parentheses.

* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.6: Treatment Effect on Productivity in the Choice Round (OLS)

	Productivity - Controls					
	Choice	Choice	Choice: Piece-rate	Choice: Piece-rate	Choice: Tournament	Choice: Tournament
Treatment	0.14	−0.16	1.65	−0.24	0.24	−0.18
	(0.60)	(0.86)	(1.50)	(1.54)	(0.67)	(0.77)
Difficult		−13.63***		−12.93***		−14.02***
		(0.54)		(1.08)		(0.53)
Treatment × Difficult		0.42		2.66		0.36
		(0.97)		(1.91)		(0.92)
Constant	15.25*	20.54***	38.73**	47.63***	9.89	12.36**
	(8.62)	(3.87)	(15.88)	(10.46)	(9.38)	(3.70)
Treatment + Interaction β		0.26		2.42		0.18
Treatment + Interaction β SE		0.45		1.12		0.53
Adjusted R^2	0.06	0.74	0.09	0.64	0.07	0.78
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Order Control	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	103	103	331	331

	Productivity - No Controls					
	Choice	Choice	Choice: Piece-rate	Choice: Piece-rate	Choice: Tournament	Choice: Tournament
Treatment	0.42	0.22	1.07	1.23	0.45	0.09
	(0.60)	(0.94)	(1.48)	(1.83)	(0.71)	(0.91)
Difficult		−13.21***		−11.05***		−13.87***
		(0.66)		(1.14)		(0.70)
Treatment × Difficult		0.19		0.52		0.07
		(1.05)		(2.05)		(1.04)
Constant	15.48***	22.41***	15.77***	20.33***	15.22***	22.98***
	(2.91)	(0.73)	(3.29)	(1.64)	(3.11)	(0.88)
Treatment + Interaction β		0.40		1.75		0.16
Treatment + Interaction β SE		0.47		0.90		0.52
Adjusted R^2	−0.00	0.66	−0.00	0.53	−0.00	0.71
Individual Controls	No	No	No	No	No	No
Order Control	Yes	Yes	Yes	Yes	Yes	Yes
N	434	434	103	103	331	331

Notes: OLS estimates of the effect of stress treatment on productivity in the choice round, controlling for order of the effort task and either including (top panel) or not including (bottom panel) the standard set of individual-level control variables. Column (1) shows the overall treatment effect on productivity in the choice round. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates if the piece-rate regime was chosen in the choice round, and Columns (5) and (6) if the tournament regime was chosen. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table S.7: Treatment Effect on Risk Aversion (OLS without individual-level controls)

	Risk Aversion			
	Share invested in risky asset	Share invested in risky asset	CRRA risk parameter	CRRA risk parameter
Treatment	−0.03	−0.03	0.11	0.12
	(−1.05)	(−0.74)	(0.86)	(0.53)
Difficult		0.02		−0.23
		(0.56)		(−1.41)
Treatment × Difficult		0.01		−0.02
		(0.12)		(−0.08)
Constant	0.61***	0.60***	0.84***	0.96***
	(11.87)	(10.36)	(4.89)	(4.85)
Treatment + Interaction β		−0.02		0.10
Treatment + Interaction β SE		0.03		0.12
Adjusted R^2	−0.00	−0.00	−0.00	0.00
Individual Controls	No	No	No	No
Order Control	Yes	Yes	Yes	Yes
N	434	434	434	434

Notes: OLS estimates of the effect of stress treatment on risk aversion, controlling for order of the effort task but not for the standard set of individual-level control variables. Column (1) shows the overall treatment effect on the share of the endowment invested in the risky asset. Column (2) shows the fully interacted model with the interaction term. Columns (3) and (4) show the same estimates for the CRRA rik aversion parameter. Robust standard errors, clustered at the session level, in parentheses.
* denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

EXPERIMENTAL INSTRUCTIONS

1 In the waiting room

Bring participants into the waiting room, ask them to sit on the chairs labelled with the number on the place card they were given at the gate.

Explain the task:

"Hello everyone! A warm welcome to the Busara Center for Behavioral Economics. I see all participants are present, thank you for your willingness to participate. You are about to start a study that investigates the effect of stress on productivity and social prefer-ences. The procedure itself could be a bit painful, as we may ask you to immerse your hand in cold water for a certain amount of time. You will get paid a show up fee of 200/400 KES, depending on where you're from, 50 KSH if you showed up on time and in addition, you can earn some extra money based on your performance in the task. This money will be transferred to your MPESA account. We will use the phone number that you registered with today. Now, please ensure that your phones are switched off com-pletely. We do this so that you can focus on the task. It is also important that you refrain from communicating with other participants. This also helps you to concentrate. If you talk to other people, we will have to send you home and you can't get paid.

Additionally, only touch the computers once you are instructed to do so.

If you are chewing gum, be so kind to take it out now.

Furthermore, please use the bathroom now, or you will have to wait until the session is over, which will last around 1 hour. It may therefore be good to go now, even if it is not urgent."

(Allow time to go to the bathroom)

"If you have any questions during the session, please raise your hand and one of the researchers will come and talk to you.

Are everyone's phones off? We will now go to the computer room, where I will give you more information about the study. Please find the computer with the number of your placecard, and sit down. Again remember that you are not allowed to speak to each other from now on, and please wait with touching the computers until we instruct you to do so."

2 In the computer room

Make participants aware of the consent form that's on their desk.

"I'd now like to ask you to turn over the Declaration of Consent in front of you, read through it and sign it if you agree. If you have questions, please ask me. When you are finished, please raise your hand so that I can collect it."

2.1 At the computer

2.1.1 Get consent

2.1.2 Cortisol Baseline (S1: white)

"Now I will explain to you how the salivettes work. With these salivettes, we collect samples for the analysis of hormones in saliva. Please take the white salivette, open it and take out the small cotton swab. Don't remove the labels, and don't put it in your mouth, yet. Wait until everyone has a cotton swab in hand. Confirm color by having respondents hold up Salivette. Now put the cotton swab into your mouth and chew lightly on it. Please don't chew to hard, and under no circumstances should you swallow it. The cotton swab should absorb as much saliva as possible. After a minute I will tell you to remove it again. "

(Stop 1 minute on your stopwatch)

"Now you can remove the cotton swab again. Please put it back in the container, close this and place it back on your table."

2.1.3 PANAS/VAS 1

"Now we will ask you to fill out a questionnaire on your computer 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 care-fully 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?"

*Items were displayed on the touch screen one after another. To strengthen understanding, each item was translated into Kiswahili by staff members, in the form of a question i.e.: "How **upset**, do you feel right now?" Ratings were made on the touch-screen using a visual analogue scale (VAS) with answering options ranging from 0-100. The VAS was supported by a color gradient ranging from green to blue, where the far green end of the gradient displayed the answering option "not at all" and the far blue end of the gradient displayed the answering option "very much". When participants touched the gradient on the screen, the corresponding number between 0-100 appeared on top of the VAS, reflecting the participants' rating. Participants were asked to rate subjective stress and pain in exactly the same manner.*

2.1.4 Working Memory Task

"In this next task, you will be shown a number on the screen for 5 seconds; this will be followed by a period of 5 seconds where the screen is blank. You are asked to remember the number dur-ing this delay, and then enter it using

Table 1: PANAS Emotions

English	Swahili
Distressed	Kusononeka
Upset	Udhika
Guilty	Kuwa na hatia
Ashamed	Aibika
Hostile	Uhasama
Irritable	Jambo linalo kera
Nervous	Wasiwasi
Jittery	Ungulika
Scared	Shtuka
Afraid	Ogopa
Pain	Uchungu
Stressed	Kusumbuka kimawazo

the number pad that appears on the screen, and confirm by hitting the green OK button. You can clear the number pad by pressing the red "Clear" button. Note that the next trial will being immediately when you have completed the last one, so pay close attention. Important: you are not allowed to note the numbers down, or to enter them into your phone. We will walk around and watch you; if we see that you write things down or into your phone, we will subtract Ksh 200 from your payment today. If you have questions, please raise your hand now. "

2.1.5 Comprehension questions and practice

"On the screen before you, you see a table with 0s and 1s. Your task is to count the number of 0s in the table on the left hand-side of the screen and to enter your answer into the number pad on the right hand side of the screen. To confirm your answer, click the OK-Button. To correct your answer push the Clear-Button. The number you typed in previously will then be deleted and you can type in a new number. Once you clicked the OK-Button, a new table will be generated on the left hand side of your screen and you are to count the 0s in the table again, until the time limit is up. While you are playing this game your number of correct and wrong answers will be displayed below the table. Try to give the correct answer for as many tables as you can and also remember to perform this task as accurately as possible."

2.1.6 Comprehension questions:

"We will now ask you two comprehension questions. You will only be allowed to participate in the real experiment, if you answer these questions correctly. If you chose the wrong answer, an information screen will pop up saying "Please raise your hand and wait for an experimenter to come to you and help you with this question"".

Comprehension Question 1: What is your task in this study?
1. Count the number of zeros in the grid (x)
2. Count the number of 1s in the grid ( )
3. Enter a letter of the alphabet into the number pad ( )

Comprehension Question 2:
How are you supposed to perform this task?
1. As slowly as possible ( )
2. As fast as possible ( )
3. As fast and as accurate as possible (x)

ASK SOMEONE TO PUT THE COOLERS ON THE WOODEN BLOCKS AND KEEP THEM UP UNTIL THE STUDY IS FINISHED.

2.1.7 30 Second Cold Pressor Procedure with Short PANAS/VAS 2

"Put hand in ice water – 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 indicate 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"

2.1.8 Cortisol Before Cold Pressor (S2: Orange)

"Now please take the orange salivette and chew as previously described."

(Stop 1 minute)

Confirm color by having respondents hold up Salivette.

TAKE THE TEMPERATURE NOW

2.1.9 60 Second Cold Pressor Procedure

"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 con-tainer or the metal divider. 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."

2.1.10 Cortisol after Cold Pressor Test (S3: Blue)

"Now please take the blue salivette and chew as previously described."

(Stop 1 minute)

Confirm color by having respondents hold up Salivette.

2.1.11 Effort Task1

"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."

2.1.12 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."

2.1.13 Effort Task2

"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."

2.1.14 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."

2.1.15 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."

2.1.16 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 pay-ment of 1 Shilling per correct answer, or you can enter your Task 1 performance into a tourna-ment 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."

2.1.17 Risk Preferences

"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 add-ed 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."

2.1.18 Cortisol after Task (S4: Green)

"Now please take the green salivette and chew as previously described."

(Stop 1 minute)

Confirm color by having respondents hold up Salivette.

2.1.19 PANAS/ VAS 3

"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 some-thing in between. You can use the entire blue-green gradient for your response, not just the ends.

Do you have any questions?"

2.1.20 Questionnaire

"Now you will fill out a brief questionnaire. Please raise your hand if you have any questions."

Table 2: PANAS Emotions

English	Swahili
Distressed	Kusononeka
Upset	Udhika
Guilty	Kuwa na hatia
Ashamed	Aibika
Hostile	Uhasama
Irritable	Jambo linalo kera
Nervous	Wasiwasi
Jittery	Ungulika
Scared	Shtuka
Afraid	Ogopa
Pain	Uchungu
Stressed	Kusumbuka kimawazo

Question 1: Please select how tall you are

Question 2: How much do you weigh (in kg)?

Question 3: How many brothers and sisters do you have?

Question 4: How much money do you earn per month (In KSh)?

Question 5: How much spending money do you normally have per month, AFTER rent, taxes, bills, etc.?

Question 6: How many peope depend entirely on your income? If none, enter zero

Question 7: Are you ENTIRELY supported by someone else financially, without earning own money?

Question 8: Are you employed in a regular job?

Question 9: Are you currently in debt?

Question 10: Did you smoke today?

Question 11: Did you drink alcohol, tea or coffee today?

Question 12: At what time did you wake up today?

2.1.21 Earnings file

"We will now show you the amount of money you earned during the three tasks you played today. You will be paid the amount you see under Overall income. If you held your hand in water for a minute, add 100 KES to this amount. If you guessed your rank correctly you may earn another 22 Shilling per correctly guessed rank. Also, add your show-up fee and your on-time bonus if you were on time."

2.1.22 Cortisol after Task (S5: Red)

"Now please take the green salivette and chew as previously described."

(Stop 1 minute)

Confirm color by having respondents hold up Salivette. Ask someone to take the coolers down again.

Measure the temperature.

If water temperature is higher than 5 degrees in coolers with ice, add ice. If water temperature in coolers with warm water is lower than 35 degrees, heat up water and bring the temperature up to 35 degrees.