***Stage 1 Registered Report***

**Does alleviating poverty increase cognitive performance?**

**Short- and long-term evidence from a randomized controlled trial**

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**Abstract**

Recent findings suggest that poverty has a deteriorating effect on cognitive functioning which can reinforce existing social inequalities. In this Registered Report, we will investigate the impact of a poverty alleviation program on cognitive performance. We will analyze data from a randomized controlled trial conducted on low-income, high-risk individuals in Liberia where a random half of the participants (n=251) received a $200 lump-sum unconditional cash transfer - equivalent approximately to 300% of their monthly income - while the other half (n= 222) did not. Several measures of executive functioning were administered 2 and 5 weeks, 12 and 13 months after the cash distributions. Extending prior literature, we will test in a randomized controlled trialboth the short-term and the long-term impact of the treatment on cognitive performance and also explore the role of potential mechanisms driving the effect.

*Keywords:* unconditional cash transfer, scarcity, cognitive functioning

**Introduction**

A variety of studies show that living in financial scarcity has a negative impact on cognitive functioning [1–6](https://www.zotero.org/google-docs/?nvcZ8r) and that decreased cognitive functioning deteriorates the economic opportunities of the poor [7–9](https://www.zotero.org/google-docs/?9aVKQQ). If so, impaired cognitive performance is one important pathway through which the self-reinforcing cycles of poverty are expressed [10](https://www.zotero.org/google-docs/?jiQG7t). This study’s central question is whether the vicious cycle of deprived cognition exists, and whether it can be broken in adulthood. To do so, we analyse pre-existing data from a cash transfer-based poverty alleviation program[11](https://www.zotero.org/google-docs/?5SubvL). Extending the previous work of Blattman et. al.,[11](https://www.zotero.org/google-docs/?ClZeEJ) who showed that a mixed unconditional cash transfer and behavioral therapy program can reduce crime and violence, in the present work we aim to test experimentally whether the cash treatment can improve cognitive performance of the poor in the short- and the long-term.

The idea that unconditional cash transfers can enhance cognitive functioning seemed to be radical even a few years ago.[[1]](#footnote-1) In recent years, however, a growing literature brought evidence that poverty has an impact on cognitive performance. In their seminal paper, Mani, Mullainathan, Shafir, and Zhao [3](https://www.zotero.org/google-docs/?RLVcW8) revealed that farmers achieved lower scores on measures of fluid intelligence and cognitive control before harvest, when poor, compared with after harvest, when rich. Although Wicherts and Scholten [12](https://www.zotero.org/google-docs/?bk0YMF) raised concerns about the robustness of the results, these findings generated interest in the scientific and policy making community, as they suggested that the poor were not less capable because of inherent traits, but because of the context of poverty. Carvalho, Meier and Wang [13](https://www.zotero.org/google-docs/?eBtoOx) did not find differences in cognitive performance between randomly assigned participants receiving online surveys before and after payday in a US context. However, reanalyzing the same dataset controlling for the distance of the cognitive measurements from payday, Mani Mullainathan, Shafir and Zhao [14](https://www.zotero.org/google-docs/?tkoAry) found supporting evidence for the effect. In a more recent study, Kaur, Mullainathan, Schillbach and Oh [15](https://www.zotero.org/google-docs/?A0DA1j) randomized the timing of income receipt to reveal its effects on the average productivity in manufacturing workers in India. They found that on cash-rich days, the average number of mistakes decreased among the poorer workers. Ong, Theseira, and Iyh [16](https://www.zotero.org/google-docs/?Hq4NeA) also showed that a one-off, unanticipated debt-relief program improved the performance of the recipients on a cognitive control task compared to their performance before the debt relief.

These results suggest that positive financial shocks can enhance the cognitive performance of the poor in the short-term. But these studies have not experimentally varied wealth, and leave the question open whether poverty alleviation programs could have enduring, long-term impacts. If the effects of extra cash on cognition dissipate quickly, it also raises the question whether such programs are a useful means to help the poor break out of poverty by changing cognitive functioning. Measuring the short- and long-term effect of cash transfers could also help theory formation and improve our understanding through which of the many possible paths is the effect of cash transfers expressed [17](https://www.zotero.org/google-docs/?m0TXZc).

There are several potential pathways through which poverty can impair cognitive performance in the short-term. The context of poverty may tax cognitive capacity by introducing scarcity-related concerns or increased anxiety and stress [3,15,18–20](https://www.zotero.org/google-docs/?kxnc3i). Furthermore, individuals living in poverty are often sleep-deprived [21,22](https://www.zotero.org/google-docs/?kdBYCz), and experience more pain [23](https://www.zotero.org/google-docs/?dRx34K), conflict [11](https://www.zotero.org/google-docs/?nvLVb9) and acute hunger [24,25](https://www.zotero.org/google-docs/?pzb0xp) which can also diminish their cognitive performance. Yet, some effects of poverty only harm cognitive performance over a longer time frame. Deprived access to different resources such as education, physical and mental health care [20,26](https://www.zotero.org/google-docs/?89SLY6) or high quality nutrition [27,28](https://www.zotero.org/google-docs/?9Xgrns), have the potential to create enduring changes in cognitive functioning particularly when experienced during childhood.

In the present study, we will test whether alleviating poverty influences cognitive functioning on a poor and vulnerable population: street youth in Monrovia, Liberia. The study participants, all men between the ages of 18 and 35, had weekly cash earnings of $17 mainly from temporary, low-skilled work. A quarter were homeless in the two weeks preceding the intervention, and they slept hungry 1.3 days a week. We will use data from a randomized controlled field experiment also described in Blattman et al.[11](https://www.zotero.org/google-docs/?d65FkI), and test the effect of a $200 lump-sum unconditional cash transfer (equivalent to roughly 300% of the participants’ monthly income) on the cognitive performance of the participants 2-5 weeks and 12-13 months after the cash transfer intervention. We will also explore the role of potential mechanisms (worrying, sleep deprivation, mental-health, hunger, recent conflicts) driving the impact of the cash treatment.

We will extend previous findings on several points. First, testing the effect of cash transfers in a randomized controlled study will allow us to provide a clearer, and less biased estimation on the treatment effects compared to previously published studies using pre-post designs [12](https://www.zotero.org/google-docs/?bd6jgQ). Second, our study design enables us to test both the short- and long-term effect of unconditional cash transfers on cognitive performance. Third, we will explore the role of a range of potential mediating channels at the same time providing input for theory formation.

**Methods**

This research was approved by the Institutional Review Board at Yale University (IRB-0912006068) and complies with all relevant ethical regulations.

In the present Registered Report, we will re-analyze the randomized controlled trial also described in Blattman et al.[11](https://www.zotero.org/google-docs/?LlG0hX). The present paper focuses on the effect of the cash intervention on cognitive functioning. At the time of the design (2009) and the original publication of Blattman et al. (2017), the authors specifically did not hypothesize any change in cognitive function, and hence excluded it from their preregistration, and focused their paper on how therapy and unconditional cash transfers should affect criminal and violent behavior. Cognitive functions were assessed to obtain an exhaustive list of baseline measures. The treatment effects on cognitive functioning were not previously analysed and published beyond the preliminary analyses on a small subset of outcomes (see Blattmann et al., 2017, Appendix D7).

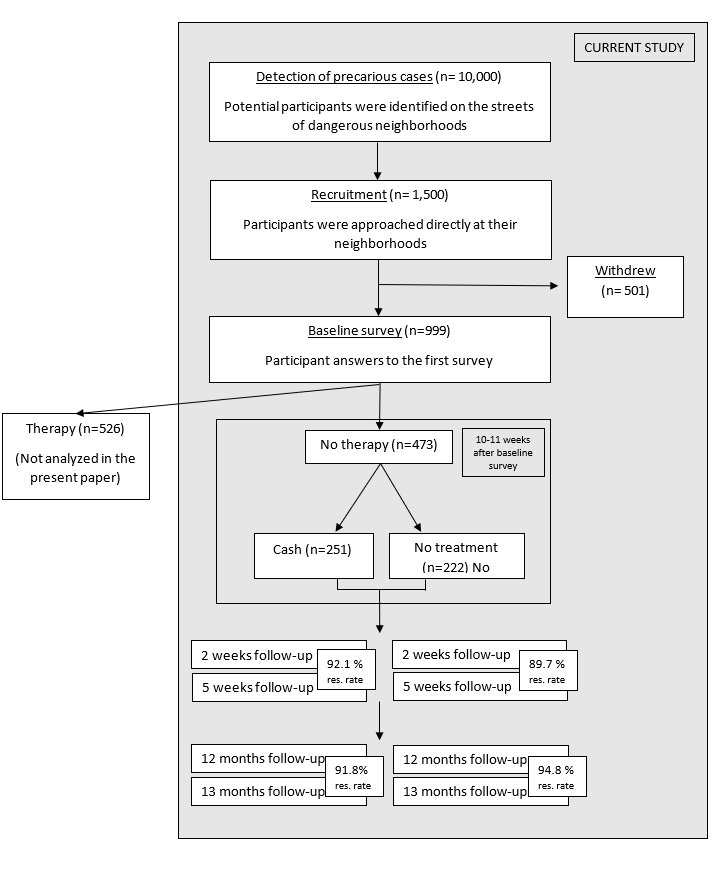
*Participants and data collection*

The study aimed to recruit 1,000 high-risk, low-income males. The Network for Empowerment and Progressive Initiatives (NEPI) — a Liberian non profit organization with strong reputation in the local neighborhoods of Monrovia and connections to the local leaders — coordinated the recruitment process. Many recruiters had graduated from previous NEPI programs and had backgrounds similar to the target population - criminal involvement, or former membership of armed groups. NEPI staff involved in the interventions did not participate in the recruitment process.

Recruiters identified and visited the five residential neighborhoods of Monrovia with the highest levels of criminality and violence, each with a population around 100,000. They looked for vulnerable participants with evident signs of homelessness and substance abuse, and approached potential participants directly on the street. To avoid spillover effects and people highly associated with one another, recruiters were instructed to approach only one in every seven potential participants. That way, 10,000 precarious cases were detected, from which only 1,500 men were invited to participate in the experiment. Next, recruiters explained the intervention and study. The cash grants were never mentioned at this point. From the initial 1,500 recruited men, 501 withdrew from the study due to lack of interest. As a result, the final sample of the 4 treatment arms (including those not analyzed in the present study) consisted of 999 poor young males with an average age of 25 years (Figure 1).

*The process of the study*

Relevant to the present research, the study had two mutually exclusive treatment arms: no treatment[[2]](#footnote-2) and treatment with the cash transfers. Note however, that in the original study[11](https://www.zotero.org/google-docs/?QgnlOi), there were two additional treatment groups (treatment with a cognitive behavior-informed therapy (CBT) and treatment with CBT followed by the cash transfer) which we do not analyze in the present paper. As the data collection of the different arms were interconnected, here we briefly discuss the study process for all treatment arms (Figure 1).

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*Fig 1. Consort diagram. Survey response rates are calculated as the difference between the total number of respondents at baseline and the number of respondents "unfound" at each endline, all divided by the number of respondents at baseline.*

After being recruited and before being assigned to any of the conditions, participants answered a baseline survey. Next, participants were asked to draw chips blindly from a pouch which determined whether they were assigned to participating or not in therapy. Crucially, participants analyzed in the present study receiving no therapy, were not engaged further until the assignment of cash treatments.[[3]](#footnote-3) 10-11 weeks after the baseline survey, all participants were invited to a public draw in groups of 50 where the lump-sum US$200 grants were randomly drawn by a nonprofit organization (Global Communities). Instead of computerized randomization, personal draws were used in order to maximize trust and transparency among the participants. Four follow-up surveys were conducted 2 and 5 weeks, and 12 and 13 months after the cash randomization by a nonprofit research organization (Innovations for Poverty Action). As a result of the randomization procedure, 22 percent of the participants were assigned to the control arm (n = 222), and 25 percent into the cash only arm (n =251) (as well as 28 percent into therapy only (n = 277), and 25 percent into the joint treatment arm (n = 249). Note that the therapy only and joint treatment arms are not analyzed in the present study. As reported in detail in Blattman et al. [11](https://www.zotero.org/google-docs/?dwkNgj), the treatment is largely balanced along the covariates reported below.

*The phases of implementation*

We implemented the study in three phases. For safety and procedural reasons, we first conducted a pilot phase with 100 men in a peri-urban part of Monrovia. Data from participants in the pilot phase were later compiled with the participants recruited later. Few changes to the intervention or protocols were required, and so a largely similar second phase of recruitment and treatment started half a year after the pilot study, with a geographical extension of the recruitment in the central areas of Monrovia. During that phase, 398 participants were recruited. The third phase of implementation followed 9 months later, and consisted of a recruitment of 501 men from three different areas of Bushrod Island.

*The treatment: unconditional cash transfers*

Individuals in the cash transfer treatment condition received US$200 in a single lump-sum by lottery **-** about 300% of monthly income for the target population[[4]](#footnote-4).

A compensation of US$10 was given for participants in the control condition. The winners were briefly advised on how to keep this money safe. However, the cash transfers were unconditional and the final decision on how they would use the money was at the participants’ discretion.

*Baseline and Follow-up surveys*

The follow-up surveys were administered verbally by trained enumerators. Each participant was asked to participate in five surveys. Once they agreed with the study terms, participants completed a baseline survey. The remaining four surveys took place 2 and 5 weeks (short-term), and then 12 and 13 months (long-term) after the cash distribution [[5]](#footnote-5). As the administration of multiple measurements at relatively short intervals have been argued to decrease noise and increase precision for key outcomes [29](https://www.zotero.org/google-docs/?Xj9HEc), the authors collected two data points both for the short-term and the long-term follow-ups. That is, the 2 and 5 weeks, and the 12 and 13 months follow-up surveys intended to measure the same underlying phenomenon, respectively. Accordingly, similarly to Blattman et al.[11](https://www.zotero.org/google-docs/?MZKycI), we will merge the responses for the 2 and 5 weeks as well as for the 12 and 13 months surveys in our analyses by taking the average of the corresponding results.

Each survey session included a roughly 90 minutes-long questionnaire, delivered verbally. It included measures such as antisocial behavior, psychological state, time preferences, social identity, and self-control among others. The survey was followed by a roughly 45-minute session of games and tests including also the executive function measures. The response time measures were administered using a stopwatch, as in the context of the study it was not feasible to collect data using computerized means. The questions and the games and tests were always administered in the same order. The average earnings from the survey and games were roughly equivalent to a half-day wage. In the current paper, we only focus on and analyze the results of the cognitive performance tests, described below. As described in detail in Blattman et al. (2017, Appendix A3), the authors collected at least five close contacts and all known addresses of the participants and spent on average three to four days locating respondents per survey to minimize attrition rates. The attrition rate of the overall endline survey was 7.6 percent after one year, which is common in field experiments in developing countries[e.g., 30](https://www.zotero.org/google-docs/?9acb2P). Most importantly, the response rates in all treatment arms were within 0.4 percent of the control group, while the joint significance tests including all baseline covariates yielded p = 0.328, suggesting that the attrition was unsystematic to the treatments.

*Cognitive performance assessment*

The detailed task materials for each task are available at [the OSF page](https://osf.io/qymaz/?view_only=1781fb681edc4cdeb61287172cd14ba2) of the project.

*The arrow tasks (attention, inhibition, switching)*[31](https://www.zotero.org/google-docs/?pIbx07): Three versions of the arrow task were developed. In each version, participants were presented with a series of 32 black or white arrows pointing up or down in an oral setting. Both the number of incorrect answers and the total time of completion were recorded. In the *arrows attention task*, participants were asked to state verbally the direction of arrows presented to them on a piece of paper. Performance on this task can signal a baseline ability to maintain attention, interpret symbols and follow directions. In the *arrows inhibition task*, participants were again presented with rows of arrows, and had to report verbally the opposite direction they were actually seeing. To complete the task successfully, one needs to inhibit the more common or prepotent response (actual direction) and produce a less common response. In the *arrows switching task*, participants were told to report verbally the actual direction of the arrow if the arrow was white, and report the opposite direction if the arrow was black. The successful completion of the task requires the maintenance of attention, the ability to switch between goals and the inhibition of prepotent responses.

*Digit span tasks (forward and backward):* Working memory capacity was assessed by an oral digit span task. The instructor read out loud two sets of digits(one at a time) in random order with a short break between the digits. Participants were asked to repeat verbally the digits either in the same (*forward-digits*) or the reverse order (*backwards-digits*). In case at least one of the two sets of digits were correctly repeated by the participant, the instructor continued reading longer-sets of digits up to a maximum of nine digits. That is, the total number of repeated digits was dependent on the performance of the participant (minimum 2, maximum 16). In order to avoid learning effects, the digit sequences were different in the surveys conducted close in time (2-weeks versus 5-weeks, and 12-months versus 13-months). The number of correctly repeated digits were recorded both for the forward and backward digit tasks.

*Maze task (response time and accuracy)*: Participants were asked to complete 3 mazes with increasing difficulty in the maze task. After completing a pilot trial, they had 2, 2 and 3 minutes to complete each of them. Both the completion time of the three mazes and the number of correctly completed mazes were recorded. Although the maze task also can signal the cognitive ability of the participants, as it is not a standardized measure of a specific cognitive function, it will be only included in the multiverse analysis section.

**Hypotheses and Data Analysis Strategy**

**Overview**

In the primary analyses, we will test the two confirmatory hypotheses outlined below. The conclusions of the paper will be based on the outcome of these primary analyses and its results will be reported in the main text of the manuscript.

*Hypothesis 1:* We hypothesize that participants receiving unconditional lump-sum cash-transfers will show better cognitive performance in the short-term compared to participants in the no treatment group (2-5 weeks)

*Hypothesis 2:* We hypothesize that participants receiving unconditional lump-sum cash-transfers will show better cognitive performance in the long-term compared to participants in the no treatment group (12-13 months).

The secondary analysis will consist of two exploratory parts. First, we will assess the robustness of the results of the primary analysis using a multiverse approach (see below for details).

Second, we will conduct multiple mediation analyses to understand the driving mechanism behind the observed effects in the primary analysis.

The detailed results of the multiverse and the mediation analyses will be published in the Appendix and only a summary of the results will be reported in the main text. Regarding the multiverse analysis, we will provide a summary about which analytical choices and dependent variables lead to different or same inferences as the main analysis (better performance vs. inconclusive results vs. worse performance). Our aim will be to reveal the robustness and the sensitivity of the results to different analytical choices.

**Statistical framework**

The statistical inferences will be based on Bayes Factors (BF). BFs indicate the relative evidence for two competing theories on the basis of the collected data [32](https://www.zotero.org/google-docs/?33fJBp). We will follow the modified recommendations of Lee and Wagenmakers [33](https://www.zotero.org/google-docs/?jl9066) on the threshold of good enough evidence. BF values above 10 and below 1/10 will be regarded as strong evidence for the alternative and the null hypothesis, respectively. If the data does not reach these thresholds, we will claim that we do not have strong evidence for either of the hypotheses, and we will interpret the BF values using their original definition, as the strength of relative evidence between the hypotheses.

Beyond the BF values, we will report the effect sizes (standardized beta coefficients), the corresponding 95% confidence intervals, the standard errors.

To assess the robustness of our conclusions to the applied scale factors of the models of H1 and H2, we will report Robustness Regions for each Bayes factor with two extreme priors (*b* = 0.09, *b* = 1.57), with the half of smallest effect size and twice of the largest effect size from the mini-meta analysis described below.

**Primary analyses**

**Dependent variables**

We will use a general executive function index as the dependent variable in the primary analysis. We will calculate the executive function index for each participant by summing the standardized values of the following measures: accuracy scores (number of correctly repeated digits) in the forward and backward digit span tasks; response time (average logarithmized completion time, *reversed scoring*) in the arrow switching and arrow inhibition tasks; accuracy (number of incorrect answers, *reversed scoring*) in the arrow switching and arrow inhibition tasks.

To ensure that we do not include executive function measures with ceiling and floor effects, we will exclude any of the measures from the calculation of the executive function index and hence from the primary analysis where more than 60% of the individuals achieve perfect scoring or zero correct answers in the given test.

**To test hypothesis 1 and 2,** we will focus on the comparison of the cash only (n = 251) and the no treatment arms (n = 222), and conduct an intention-to-treat Bayesian regression analysis in the short-term and in the long-term phase separately.

The parameters of the models are specified below:

Yi j = τ 1 Cash i + Xi λ + γ j + ε ij ,

where Y is the outcome variable, ‘Cash’ is a dummy for the random assignment to the treatment involving Cash transfer, X is a vector of control characteristics, and γ is the fixed effect for each randomization block. In different specifications of the model, the outcome variable, Y, is the result of the executive function index 2-5 weeks, or 12-13 month after the intervention. The control characteristics, X, will include the same variables as Blattman et al.: age, married or partnered, number of children in the household, years of schooling, having any disability, peer- excombatant, weekly cash earnings, saving stock, working hours, selling drugs, using marijuana daily, using hard drugs daily, and committing theft in the past 2 weeks. To control for outliers, we will winsorize the continuous variables at the 99th percentile. Furthermore, we will exclude all the individuals who did not achieve at least an 80% success rate in the arrow attention test. Not being able to finish the arrow attention test can signal a general inability or lack of motivation to produce meaningful results in any of the additional cognitive function measures. Missing values will be imputed at the median level.

*Calculation of BFs.* We will model the predictions of the hypotheses by using a half-Cauchy distribution with a mode of zero and with the scale factor explained below [34](https://www.zotero.org/google-docs/?Ga3dWW).

Previous studies testing the effect of cash transfers applied various designs and cognitive function measures that were different from the measures used in the present paper. Consequently, instead of using one measure from a specific paper to estimate the expected effect size (scale factor) for the BF calculation, we conducted a mini meta-analysis on previously published field studies providing causal evidence on the effect of poverty on cognitive functions, where variance of real money was captured involving significant uncertainty [14](https://www.zotero.org/google-docs/?8rPHwn). The analysis code of the meta-analysis is available at [the OSF page](https://osf.io/qymaz/?view_only=1781fb681edc4cdeb61287172cd14ba2) of the project. The result of the meta-analysis involving 5 measures from two studies [3,16](https://www.zotero.org/google-docs/?60G4YA) showed a standardized effect size of *ß* =0.34. Accordingly, when calculating the BF, we will use 0.34 as the scale factor of the half-Cauchy distribution modelling the effect of cash transfers on cognitive function measures. As detailed above, to further ensure the robustness of our results to the applied scale factors, we will report Robustness Regions for each hypothesis in the primary analyses.

**Bayes Factor Design Analysis**

To estimate the correct and misleading rate of evidence of the proposed study, we conducted a Bayesian Factor Design Analysis using the BFDA packages in R [35](https://www.zotero.org/google-docs/?mprTT8). The BFDA is an alternative of the frequentist power analyses which enables researchers to estimate the informativeness of the study in a Bayesian framework.

For each model in our primary analyses, we conducted 10,000 simulations. Our calculations were carried out with the assumptions that alternative hypotheses are true. For the simulations, we used the effect sizes and the sample sizes detailed above. In case the sample sizes were not matched between the comparison groups, to provide a conservative estimate, we used the sample size of the smaller group to calculate our estimations. The long-term rates of correct evidence were calculated as the proportion of iterations where strong evidence (BF > 10) was found for the existence of the effect. The long-term rates of misleading evidence were computed as the proportion of iterations where the evidence strongly supported the null hypothesis (BF < 10).

We found that given that the alternative hypotheses are true, with the parameters detailed above, the model provides correct inference in 82% and inconclusive results in 18% of the simulations for H1 and H2, while we would make incorrect inferences only in less than 0.01% of the cases. Although our design is not optimized to reliably detect the null effect, we calculated the rate of misleading evidence also with the assumption that the null hypothesis is true for each of our hypotheses. The results showed the rates of misleading evidence were < 1% for both of the hypotheses. The analysis code of BFDA analysis is available at the [OSF page](https://osf.io/qymaz/?view_only=1781fb681edc4cdeb61287172cd14ba2) of the project.

**Secondary analyses**

**Multiverse analysis**

To assess the robustness of the results and conclusions of the primary analysis, we will perform a multiverse analysis which “ involves performing all analyses across the whole set of alternatively processed data sets corresponding to a large set of reasonable scenarios“ [36](https://www.zotero.org/google-docs/?P4ARxr). We argue that the addition of a multiverse analysis is useful given that there are several choices (e.g., choosing of the dependent variables, transforming and coding the data and choosing the specific analysis techniques) which can influence the results. A multiverse analysis enables researchers to explore how much the results change due to choices in the data processing and analysis and which choices have the strongest effect on the conclusions. The multiverse analysis will be explorative by nature as we do not have specific hypotheses for each analysis.

Here we will conduct multiple versions of the Intent-to-treat analyses specified in the primary analysis section with and without control variables, with 3 different priors, across 8 ( 2 (exclusion criteria) x 4 (imputation method) alternatively processed datasets predicting 17 different cognitive function measures.

**Alternative analytical approaches**

*Control variables:* We will repeat all the analysis with and without the control variables as specified in the primary analysis.

*Different priors:* We will repeat all the analysis with three different priors: the effect size used in the primary analysis (b=0.34), as well as the half of the smallest effect size (b=0.09) and twice of the largest effect size (b=1.57) from the mini meta-analysis described above.

**Alternatively processed datasets**

In this section, we detail which alternative datasets will be used in the multiverse analysis.

*Exclusion criteria for individuals:* We will repeat all analyses with two different exclusion criteria. First, we will winsorize the continuous variables at the 99th percentile and we will also exclude all the individuals, who did not achieve at least a 80% success rate in the arrow attention test. Second, we will apply no exclusion criteria on individuals.

*Handling of missing data:* We will repeat all the ITT analysis with using the following imputation methods for the outcome variables: 1) imputing the median value; 2) imputing missing dependent variables for the treatment (control) group as the found treatment (control) mean plus (minus) 0.10, 0.25, or 1 SD of the found treatment (control) distribution [37](https://www.zotero.org/google-docs/?jEnj1D).

**Additional cognitive function measures and indexes**

To further test the robustness and specificity of the findings in the primary analysis, we will report the results separately for the 6 executive function measures which comprised the aggregate measure and include 10 new measures of cognitive function as part of the multiverse analysis. The additional cognitive performance measures will be calculated as follows:

*Accuracy scores in the digit span tasks*: To calculate accuracy in the digit span task, we will use the number of correctly repeated digits for each participant both in the backward and in forward digit span tasks separately.

*Response time in the arrow tasks*: To calculate accuracy in the arrow tasks, we will use the average logarithmized completion times for each participant in the arrow attention, arrow switching and arrow inhibition tasks separately.

*Accuracy scores in the arrow tasks:* To calculate accuracy in the arrow tasks, we will use the number of incorrect answers for each participant in the arrow attention, arrow switching and arrow inhibition tasks separately.

*Digit span index*:To calculate an overall accuracy in the working memory tasks, we will calculate the average number of incorrect responses per participant separately both for the backward and forward digit tasks and standardize the obtained values. A new digit span index will be calculated for each participant by adding the two standardized values.

*Arrow attention response time:* We will calculate the average logarithmized completion time for each individual in the arrow attention task.

*Arrow attention accuracy:* We will calculate the sum of correct answers for each individual in the arrow attention task.

*Arrow task response time index:* To estimate the overall response time across the arrow tasks, we will calculate the average logarithmized response time per participant separately for each arrow task and standardize the obtained values. A new arrow tasks response time index will be calculated for each participant by summing the standardized values.

*Arrow task accuracy index:* To estimate the overall accuracy across the arrow tasks, we will calculate the average accuracy per participant separately for each arrow task and standardize the obtained values. A new arrow tasks accuracy index will be calculated for each participant by summing the standardized values.

*Inverse efficiency index for each arrow task separately:* When measuring cognitive performance, the combination of speed and accuracy can increase the efficiency to detect the effects as it can account for a larger number or proportion of variance [38](https://www.zotero.org/google-docs/?XrxFC1). However, to obtain unbiased results from these combined measures, the proportion of correct answers need to be over 90% in a given task and have high positive correlation between reaction time and accuracy [39](https://www.zotero.org/google-docs/?7f2ktl). Accordingly, to increase the sensitivity of our analyses, we will calculate the inverse efficiency score [40](https://www.zotero.org/google-docs/?6sBfSg) for the arrow tasks, given that each of the tasks, the proportion of correct answers is over 90% and the Pearson correlation coefficient between reaction time and accuracy is higher than 0.6. For the arrow tasks that do not meet this criteria, we will only report the accuracy and response time.

*Maze task response time)*: We will calculate the average logarithmized response time for each individual on the maze tasks. For individuals not able to complete a maze task, or having an impossible (higher than the maximum allowed) completion time, we will impute the maximum allowed response time.

*Maze task accuracy:* We will sum the number of correctly solved mazes for each participant.

As a result, the following dependent variables will be included in the multiverse analysis:

1. Arrow switching - accuracy
2. Arrow switching- RT
3. Arrow switching- Inverse efficiency index
4. Arrow inhibition - accuracy
5. Arrow inhibition - RT
6. Arrow inhibition - Inverse efficiency index
7. Arrow attention - Accuracy
8. Arrow attention - RT
9. Arrow attention - Inverse efficiency index
10. Arrow tasks response time index
11. Arrow tasks accuracy index
12. Forward Digits - accuracy
13. Backward digits - accuracy
14. Digit span index
15. Maze - accuracy
16. Maze - total completion time
17. Executive function index (included in the primary analysis as well)

**Mediation analyses: exploring the potential mechanisms**

To explore the mechanisms behind the impact of the programs, we will conduct mediation analyses. We will only conduct mediation analysis for the associations where the primary analysis revealed strong support (BF >10) for the effect [41](https://www.zotero.org/google-docs/?vzqzBQ). For example, if we find strong evidence that cash transfer improves cognitive performance in the short-term but not in the long-term, then we will conduct mediation analysis only for the short-term treatment.

Following recent recommendations [42,43](https://www.zotero.org/google-docs/?AZXr2p), we will apply the method of joint significance to test the indirect effects of the treatments. That is, to claim a mediation in the example above, we need to find supporting evidence both for the effects of cash transfers on the mediator(s) and the effect of mediator(s) on the executive function index separately. We will test the indirect effects of a specific program separately for each mediator. We will apply the same approach to handle missing data and exclusion criteria as in the primary analysis.

Following Dienes [44](https://www.zotero.org/google-docs/?nrOlr1), if either of the BFs of the results tests are less than our threshold (BF < 10 in our case), there is no evidence for mediation. If both of the BFs are greater than 10, it would suggest strong evidence for at least partial mediation.

We will use the total-effect heuristic to model the prior distributions when testing the mediations. The total-effect heuristic builds on the assumption that the indirect effect cannot be larger than the direct effect, and that in most cases there is no reason to expect the effect to be smaller or larger. Accordingly, we will use a uniform distribution [0, total effect] to model the H1 and H2 .

In the mediation analyses, we will focus on the following variables: worrying, sleeping rough, recent hunger, depression and conflicts. Worrying is thought to deprive cognitive functioning through intrusive thoughts' effect on mental bandwidths [15,18](https://www.zotero.org/google-docs/?wuMPdj). Sleeping rough [21,22](https://www.zotero.org/google-docs/?eA4XvV), recent hunger[24,25](https://www.zotero.org/google-docs/?U0h37y) and depression[20](https://www.zotero.org/google-docs/?sFbG7Y) have been shown to have direct physiological effects on cognition. We hypothesized that conflict may impact cognition more indirectly, by increasing stress or by taxing attention through focusing mental resources on the object of conflict. The items of the conflict index aim to capture behavioral patterns which we assume to be highly correlated with the frequency or severity of conflicts our respondents are engaged in**.**

The calculation of these variables is described below. Note that we will use the standardized mean effects of the survey items when calculating these variables. First we will standardize the individual responses on each survey item, average them and then standardize the composite score again for each variable.

*Worrying index:* A worrying index aims to capture concerns potentially taxing one’s cognitive capacity. The worrying index will be created from the responses on two following two items: ‘I’m relaxed most of the time’ (coded reversely) and ‘I worry about things'.

*Sleeping rough:* Sleeping rough will be approximated by the answer of the participants on the following question: ‘In the last 2 weeks, how long have you slept outside in total?’

*Depression index:* To estimate the level of symptoms of depression in the participants, a new index will be created from the following items: ‘Feels bad doing things you normally do’, ‘Hard time hearing people when thinking about bad things’, ‘Felt sad or down-hearted’, ‘Feels tired when even not doing anything’, ‘Lost appetite from feeling bad’, ‘Felt unimportant to everyone’. These items were based on previous work adapting depression measurement to the local context using idioms which are common in Liberia when describing mental health and mood [45](https://www.zotero.org/google-docs/?fECjrx).

*Hunger*: Hunger will be measured by the following question: ‘How many days in the last 2 weeks did you sleep hungry?’

*Conflict:* To approximate recent conflicts, we will adopt a modified version of the antisocial behavior index from Blattman et al. [11](https://www.zotero.org/google-docs/?4aGnDq). Accordingly, the index will include questions on the following topics. 1) *Fights*: nine types of verbal and physical fights were asked in the past two weeks including ‘small dispute with a neighbor, small dispute with a leader, small dispute with the police, large fight with a leader, large fight with police, physical fight, engaged in a fight with weapon, fined for fight’. 2) *Weapons*: participants were asked if they carried a weapon on their body for protection in the last two weeks. 3) *Arrests:* participants reported whether they were arrested in the last two weeks. 4) *Aggressive behavior:* 9 questions were adapted to Liberian English from a standard scale [46](https://www.zotero.org/google-docs/?AkVwto) while 10 questions were added based on the insights from qualitative interviews. The following 19 questions were asked about different forms of aggression. ‘In the last 4 weeks, have you been quick to react against others? In the last 4 weeks, have you refused to take advice? Do you sometimes make hard jokes about people? In the last 4 weeks, have you intentionally destroyed property? Do you sometimes cheat or scrape from people? In the last 4 weeks, have you ever had confusion with people about things? In the last 4 weeks, did you let others see your frustration when you were frustrated? In the last 4 weeks, have you threatened other people? In the last 4 weeks, have you taken things from behind other people without asking them? In the last 4 weeks, have you easily controlled your vexation when vexed? Do you get vexed when you lose a game? Can you feel fine when you hit or yell at somebody? If you are under attack can you hit that person to defend yourself? When someone teases you, does that make you vexed? Do you ever fight to show that you are the stronger person? Do you ever damage things as a joke or for fun? Do you ever hurt the person you are playing football with for you to win? Do you ever use force on somebody to do something for you? Do you ever cuss somebody to do something for you?’*.*

**Discussion**

[Here, we will discuss the implications of the results, and put them in a greater framework,

including the potential limitations]

**Data and Code Availability**

A de-identified and masked dataset and all the code used for data management and analysis will be openly available at the project’s OSF page.

**Preregistration**

After Stage 1 in principle acceptance, we will publicly preregister the study plan on OSF.

**Competing interest statement**

The authors declare no competing interests.

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**Author contributions**BS developed the first version of hypotheses and analysis plan as well as wrote the first version of the manuscript. KT, GN and PB have contributed to the improvement of the analysis plan and provided suggestions to the manuscript. CB, JJ, and MS were responsible for the design of the randomized controlled trial, data collection, as well as supervised and provided suggestions on the hypotheses, analyses plan, and the manuscript of the Registered Report.

**Data handling prior to the submission of the Registered Report**

Prior to the submission of the present manuscript, no confirmatory or exploratory analysis were conducted by BS, AT and GN. BS and AT have gained access to the data in December 2019 while GN downloaded the data in February 2020. CB, JJ, and MS had access to data immediately after it was collected. At the time of publishing Blattman et al. [11](https://www.zotero.org/google-docs/?RIHR7K) , CB, JJ, and MS did not hypothesize change in executive functions, thus no analyses had been carried out and published on the topic of the present paper beyond a preliminary analyses discussed in Table D7 in the online Appendix of Blattman et al. [11](https://www.zotero.org/google-docs/?EeINEU), which reports the programs’ 12-13 months impact on a narrow set of cognitive measures.

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**Design Table**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Question** | **Hypothesis** | **Sampling plan** | **Analysis Plan** | **Interpretation given to different outcomes** |
| Can a lump-sum unconditional cash treatment significantly improve the cognitive performance of the poor in the short-term? | We hypothesize that participants receiving unconditional lump-sum cash-transfers ($200) will show better cognitive performance (as measured with the general executive function index) in the short-term (2-5 weeks) compared to participants in the no treatment group. | Using a Bayesian Factor Design Analysis we found that the model provides correct inference in 82% and inconclusive inference in 18% of the simulations, while incorrect inferences would be made in less than 0.01% of the cases. | We will compare the cash and the no treatment groups, and conduct intention-to-treat Bayesian regression analysis. The parameters of the models are specified below:  Yi j = τ 1 Cash i + Xi λ + γ j + ε ij  , where Y is the executive function index 2-5 weeks after the  treatment, ‘Cash’ is dummy for the random assignment to the treatment  involving Cash transfer, X contains the control characteristics, and γ is the  fixed effect for each randomization block. | The statistical inferences and interpretation will be based on the Bayes Factors (BF). BF values above 10 and below 1/10 will be regarded as strong evidence for the alternative and the null hypothesis, otherwise we will interpret the BF as the strength of relative evidence between the hypotheses. |
| Can a lump-sum unconditional cash treatment significantly improve the cognitive performance of the poor in the long-term? | We hypothesize that participants receiving unconditional lump-sum cash-transfers ($200) will show better cognitive performance (as measured with the general executive function index) in the long-term (12-13 months) compared to participants in the no treatment group. | Using a Bayesian Factor Design Analysis we found that the model provides correct inference in 82% and inconclusive inference in 18% of the simulations, while incorrect inferences would be made in less than 0.01% of the cases | We will compare the cash and the no treatment groups, and conduct an intention-to-treat Bayesian regression analysis. The parameters of the models are specified below:  Yi j = τ 1 Cash i + Xi λ + γ j + ε ij  , where Y is the executive function index 2-13 month after  the treatment, ‘Cash’ is dummy for the random assignment to the treatment  involving Cash transfer, X contains the control characteristics, and γ is the  fixed effect for each randomization block. | The statistical inferences and interpretation will be based on the Bayes Factors (BF). BF values above 10 and below 1/10 will be regarded as strong evidence for the alternative and the null hypothesis, otherwise we will interpret the BF as the strength of relative evidence between the hypotheses. |

**Appendix**

**The Arrow task**

**Arrows Attention**

Now we are going to play a game with arrows. I want you to tell me which directions the arrows are pointing to- up or down. First we will practice with the example arrows.

*PLACE EXAMPLE ARROW SHEET IN FRONT OF RESPONDENT*

*POINT TO FIRST ARROW ON EXAMPLE SHEET* This first one is pointing down so you should say down.

*POINT TO SECOND ARROW ON EXAMPLE SHEET* This one is pointing up so you should say up.

Let’s practice with the arrows on this sheet. Can you tell me the directions of the arrows in both rows? Say the directions as quickly as possible. *POINT WHILE YOU READ THE INSTRUCTIONS* Start with row 1 from left to right and continue with the arrows in row 2 starting from left to right. Say “1” when you start line 1 and say “2” when you start line 2. You do not have to stop in between rows, continue all the way until the very last arrow in row 2.

Let’s practice!

*CORRECT ANY MISTAKES, KEEP DOING THE EXAMPLES UNTIL THEY HAVE IT CORRECT.*

Great. Now I will give you a whole page of arrows with 4 rows.

*TURN OVER SHEET TO SHOW REAL ARROWS TO RESPONDENT. POINT WHILE READING THE INSTRUCTIONS*

When I say “go”, please say all the directions of the arrows from left to right, starting from row 1 to row 4. You do not have to stop in between rows, continue all the way until the very last arrow in row 4. Read as quickly as you can without making mistakes and read out the number in front of the row before reading the row. Just to make sure, where do you start reading?

*CORRECT IF RESPONDENT DOES NOT POINT TO ONE*

*PREPARE STOPWATCH. SAY “GO”*

1. *RECORD TOTAL NUMBER WRONG*
2. *RECORD TIME TO COMPLETION*

**Arrow Inhibition**

Now we will practice something else. You should tell me the opposite. Do you know what opposite means? For example, the opposite of “right” is what? (*Left*)

*POINT TO FIRST ARROW ON THE EXAMPLE SHEET* This first one is pointing down so you should say up because up is the opposite of down.

*POINT TO SECOND ARROW ON THE EXAMPLE SHEET* This second one is pointing up so you should say down.

Let’s practice with the arrows on this sheet. Can you tell me the directions of the arrows in both rows? Say the directions as quickly as possible. *POINT WHILE YOU READ THE INSTRUCTIONS* Start with row 1 from left to right and continue with the arrows in row 2 starting from left to right. Say “1” when you start line 1 and say “2” when you start line 2. You do not have to stop in between rows, continue all the way until the very last arrow in row 2.

Let’s practice!

*CORRECT ANY MISTAKES, KEEP DOING THE EXAMPLES UNTIL THEY HAVE IT CORRECT.*

Great. Now I will give you a whole page of arrows with 4 rows.

*TURN OVER SHEET TO SHOW REAL ARROWS TO RESPONDENT. POINT WHILE READING THE INSTRUCTIONS*

When I say “go”, please say all the directions of the arrows from left to right, starting from row 1 to row 4. You do not have to stop in between rows, continue all the way until the very last arrow in row 4. Read as quickly as you can without making mistakes and read out the number in front of the row before reading the row.

*PREPARE STOPWATCH. SAY “GO”.*

1. *RECORD TOTAL NUMBER WRONG*
2. *RECORD TIME TO COMPLETION*

**Arrow Switching**

Now we are going to play a different way.

*POINT TO FIRST WHITE ARROW ON EXAMPLE SHEET* If you see a white arrow, you should do the normal thing and tell me if it is up or down.

*POINT TO BLACK ARROW ON EXAMPLE SHEET But* if you see a black arrow, you should tell me the opposite like we just did. If the black arrow points up you say down.

Let’s practice with the arrows on this sheet. Can you tell me the directions of the arrows in both rows? Say the directions as quickly as possible. *POINT WHILE YOU READ THE INSTRUCTIONS* Start with row 1 from left to right and continue with the arrows in row 2 starting from left to right. Say “1” when you start line 1 and say “2” when you start line 2. You do not have to stop in between rows, continue all the way until the very last arrow in row 2.

Let’s practice!

*CORRECT ANY MISTAKES, KEEP DOING THE EXAMPLES UNTIL THEY HAVE IT CORRECT.*

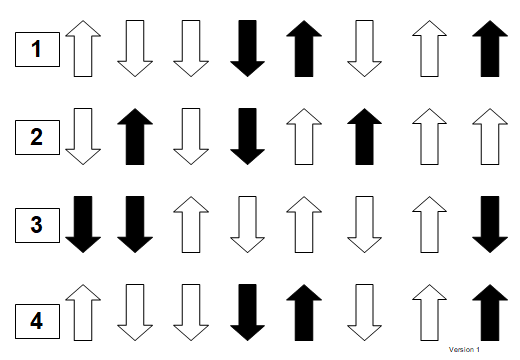
Great. Now I will give you a whole page of arrows with 4 rows.

*TURN OVER SHEET TO SHOW REAL ARROWS TO RESPONDENT. POINT WHILE READING THE INSTRUCTIONS*

When I say “go”, please say all the directions of the arrows from left to right, starting from row 1 to row 4. You do not have to stop in between rows, continue all the way until the very last arrow in row 4. Read as quickly as you can without making mistakes and read out the number in front of the row before reading the row.

*PREPARE STOPWATCH. SAY “GO”.*

1. *RECORD TOTAL NUMBER WRONG*
2. *RECORD TIME TO COMPLETION*

*  
Figure S1. Exemplary arrows sequences presented in the arrow tasks.*

*Additional notes:*

* *Turn over the arrows sheet as soon as the respondent is finished with the ‘real’ arrows*
* *It is ok if the respondent points at the arrows but do not force him to do so*
* *If the respondent says a wrong direction and then corrects himself, count it as correct*
* *If you get lost, wait until the respondent gives the number of the next row so you can catch up*
* *If you are lost and the respondent is not calling out the rows then ask him which row he is on*
* *Even if you are lost, do not stop the timer until the respondent has finished.*
* *Do not strike through the arrows where you got lost, assume they are correct*

**Digit task**

**Digit Forward**

I am going to ask you to say some numbers. This is not easy but if you do it good, I will give you ten LDs when we are finished with all of the numbers in the numbers section.

*PUT 10 LD ON THE TABLE IN FRONT OF RESPONDENT*

Listen carefully while I read some numbers. In each case, please repeat them back to me. For example, if I say “7-9” then you should say “7-9” back to me. After I finish the numbers that you need to repeat back to me I will nod my head so you know it’s your turn. I will be saying the numbers slowly, so please do not repeat them until I nod my head. To practice, if I say “1-5” *NOD* what should you say?

1. *RECORD PRACTICE CORRECT YES/NO*

*IF YES (1-5) MOVE TO ACTIVITY*

*IF NO TELL THEM THE RIGHT ANSWER. AND SAY:* To practice again, if I say “1-3” what should you say? (*Should be 1-3)*

***Read the numbers in a loud and clear voice, slowly and consistently, mentally counting one second in between each number.*** *Do not congratulate respondent for right answers or tell them they are wrong. Do not repeat numbers after you have read them once. If they get two wrong in a group say “Thank you” and continue to reverse digit span. If they get one or both correct in a group continue with forward digit span to the next group.*

I’m going to start now. I will not repeat the numbers, so please listen carefully.

|  |  |  |
| --- | --- | --- |
| **FORWARD DIGIT SPAN** | | |
| **Group B** | 2-9 NOD  4-6 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group C** | 3-8-6 NOD  6-1-2 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group D** | 3-4-1-7 NOD  6-1-5-8 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group E** | 8-4-2-3-9 NOD  5-2-1-8-6 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group F** | 3-8-9-1-7-4 NOD  7-9-6-4-8-3 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group G** | 5-1-7-4-2-3-8 NOD  9-8-5-2-1-6-3 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group H** | 1-8-4-5-9-7-6-3 NOD  2-9-7-6-3-1-5-4 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group I** | 5-3-8-7-1-2-4-6-9 NOD  4-2-6-9-1-7-8-3-5 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |

*Additional notes:*

* *If they get the example wrong this does NOT count against them.*
* *Read the numbers from the protocol not from the recording sheet*
* *Read the numbers in a loud and clear voice, slowly and consistently, mentally counting one second in between each number. If you say them fast or grouped together (like you would with a telephone number) they will be able to remember them more easily. You could pick a word or sentence that lasts one second and say it in your head (e.g. one-one-thousand)*
* *Wait until the end of the task to give 10LD*

**Digit Backward**

*DO NOT INTRODUCE THIS ACTIVITY AS NEW ACTIVITY. (We are not giving out LD until all of the numbers are finished)*

Now listen carefully while I read some more numbers. This time, please repeat them back to me in the opposite way. For example, if I say “3-8” then you should say “8-3” back to me. To practice, if I say “7-1-2” what should you say?

*A.* *RECORD PRACTICE CORRECT YES/NO*

*IF YES (2-1-7) MOVE TO ACTIVITY*

*IF NO TELL THEM THE RIGHT ANSWER AND SAY:* To practice again, if I say “4-1” what should you say? (*Should be 1-4)*

***Read the numbers in a loud and clear voice, slowly and consistently, mentally counting one second in between each number****. Do not congratulate respondent for answers or tell them they are wrong. Do not repeat numbers after you have read them once. If they get two wrongs in a group say “Thank you” and continue to activity nine. If they get one or both correct in a group, continue with reverse digit span to the next group.*

I’m going to start now. Again I cannot repeat the numbers, so please listen carefully.

|  |  |  |
| --- | --- | --- |
| **REVERSE DIGIT SPAN** | | |
| **Group B** | 2-1 NOD  1-3 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group C** | 3-5 NOD  6-4 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group D** | 5-7-4 NOD  2-5-9 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group E** | 7-2-9-6 NOD  8-4-9-3 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group F** | 4-1-3-5-7 NOD  9-7-8-5-2 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group G** | 1-6-5-2-9-8 NOD  3-6-7-1-9-4 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group H** | 8-5-9-2-3-4-6 NOD  4-5-7-9-2-8-1 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |
| **Group I** | 6-9-1-7-3-2-5-8 NOD  3-1-7-9-5-4-8-2 NOD | If get right or wrong continue.  If get both wrong, discontinue. If get one or both right, continue to next group. |

Thank you.

*GIVE 10 LD* You did this well enough to get 10LD. *(Note – they always get the 10 LD no matter how they perform).*

**Maze**

**Introduction**

This activity uses mazes. A maze is a picture that has a number of small roads in it. One road travels from the beginning of the maze to the end of the maze. The goal of a maze is to find your way out. You should get from the beginning to the end as quickly and directly as possible. I will first show you how to complete a small maze in case you have never seen a maze before. I will then give a maze to you and time how long it takes you to finish. There are three mazes. I will give you 2 minutes for the first one, 2 minutes for the second one, and 3 minutes for the third one. If you would take more minutes for each maze, don’t feel bad, but we will move on to the next one.

**Example**

*SHOW EXAMPLE MAZE* Here is an example maze*.*

I will now show you how to do the maz*e.*

*DO MAZE FROM START TO FINISH. POINT WHILE YOU READ THE INSTRUCTIONS*

You see, this is the beginning and this is the end of the maze. You start from here and drive through the maze until you come outside here to the finish line.

*DO MAZE AGAIN BUT MAKE A WRONG TURN (BACKTRACK) THEN GET BACK ON CORRECT PATH*

But if you are playing and mistakenly missed the road, just turn around without hitting the wall and get on the right road so that you can come outside.

*POINT WHILE YOU READ THE INSTRUCTIONS*

You cannot go around the maze to get to the end, and you cannot cross any walls. You must stay on the road.

Do you understand all that I say?

*IF YES, SAY:* Now it’s your time to do the mazes.

*IF NO, CONTINUE TO EXPLAIN*

*GIVE PEN* You will use this pen to mark the road you take, and I want you to keep the pen on the paper the whole time. Wait until I turn over the maze and say “go” to start.

*PREPARE STOPWATCH. TURN OVER THE MAZE. POINT TO START, SAY “GO” AND START STOPWATCH*

1. *RECORD TIME RESPONDENT FIRST TOUCHED MAZE*
2. *RECORD CORRECT PATH YES/NO*
3. *RECORD NUMBER OF BACKTRACKS*
4. *RECORD FINISHED YES/NO*
5. *RECORD TOTAL TIME*

*TURN OVER NEXT MAZE AND RECORD A. to E. WHEN THEY FINISH*

Thank you, let’s continue to the next activity.

*Additional notes:*

* *Have all mazes ready to turn over after they finish the previous one. Point to start and say “Go”*
* *If they break a rule (i.e. cross a line or raise their pen) tell them it is an illegal move*
* *Check on your recording sheet that time first touched the maze is smaller than total time*

1. Indeed at the time of the design of the present study, the authors did not expect an effect of the treatments on cognitive performance. Cognitive functions were assessed to obtain an exhaustive list of baseline measures. [↑](#footnote-ref-1)
2. Individuals in the no treatment group received US$10 as a consolation prize. This was true for the 899 participants in Phases 2 and 3 but not the 100 individuals in Phase 1. [↑](#footnote-ref-2)
3. For those in the therapy group the 8-week long therapy started one week after the random assignment. The Sustainable Transformation of Youth in Liberia, a cognitive behavioral therapy informed program was a psychological treatment and aimed to have a lasting effect on the participants' life in two main domains. First, it tried to encourage future orientation over present-biased behavior. Second, it aimed to help participants to self-identify as a normal society member by exercising behavioral patterns which are characteristic of the mainstream identity. [↑](#footnote-ref-3)
4. During the preparation of the project, we interviewed a group of local individuals about the start-up cost of a small enterprise estimating the range between $75 and $125. We also assumed that people have other spending pressures and precautionary saving motives. That, combined with our budget constraints is how the $200 was determined. [↑](#footnote-ref-4)
5. Note, that in the pilot phase, instead of the 2 and 5 week surveys, there was only a 3 week survey. The exact average time for conducting the surveys after the grants were 2.2, 5.7, 55.4, and 61.1 weeks. [↑](#footnote-ref-5)