Does alleviating poverty increase cognitive performance? Short and long term evidence from a randomized controlled trial

PCI Registered Report Peer-review

The current study examines the effects of a poverty alleviating intervention on the cognitive performance of high-risk males in Liberia. In an RTC, participants are assigned to the intervention condition in which they receive a cash lump-sum (n = 251, equivalent to 300% of their income) or a control condition in which they do not receive this (n = 222). Cognitive functioning is then measured in the short and long-term on various performance measures.

There are several strengths to this proposal: (1) it is very well written and clear and tests an important research question with real-world applications; (2) the effect size estimate is based upon a mini meta-analysis and BDFA simulations, (3) there are contingencies in place for floor/ceiling effects and appropriate exclusion criteria, (4) and the sample size is sufficient to provide informative results coupled with a strong rationale for Bayesian evidence to inform the conclusions of the study. With this said, I do have a several concerns regarding the theoretical rationale and hypotheses and the potential for methodological flexibility with task measurement indices. After outlining these main points in detail, I also outline some minor points that are easily clarified. In sum, I believe this research has merit and the current problems could be resolved in a revision.

Theory and Hypotheses

The study aims to investigate the effects of a poverty alleviation programme on cognitive functioning and hypothesises that this will improve cognitive performance in the short term (2-5 weeks) and long-term (12-13 months). The hypotheses are written very clearly and focus on aggregate cognitive functioning, as do the primary analyses of the associated tasks. However, I do have concern with aggregating cognitive performance in this way rather than assessing the sub-components of attention, inhibition, shifting, switching, and working memory separately, as well as with the broader theory and use of the term 'cognitive functioning', as I will now detail below:

Cognitive functioning is a general umbrella term, and I believe you are actually testing the sub-components of executive functioning (EF; see Diamond, 2013). The tasks you use within the Method measure attention, inhibition, shifting, switching, and working memory. What is the theoretical rational for assessing 'cognitive functioning' collapsed across these tasks? Is there any research in the literature which suggests that these sub-components are impacted to varying degrees by poverty? To highlight my point, there is some work within the separate literature on 'stereotype threat' which suggests that the cognitive load imposed by negative stereotypes impacts the EF of updating more than shifting and inhibition (see Rydell et al., 2013). Whilst the phenomenon of stereotype threat is challenged, it does allow us to apply the same theoretical rationale to the current study - it is likely that all of your sub-components of 'cognitive performance' will be improved by the intervention, or is it more likely that this intervention will have a greater effect on some than others? I worry that lumping them all together in the primary analyses may obscure important findings. **A greater theoretical rationale is required to explain why you are focusing on 'cognitive functioning/EF' in general rather than its sub-components; this also feeds into hypothesis generation.**

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135-168.

Rydell, R. J., Van Loo, K. J., & Boucher, K. L. (2014). Stereotype threat and executive functions: Which functions mediate different threat-related outcomes? *Personality and Social Psychology Bulletin*, *40*(3), 377-390.

Methodology

Potential procedural flexibility

From the Appendix which outlines the task, it is clarified that reaction time indices for cognitive functioning is measured using a stopwatch (but this is not specified within the manuscript, see below). This measure has the potential to allow for procedural/methodological flexibility because of the researcher's control compared to programmed experimental tasks. The rationale for the equipment used should therefore be specified, even if this is due to technological resources or the environment in which the study was conducted (I understand the constraints posed by naturalistic settings, especially in rural settings such as for street youth in Liberia).

Details aiding replication

I find myself reading between the lines a little to understand that this is a secondary data analysis of a study conducted originally by Blattmann et al. (2017). This is because a lot of the relevant information about this is appended within footnotes. I recommend transparently stating this within the sub-section "The process of the study"; in this sub-section, statements such as "in the original study" are included without reference to this original study, and this paragraph currently assumes some prior knowledge on behalf of the reader. You could also clarify Figure 1 by highlighting the focus of the current study; this could be achieved by putting a box around the "cash" and "no treatment" arms, and subsequent follow-up surveys, and stating above the box "current study". This would aid the reader's understanding.

Page 8, sub-section "The treatment: unconditional cash transfers". Can you provide greater detail of when the cash transfers were distributed, i.e. after the baseline measures of cognitive functioning. Was this given as a one-off cash lump sum?

I have read through the Appendix on OSF which helpfully provides the materials used. This has clarified some aspects of the written Method section, allowing me to make some recommendations that would aid replication by independent teams. First, on Page 9 under "cognitive function assessment" it should be clarified that participants were asked to state VERBALLY the direction of the arrows (otherwise a reader may think they wrote down their answers). The same applies for the other tasks. Second, and perhaps most importantly, you do not specify procedural details about each task – how many trials were there? How was performance measured? (I know this is via a stopwatch from looking at the Appendix, but this is not specified within the manuscript), Are you looking at both RT and accuracy or only one of these, and why? Third, for the arrows attention task, you state that both the number of incorrect answers and the total time of completion were recorded, but you don't specify this for the other tasks. It would be best to specifically state which dependent variables you are analysing here. Amending this is a requirement for PCI RRs which asks reviewers to assess **Is the protocol sufficiently detailed to enable replication by an expert in the field, and to close off sources of undisclosed procedural or analytic flexibility?**

Can the measures used to assess the secondary outcomes of worry, sleep, depression etc. not be included in the Methods section rather than outlined in the Analysis Plan?

There is a typo Page 8, line 13 which states "arrow taks" rather than "arrow tasks".

Analysis Plan

I am not an expert in BDFA or multi-verse analyses, so am not able to comment on this aspect of the manuscript. The Bayes factors specified as 'good enough evidence' for the alternative and null hypothesis appear to be robust and well justified. There is a clear distinction between primary and secondary analyses.

I have looked through the following analysis code uploaded to OSF: "BDFA.Rmd" and "preliminary_effectsize.Rmd". For the BDFA.Rmd code I have identified a potential (minor) error, as follows:

From the R code:

```{r}
mani_dat    <-    read_dta("D:/Dropbox/055_Scarcity    meataanalysis/Data/Data    for    meta-
analysis/Mani/Mani_Table1_Data.dta")
```

Should this be read_dat rather than read_dta?

Potential limitations of the study

I have identified one limitation of this study which may impact the findings. The manuscript states "the cash transfers were unconditional and the final decision on how they would use the money was at the participants' discretion." and in another section states the sample were "vulnerable participants with evident signs of homelessness and substance abuse". Without knowing what participants spent this money on, but knowing that they had evident signs of substance abuse, how can we be sure that they did not spend the money on substances that would have a deleterious effect on cognitive functioning? With this in mind, it is possible that you may find null effects or effects opposite to your predictions, but you would not be able to pinpoint that this was the explanation. Is there any contingency or analysis you could put in place that would allow you to rule this out? If not, I would acknowledge this as a potential limitation in the Stage 1 manuscript .

Minor points

Abstract

It would be good to clarify in the Abstract (and in the main text) whether the lump sum was a one-off payment (given in only one month) [or did they receive this on multiple occasions, if so, how many?]. I also recommend including the sample size allocated to each of the two conditions.

The following sentence is a little confusing because it is not clear whether you are testing the effect of poverty on cognitive functioning, or whether this reinforces existing inequalities. I understand what you mean because I have read the manuscript, but this could be clarified. "In this registered report, we will investigate the impact of a poverty alleviation program on cognitive performance to test this effect". It may be as simple as removing "to test this effect".

It would be useful to specify the mechanisms being investigated (worrying, sleep deprivation, mental-health, hunger, recent conflicts).

Introduction

Would it be best to have the hypotheses at the end of the Introduction rather than within the Hypotheses and Data Analysis Strategy? In the latter section, you can then simply refer back to these hypotheses.

I am confused by footnote 1 which relates to the sentence "The idea that unconditional cash transfers can enhance cognitive functioning seemed to be radical even a few years ago.[1]", The footnote states: "[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". What changed your mind about this effect? This needs to be clearer to clarify that you haven't yet looked at, or analysed, any part of your data. I would also state the date (if you recall) that the study was designed initially, so this is completely transparent. You could state

something like "This is a secondary data analysis of [REFERENCE]. Indeed, at the time of the design of this study (MM-YY), 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. This data has therefore not yet been analysed".

On the Fig 1 flowchart, could you add when the cash was disseminated?

Methods:

Page 8 states "As a result of the randomization procedure, 22 percent of the participants were assigned to the control arm, and 25 percent into the cash only arm (as well as 28 percent into therapy only, and 25 percent into the joint treatment arm)". For clarity, can you specify how many participants were assigned to each condition in brackets (i.e. 22 percent [*n* = XXX] were…).

Phases of implementation – were the 100 participants who were first included in the pilot phase compiled with the participants recruited thereafter? This could be stated explicitly.

I hope these comments prove useful to you,

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