

# Poverty and Cognitive Function: Pre-analysis plan\*

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## **Abstract**

This document describes the analysis plan for a randomized experiment examining the psychological effects of poverty on cognitive function. We will recruit 2000 respondents from Amazon Mechanical Turk and expose our treatment group to a prime that triggers feelings of poverty (Mani et al., 2013). Then, participants complete ten Raven progressive matrices and 75 items of a Stroop task. The design of the study is a replication of the study by Mani et al. (2013). This plan outlines the design of the experiments, the outcomes of interest, the econometric approach and the dimensions of heterogeneity we intend to explore.

**Keywords:** Poverty, Cognitive Function, Experiment.

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# 1 Introduction

Poverty is one of the most serious issues facing the world today: more than 1.5 billion individuals live on less than \$1 a day. Poverty has far-reaching consequences, not only materially, but also psychologically. Feelings of poverty have recently been shown to negatively affect cognition (Mani et al., 2013; Shah et al., 2012). Specifically, Mani et al. (2013) find that when poor respondents are exposed to a difficult financial scenario, they exhibit impaired performance on cognitive tasks, in particular Raven’s Progressive Matrices, a measure of fluid intelligence, and a spatial compatibility task, a measure of cognitive control.

We intend to replicate their findings on Amazon Mechanical Turk using a larger sample and incentivizing responses to our measures of cognitive function. In our experiment, we present our respondents with an adapted version of the primes used by Mani et al. (2013) that fits the MTurk environment. In a pilot study conducted on August 1st using a sample of respondents from Amazon Mechanical Turk, we have shown that our adapted primes significantly affect financial worries and satisfaction with income and that the effects are completely driven by poorer individuals. Just as in Mani et al. (2013), respondents are faced with either an easy or a hard financial scenario. Then, we let our participants complete ten Raven Progressive Matrices and 75 items in a Stroop task.

## 2 Design

### 2.1 Our Sample

We will run our experiment on Amazon Mechanical Turk (AMT), an online crowdsourcing marketplace developed in 2005 by Amazon.com, Inc. This platform is now commonly used by academics to conduct online experiments, as it provides a cheap and efficient way of recruiting participants.

A link to our experiment will be openly posted on AMT with a description stating that the survey paid \$2.60 for approximately 20 minutes, i.e., an hourly wage of about \$8. This is higher than the average effective wage on mTurk which according to Amazon is around \$4.80 per hour (Kuziemko et al., 2015; Mason and Suri, 2012). In addition, all of our participants will receive bonuses depending on the number of correct responses in

the Raven matrices and the stroop task. In particular, they will receive five cents for each correct answer to a Raven matrix and one cent for each correct answer to an item in the Stroop task. They will also be told that their payoff will be reduced by 2 cents per 10 seconds spent answering the items of the Stroop task.

## **2.2 Treatment**

### **2.2.1 Poverty Prime**

We have adapted the poverty primes by Mani et al. (2013) to the MTurk environment. As in Mani et al. (2013), we present our respondents with hypothetical scenarios, each of which describes a financial problem. We randomly assign our respondents to either a hard or an easy financial scenario.

In the first financial scenario they need to explain how they would deal with an income decrease of 20% (5%) in the hard (easy) financial scenario. We then ask them a variety of questions on whether this income shock would substantially affect their situation and what kind of sacrifices they would need to make. In the second scenario people explain how they would deal with a situation in which they need to come up with an amount of money: In the hard (easy) financial scenario respondents are asked how they would come up with \$3000 (\$150) in a short notice. The order with which these financial scenarios is presented is randomized. Respondents write down how they might deal with the financial scenarios. The aim of exposure to these scenarios is to trigger feelings of poverty.

We have made two main changes to the primes used by Mani et al. (2013): first, we increased the amounts for the hard financial scenarios. Second, we removed two financial scenarios because they did not seem well-suited for the MTurk population. We have conducted a pilot study with a sample of 350 participants on August 1st in which we document that our two primes successfully affect financial worries. In particular, poorer individuals from our sample are quite strongly affected by our treatment: They display substantially stronger financial worries and lower levels of satisfaction with income. The primes are further explained in Appendix A. Moreover, at the very end of the document we attach the exact experimental instructions.

### **2.2.2 Data Collection**

We design this experiment using “Qualtrics” and will post the link to our experiment on Amazon Mechanical Turk. At the beginning of the experiment the respondents will complete a questionnaire on demographics. Then they are randomly assigned to treatment and control groups (Appendix A). Immediately following the priming, respondents will complete simple manipulation checks (Appendix B), followed by the Raven Progressive Matrices and the Stroop task. Finally, our participants will complete a few questions on savings and credit constraints.

## **2.3 Schedule of Tasks and Treatments**

The sequence of the different tasks in our experiment is as follows:

1. Simple demographics
2. Poverty primes.
3. Manipulation checks.
4. Raven Progressive Matrices
5. Stroop test
6. Credit constraints

## **2.4 Power Calculations**

The chosen sample size of 1012 participants for the experiment ensures that we can detect an effect size of about 0.18 at a significance level of 0.05 with a power of 0.8. Given that the effect sizes reported by Mani et al. (2013) are between 0.8 of a standard deviation and 1 standard deviation, we can be confident that our sample is sufficiently large to provide us with sufficient statistical power to detect effects.

## 3 Econometric Approach

### 3.1 Main Specification

We compare the measures of cognitive capacity between our treatment group and the control group.  $Treatment_i$  takes value one for those participants receiving the difficult financial scenario and value zero for those receiving the easy financial scenario. Our main specification is given by:

$$y_i = \alpha_0 + \alpha_1 Treatment_i + \varepsilon_i \quad (1)$$

Here our coefficient of interest is  $\alpha_1$  which gives us the treatment effect of the poverty prime on cognitive function for the whole sample.  $\varepsilon_i$  is the idiosyncratic error term. We expect that our treatment effects are stronger for individuals experiencing higher levels of poverty. We make use of an indicator variable  $Poor_i$  which takes value one for all individuals below the median income in our sample. Then, we estimate how our treatment differentially affects those living in higher levels of poverty in comparison to those who are not poor.

$$y_i = \beta_0 + \beta_1 Treatment_i \times Poor_i + \beta_2 Treatment_i + \beta_3 Poor_i + \varepsilon_i \quad (2)$$

Our main coefficient of interest is  $\beta_1$  which gives us the treatment effect of the prime for the poorer half of our sample.  $\beta_2$  is the treatment effect of the prime for the “richer half of our sample”. In an alternative specification, we will also interact income  $inc_i$  with our treatment indicator. Here, our specification of interest is given as follows:

$$y_i = \gamma_0 + \gamma_1 Treatment_i \times inc_i + \gamma_2 Treatment_i + \gamma_3 inc_i + \varepsilon_i \quad (3)$$

### 3.2 Accounting for multiple inferences

#### 3.2.1 Estimating the system of related equations

We might expect that the errors for the regressions for the Stroop and the Raven matrices are correlated. Instead of estimating these equations separately, we can estimate the system of seemingly unrelated regressions (SUR) to improve the precision of the coefficient

estimates (Zellner, 1962). SUR estimation is equivalent to OLS when the error terms are in fact uncorrelated between the regressions, or when each equation contains the same set of regressors. Simultaneous estimation allows us to perform Wald tests of joint significance on the treatment coefficients.

## 4 Main Outcome Variables

1. Stroop task: Our participants will be presented with a series of color words (blue, yellow, green, red). These words will appear in different colors, sometimes matching the word (e.g., the word blue, written in blue), and sometimes not matching the word (e.g., the word blue, written in yellow). The respondent's task is to indicate, as quickly and accurately as possible, the color in which the word is written, whether or not that matches the word itself. They are supposed to click the letter on the keyboard that matches the first letter of the color of the word. We incentivize the responses to this task by giving 1 cent for each correct answer, but reducing participants payoffs by 2 cents per 10 seconds it takes them to complete all items in the Stroop task and their payoff from this task cannot go negative. Respondents must complete 75 items without any time limits. In this task, we measure the number of correct answers and reaction time. We are interested in the number of correct responses and the response time to the incongruent items (where meaning of word and color do not match).
2. Raven Progressive Matrices: This task measures fluid intelligence. Each trial consists of a pattern, with part of the pattern missing. Respondents are asked to choose the correct figure, from a set of 8 candidate figures, which best completes the overall pattern. We incentivize the responses to this task by giving five cents for each correct answer. Respondents must complete ten questions without any time limits. In this task, we measure the number of correct answers and reaction time. We have chosen Raven matrices that were neither too easy nor too hard based on a Pilot of 50 respondents from MTurk on August 4th.
3. Manipulation Check (Appendix B)
  - Financial Worries: This 4-item questionnaire provides an additional manipu-

lation check for our poverty primes. We ask respondents to self-report on a Likert scale how worried they are about their financial situation.

- Satisfaction with income
- MacArthur Socioeconomic Ladder

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## A Poverty Primes adapted from (Mani et al., 2013)

We will now ask you to imagine various scenarios, and we will ask you to explain how you would deal with them.

- Scenario 1: Imagine that the economy is going through difficult times, like in the recent financial crisis. Consider a scenario where your income suddenly decreases by 20% (5%)\* due the bad economic circumstances.

Then participants are asked to what extent they agree with the following statement (On a 4-point scale: 1 - strongly disagree, 2- disagree, 3 - agree, 4- strongly agree):

“Given my situation, I would be able to maintain roughly the same lifestyle under those new circumstances.”

All participants selecting either 1 or 2 they will be further prompted to answer the following: In the previous question, you said that you would not be able to maintain roughly the same lifestyle if your income decreased by 20% (5%). What changes would you need to make? Three sentences should be enough.

Subsequently, all participants will be presented with the following question: In what ways would the 20 % (5%) reduction in your income affect your leisure, housing or travel plans? Three sentences should be enough. Finally, they are asked to answer a last question: To what extent do you agree with the following statement? (On a 4-point scale: 1 - strongly disagree, 2- disagree, 3 - agree, 4- strongly agree)

"The 20% (5%) decrease in my income would strongly impact my leisure, housing, or travel plans."

- Scenario 2: Imagine that an unforeseen event requires of you an immediate \$3,000 (\$150) expense. Are there ways in which you may be able to come up with that amount of money on a very short notice? Participants answer this first question with either yes or no. Then, they are presented with the following open-ended question:

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\*The numbers in brackets are those from the easy financial scenario, while the numbers not in brackets are from the hard financial scenario.

How would you go about getting \$3000 (\$150) on a very short notice?

Three sentences should be enough.

Finally, they are asked to answer two-likert type questions: To what extent do you agree with the following statement? (On a 4-point scale: 1 - strongly disagree, 2- disagree, 3 - agree, 4- strongly agree)

- Coming up with \$3000 (\$150) on a very short notice would cause me long-lasting financial hardship.
- Coming up with \$3000 (\$150) on a very short notice would require me to make sacrifices that have long-term consequences.

## **B Manipulation checks**

### **B.1 Financial Worries Scale**

Participants will be asked: To what extent do you agree to the following statements? The scale is as follows:

- 1 - Strongly Disagree
- 2 - Disagree
- 3 - Neither Disagree nor Agree
- 4 - Agree
- 5 - Strongly Agree.

1. I am very worried about my financial situation.
2. I am very worried about having enough money to make ends meet.
3. I am very worried about not being able to find money in case I really need it.
4. I often feel ashamed because of my current financial situation.

### **B.2 Satisfaction with Income**

In addition, all participant will be asked the following question: How satisfied are you with your household income level? The scale is as follows:

- 1 - Very dissatisfied
- 2 - Dissatisfied
- 3 - Somewhat dissatisfied
- 4 - Neutral
- 5 - Somewhat satisfied
- 6- Satisfied
- 7- Very Satisfied

### **B.3 MacArthur Socio Economic Ladder**

Think of this scale as representing where people stand in the United States. At the top of the scale (10) are the people who are the best off - those who have the most money, the most education and the most respected jobs. At the bottom of the scale (1) are the people who are the worst off — who have the least money, least education, and the least respected jobs or no job. The lower you are, the closer you are to the people at the very bottom. Where would you place yourself on this scale?