Expaining Atheism Preregistration: Pilot 1, Cognitive Biases

INSERT DATE

# Study Information

## Title

EA Preregistration Pilot 1: Cognitive Biases

## Description

This preregistration is part of a number of preregistrations for the Explaining Atheism project. Our other registrations can be found on the OSF here [ADD LINK], with copies on our FigShare, and on my GitHub.

This registration is for a survey based test of the effect of various cognitive bias variables on belief and non-belief in Brazil, Denmark and the UK. A wide number of cognitive bias variables have been suggested to drive belief, and these will be tested here. Moreover, we will attempt to replicate the specific relationships between cognitive bias variables and belief observed in the path model of Willard et al. (2020; INSERT LINK) in Czech and Slovakian samples, built around anthropomorphism.

## Hypotheses

The primary prediction is that the relationships between Anthropomorphism, Dualism, Mentalizing, Teleology and Belief in God and Supernatural Beliefs will reflect the path model of Willard et al., (2020, Fig 1.)

We will also test the effects of each Cognitive Bias variable, in addition to Schizotypy, on Belief in God and Supernatural Belief measures. With the following predictions:

Greater levels of Anthroporphism will predict higher levels of:

1. Belief In God
2. Supernatural Agents Belief

Greater levels of Promiscuous Teleology will predict higher levels of:

1. Belief In God
2. Supernatural Agents Belief

Greater levels of Mentalizing will predict higher levels of:

1. Belief In God
2. Supernatural Agents Belief

Greater levels of Dualism will predict higher levels of:

1. Belief In God
2. Supernatural Agents Belief

Greater levels of Schizotypy will predict higher levels of:

1. Spiritual Experience

# Design Plan

## Study type

**Observational Study**. Data is collected from study subjects that are not randomly assigned to a treatment. This includes surveys, natural experiments, and regression discontinuity designs.

## Study design

This registration is for the analysis of data collected as part of our first pilot which is comprised of 5 separate surveys, one for each of the explanatory variable clusters noted in the exploratory pre-registration (see here: ). This specific registration concerns our “Cognitive Bias” explanatory variables, and is run in Brazil, Denmark and the UK.

## Randomization

The order of the items within the Cognitive Bias questionnaires specified above are randomised. Both the General Belief and Supernatural Belief questionnaires are also randomised within questionnaire.

# Sampling Plan

We will collect representative samples for each nation. This will be done by an independent survey company, and the samples will be representative for the national population by Age, Sex and Geographic Region.

## Existing data

**Registration prior to accessing the data**. As of the date of submission, the data exist, but have not been accessed by you or your collaborators. Commonly, this includes data that has been collected by another researcher or institution.

At the time of registration the data is being collected by the survey company on our teams behalf. No member of our research team has seen any of the data, nor any summary statistics.

## Data collection procedures

Participants are recruited by the independent survey company, Savanta Comres, from their pool of participants. Participants will be paid a local rate for their participation, and will be selected to meet representativeness requirements outlined above.

## Sample size

The sample size is 500 participants per nation.

Brazil = 500

UK = 500

Denmark = 500

## Sample size rationale

Samples are the maximally viable sample for the financial means of the project.

# Variables

## Measured variables

The explanatory variables of primary interest are:

* Anthropomorphism
* Mind-Body Dualism
* Mentalizing
* Promiscuous Teleology
* Schizotypy

These are part of a survey with other cognitive bias measures. See attached variables document for definitions:

Similarly the outcome variables of interest are part of a wide range of response variables that are collected, see the attached codebook for all other variables in the study. The outcome variables by which we will test our hypotheses are as follows. Again, see attached variables document for detailed defintions:

* Belief in God (continuous)
* Belief in God (binary)

Details of what comprises each of these measures and scales can be found in the attached codebook.

## Indices

See attached codebook.

# Analysis Plan

In addition to the path model noted above, we will run confirmatory analyses for each of the hypotheses noted above. We will also run a number of exploratory analyses outlined in the “Exploratory Analyses” section below. The confirmatory analyses are as follows:

*Confirmatory Analyses*

| Analysis | Explanatory Variables | Outcome Variable |
| --- | --- | --- |
| Cognitive Bias 1 | Anthropomporphism | Belief in God (Continuous) |
| Cognitive Bias 2 | Anthropomporphism | Belief in God (Binary) |
| Cognitive Bias 3 | Anthropomporphism | Supernatural Being Existence |
| Cognitive Bias 4 | Dualism | Belief in God (Continuous) |
| Cognitive Bias 5 | Dualism | Belief in God (Binary) |
| Cognitive Bias 6 | Dualism | Supernatural Being Existence |
| Cognitive Bias 7 | Mentalizing | Belief in God (Continuous) |
| Cognitive Bias 8 | Mentalizing | Belief in God (Binary) |
| Cognitive Bias 9 | Mentalizing | Supernatural Being Existence |
| Cognitive Bias 10 | Promiscuous Teleology | Belief in God (Continuous) |
| Cognitive Bias 11 | Promiscuous Teleology | Belief in God (Binary) |
| Cognitive Bias 12 | Promiscuous Teleology | Supernatural Being Existence |
| Cognitive Bias 13 | Schizotypy | Spiritual Experience (personal) |

## Statistical models

Bayesian Regression Models will be used to make inferences in the first instance.

Model specifications can be found in the attached Excel file.

We will treat outcome variables that are single Likert scale measures as ordinal, and as such will use cumulative probit regression following the following structure:

library("brms")  
  
exampleProbitModel <-  
 brm(formula = outcome\_variable ~ explanatory\_variable\_1 +  
 explanatory\_variable\_2 +  
 explanatory\_variable\_3 +  
 explanatory\_variable\_n,  
 prior = priors,  
 data = data,   
 family = cumulative(link = "probit"),  
 chains = 4,  
 cores = 4,  
 threads = 2,  
 iter = 3000,  
 warmup = 1000,  
 seed = 2023,   
 backend = "cmdstanr")

For binary outcomes we will use logistic regression with the following format:

library("brms")  
  
exampleLogisticModel<-   
 brm(formula = outcome\_variable ~ explanatory\_variable\_1 +  
 explanatory\_variable\_2 +  
 explanatory\_variable\_3 +  
 explanatory\_variable\_n,  
 prior = priors,  
 data = data,   
 family = bernoulli(link = "logit"),  
 chains = 4,  
 cores = 4,  
 threads = 2,  
 iter = 3000,  
 warmup = 1000,  
 seed = 2023,   
 backend = "cmdstanr")

And for continuous outcomes we will use gaussian multiple regression:

library("brms")  
  
exampleLogisticModel<-   
 brm(formula = outcome\_variable ~ explanatory\_variable\_1 +  
 explanatory\_variable\_2 +  
 explanatory\_variable\_3 +  
 explanatory\_variable\_n,  
 prior = priors,  
 data = data,   
 family = gaussian(),  
 chains = 4,  
 cores = 4,  
 threads = 2,  
 iter = 3000,  
 warmup = 1000,  
 seed = 2023,   
 backend = "cmdstanr")

We will set the following uninformative priors for our outcome variables:

For betas and intercepts we will set a normally distributed prior with a mean of 0 and a standard deviation of 1.

For ordinal probit models we will set a normal distribution for the thresholds, following [Kurz](https://solomonkurz.netlify.app/blog/2021-12-29-notes-on-the-bayesian-cumulative-probit/).

To attempt to replicate the path model of Willard et al (2019), we will use the following lavaan model specification in the first instance:

pathModel <- '  
 # regressions  
 Dualism ~ Mentalizing  
 Teleology ~ Mentalizing  
 Anthropomorphism ~ Mentalizing + Religious ID  
 Belief in God ~ Dualism + Teleology + Religious ID  
 Supernatural Belief ~ Dualism + Teleology + Anthropomorphism  
 Purpose ~ Dualism + Teleology + Anthropomorphism + Belief in God  
   
 # residual covariances  
 Anthropomorphism ~~ Teleology  
 Anthropomorphism ~~ Dualism  
 Teleology ~~ Dualism  
 Belief in God ~~ Supernatural Belief  
 Supernatural Belief ~~ Purpose  
 Mentalizing ~~ Purpose  
'

## Transformations

In some instances response variables are dummy coded binary variables from a categorical response option - see attached codebook for all variable definitions.

As a default we will center likert response scores at the center of the scale, unless the scale has a meaningful interval (e.g. age, n years).

## Inference criteria

In the first instance, inferences about whether a variable has or does not have a theoretically relevant effect will be done based on examination of the posterior distributions of parameter estimates.

More specifically we will examine the extent to which the credible intervals of these posterior distributions overlap with a Region of Practical Equivalence (ROPE), that is, a specified region we consider to be theoretically equivalent to zero. This will be done using the {bayestestR} package (<https://easystats.github.io/bayestestR/articles/region_of_practical_equivalence.html>) in R. For our Gaussian and Cumulative Probit models we will use the default range -0.1 to 0.1 for standardized effect sizes, which equates to a “negligible effect size”, and -0.18 to 0.18 for logistic models.

## Data exclusion

Participants who fail data quality checks are removed and replaced by the survey provider prior to our analysis. In the first instance outliers will not be removed, however sensitivity analysis will be run on any published final models.

## Missing data

The data collection process does not allow missing data.

## Exploratory analyses (optional)

We will also run analyses of the psychometric properties of the scales used, along with measurement invariance analyses.

# Other

## Other (Optional)

This work is part of a larger scale project using the same data. See decription for further information.

# References

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