Pre-Registration Document

Project working title: Climate Change Beliefs and Cooperative Phenotype

Date: 18th July 2019

A. Hypotheses

Hypothesis 1: Cooperative phenotype (latent variable with loadings from the Dictator Game, Trust Game Give, Trust Game Return, Public Goods Game, and Stag Hunt Game) will positively predict pro-environmental behaviour (sacrifice enacted).

Hypothesis 2: Cooperative phenotype (latent variable with loadings from the Dictator Game, Trust Game Give, Trust Game Return, Public Goods Game, and Stag Hunt Game) will positively predict climate change beliefs (latent variable with loadings from climate change belief in reality, belief in human caused, and concern)

Hypothesis 3: Pro-environmental behaviour (sacrifice enacted) will mediate the relationship between cooperative phenotype and belief in the reality of climate change

B. Methods

Variables measured

The following table lists the variables from the New Zealand Attitudes and Values Study (NZAVS). A full data dictionary can be found here: https://www.psych.auckland.ac.nz/en/about/our-research/research-groups/new-zealand-attitudes-and-values-study/nzavs-tech-docs.html.

Variable	Variable name	Item text	Range
ENSACM	Pro-environmental behaviour – sacrifice enacted	Have you made sacrifices to your standard of living (e.g., accepted higher prices, driven less, conserved energy) in order to protect the environment?	1-7
CLICHR	Climate change – belief in reality	Climate change is real.	1-7
CLICHC	Climate change – belief in human caused	Climate change is caused by humans.	1-7
CLICHA	Climate change – concern	I am deeply concerned about climate change.	1-7
AGE	Age	What is your date of birth?	NA
GEN	Gender	What is your gender?	NA
ETHCAT	Ethnicity	Which ethnic group do you belong to? (NZ census question)	NA
POLREP	Political party support	Reported political party support	NA
NZREG	Education	*Ordinal-rank measure of level of attainment*	0-10

We will also measure the following behavioural variables from four one-shot economic games designed to measure variation in cooperation. Possible ranges are given, but these will all be standardised (0-1) across games before analysis.

Variable	Variable name	Operationalised	Range
DG	Dictator Game	Number of points given to Player B	0 – 100 points
TG1	Trust Game (Give)	Decision to give to Player B	Yes / No
TG2	Trust Game (Return)	Number of points returned to Player A	0 – 150 points
PGG	Public Goods Game	Number of points contributed	0 – 100 points
SH	Stag-Hunt Game	Decision to contribute	Yes / No

Planned sample

Participants will be sampled from those currently participating in the longitudinal NZAVS study, who agreed to take part in an additional study about 'economic decisions in groups'. Participants will be deemed ineligible for the study if they (1) do not have adequate access to the Internet, (2) do not have a quiet place to participate in the study, and (3) do not have a New Zealand bank account (for payment purposes). Participants also must be living in New Zealand to participate. We will terminate data collection once 1000 participants have completed our economic games.

Exclusion criteria

After the games, a participant's data will be excluded if the participant takes less than 5 minutes or more than 50 minutes to complete all eight games. We also retain only individuals who passed the comprehension questions for all four cooperation games. Because of these exclusion criteria, our final retained sample size may be below 1000.

Procedure

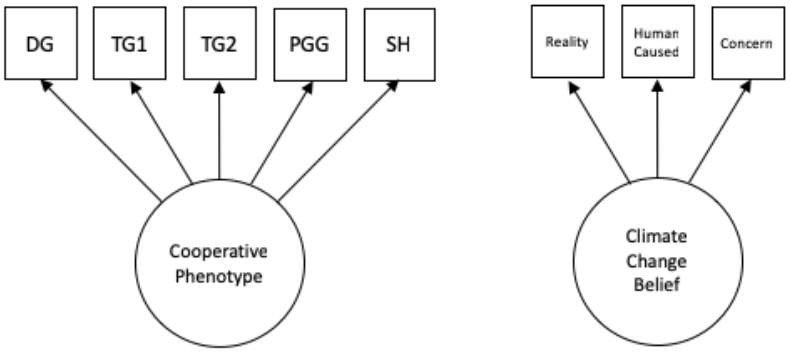
All games involve one-shot decisions between multiple players. The strategy method is used to elicit responses in all possible roles. We include three cooperation games, in which individuals decide whether to pay a personal cost to benefit another player: *Dictator Game*, *Trust Game*, and *Public Goods Game*. We also include a coordination game – *Stag-Hunt Game* – which is kept as identical to the Public Goods Game as possible. These economic games are presented in a random order along with four other games designed to measure norm-enforcing punishment (for another project, expanded on here https://osf.io/dwx8g/). Using oTree software (Chen, Schonger, & Wickens, 2016), real-time post-hoc matching occurs in groups of four. Participants have a 50-minute time limit to complete the eight economic games. Any participants who take longer than 50 minutes will be skipped ahead to the waiting lobby.

C. Analysis Plan

Before all analyses, game data will be standardised to vary between 0 and 1, and dummy variables (0 or 1) will be used for all binary choices. Data will be excluded following the exclusion criteria above. We will run structural equation models using the *lavaan* package (Rosseel, 2012) in R v3.6.1 (R Core Team, 2018). Since this dataset contains binary variables (TG1, SH) and other non-normal continuous variables, we will use diagonally weighted least squares estimation with robust standard errors (Li, 2016).

Analysis 1

We first run two confirmatory factor analyses, to ensure that the latent variables we use going forward fit the data well. The first model is of "cooperative phenotype", with five loadings from the Dictator Game, Trust Game (Give), Trust Game (Return), Public Goods Game, and Stag-Hunt Game. The second model is of "climate change belief", with three loadings from belief in the reality of climate change, belief that climate change is human caused, and concern for climate change.

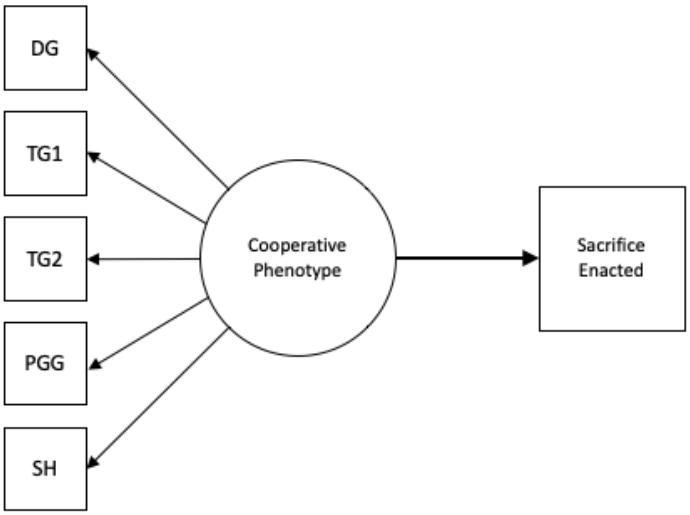


We expect these two separate one-factor models to fit the data well, as measured by following the following criteria:

- *Root Mean Square Error of Approximation.* Excellent fit < .01. Good fit < .05. Mediocre fit < .08 (MacCallum, Browne, & Sugawara, 1996).
- *Standardized Root Mean Square Residual.* Good fit < .08 (Hu & Bentler, 1999).

Analysis 2

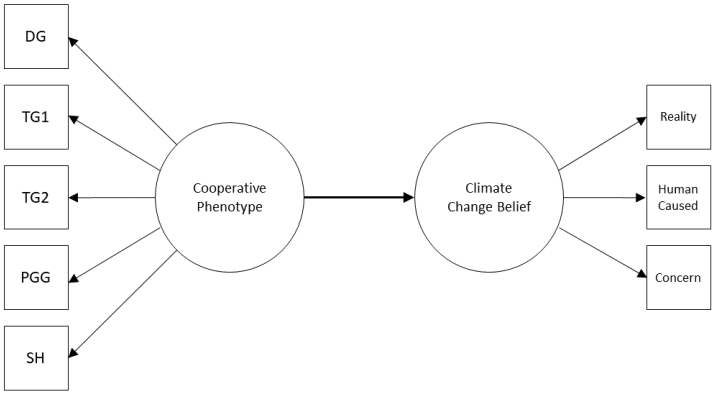
We regress pro-environmental behaviour (sacrifice enacted) on the latent variable "cooperative phenotype". We expect this model to fit the data well, as measured by the above criteria, and that cooperative phenotype will positively predict pro-environmental behaviour (sacrifice enacted) (p < .05).



We also fit further models that (1) use simply behaviour in the Public Goods Game as the independent variable, replacing the cooperative phenotype latent variable, and (2) include a variety of controls, including age, gender, ethnicity, political party supported, and education (first independently, and then all together in a full model).

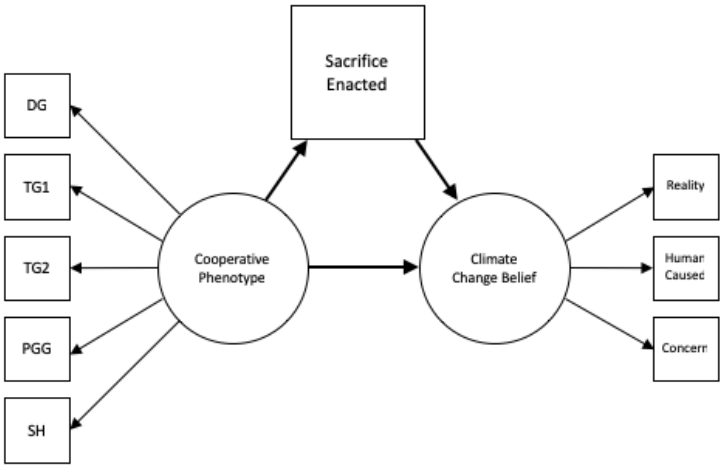
Analysis 3

We regress the latent variable "climate change belief" onto the latent variable "cooperative phenotype". We expect this model to fit the data well, as measured by the above criteria, and that cooperative phenotype will positively predict climate change belief ($p < .05$). We will also fit further model variants as outlined in Analysis 2.



Analysis 4

We conduct a mediation model whereby pro-environmental behaviour (sacrifice enacted) mediates the relationship between "cooperative phenotype" and "climate change belief". We expect that this model will fit the data well. We also predict that the direct effect of cooperative phenotype predicting climate change beliefs will be non-significant ($p > .05$), but the paths from cooperative phenotype to pro-environmental behaviour (sacrifice enacted) and from pro-environmental behaviour (sacrifice enacted) to climate change belief will be significant ($p < .05$), indicating a full mediation effect. We will also fit further model variants as outlined in Analysis 2.



References

Chen, D. L., Schonger, M., & Wickens, C. (2016). oTree-An open-source platform for laboratory, online, and field experiments. *Journal of Behavioral and Experimental Finance*, *9*, 88–97. https://doi.org/10.1016/j.jbef.2015.12.001

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Li, C. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods*, *48*(3), 936–949. https://doi.org/10.3758/s13428-015-0619-7

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*(2), 130–149. https://doi.org/10.1037/1082-989x.1.2.130

R Core Team. (2018). R: A language and environment for statistical computing. Vienna, Austria. Retrieved from https://www.r-project.org/

Rosseel, Y. (2012). lavaan: an R package for structural equation modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02