Supplementary Materials for

Spreading inequality: Neural computations underlying paying-it-forward reciprocity

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Methods Details and Additional Results

Online Task

The online task was done prior to the fMRI study via Qualtrics (https://www.qualtrics.com/). The goal of this task was to collect the real decisions that would be used as stimuli (in Game 1) for the fMRI experiment, which makes the context real and also consistent with the no deception rule in neuroeconomic studies (Glimcher and Fehr, 2013). Two independent groups of participants were recruited for this task (i.e., Online Group A and Group B, each with 50 online participants playing the role of Player A and Player B respectively). Participants in the role of Player A played a multi-shot dictator game (labelled as “money split game”) as the proposer. Specifically, each Player A made 49 binary choices with two options of payoff distributions between him-/herself and anonymous partners (i.e., the fMRI participants). One of the options was the target split with the joint payoff of €10 (i.e., 24 different greedy and 24 different generous splits respectively, and 1 equal split; see Supplementary Table S1 for the full payoff list) which would be later used in the fMRI study. The alternative option was always equal but with a fixed lower joint payoff (i.e., €0.5/ €0.5). We used this setup to bias Player As to select the target split for the majority of the time. Importantly, they were told that some of their decisions (no more than two) would be used in a later study and that one of their choices was selected to pay them after they finished the online choice task. For participants in the role of Player B, they were invited to a one-shot dictator game as the recipient. They did not need to make any decision and would receive a certain amount of money dependent on decisions from participants in the current fMRI study.

Data Analyses

Regression Analyses
All behavioral analyses were conducted using R (http://www.r-project.org/) and relevant packages (R Core Team, 2014). We excluded trials with either an unrealistically fast response (i.e., decision time < 200 ms) or no response (i.e., 22 trials out of 6912 trials in total, ~ 0.3 %), which led to a dataset consisting of 6890 valid trials. We labelled the specific decision in Game 2 as a generous choice if participants chose the option which earned them relatively less (i.e., choosing either the equal option when the alternative unequal option was advantageous to participants, or the unequal option disadvantageous to participants when the alternative option was equal; see Supplementary Table S2 for details) and more for Player B and otherwise a selfish choice.

We took the repeated mixed-effect regressions as our general statistical approach. The fixed-effect predictors were coded as dummy variables, namely partner (reference level: computer), split (reference level: greedy) as well as decision (reference level: selfish; only used for analyses on decision time). Our procedure was as follows: 1) we first created a null model (i.e., only including the participant-based random effects), a main-effect only model and a main-and-interaction model respectively; 2) we then compared these models using a likelihood ratio test (LRT; by the anova function) and examined whether the inclusion of main effects or interactions between fixed-effect predictors improves the model fit. All regression models treated different intercepts for each participant as random effects (i.e. intercept-only models). Besides, all reported p values are two-tailed and p < 0.05 was considered statistically significant.

In particular, we performed the mixed-effect logistic regression on decision data in Game 2 (i.e., binary response: 0 = choosing the selfish option, 1 = choosing the generous option) by the glmer function in the “lme4” package (Bates et al., 2013). The main-effect only model consisted of partner and split as the fixed-effect predictors. The main-and-interaction model additionally consisted of partner × split as the fixed-effect predictors. For the decision time, we performed the mixed-effect
linear regression by the \textit{lmer} function in the “lme4” package. The main-effect only model consisted of decision, partner, and split as the fixed-effect predictors. The main-and-2-way-interaction model additionally consisted of decision $\times$ partner, decision $\times$ split, partner $\times$ split as the fixed-effect predictors. Based on that, the main-and-all-interaction model also included decision $\times$ partner $\times$ split as the fixed-effect predictor.

\textit{Computational Modeling}

We adopted the Fehr-Schmidt model, which captured people’s inequality aversion (in Game 2) in both the advantageous and disadvantageous inequality domains (Fehr and Schmidt, 1999). The model is formally represented by the following equation:

$$u(x_s, x_o) = x_s - \alpha \max(0, x_o - x_s) - \beta \max(0, x_s - x_o) \quad (1)$$

where $u$ denotes the participant’s subjective utility for the given option. $x_s$ and $x_o$ represent participant’s payoff and the other players’ payoff, respectively. $\alpha$ and $\beta$ are free parameters of social preference that we need to estimate given individual’s decisions in the tasks mentioned above. In particular, $\alpha$ measures the degree of aversion to payoff inequality in the disadvantageous domain (i.e., how the participant dislikes that he/she earned less than Player B; also named as “envy” parameter). Likewise, $\beta$ measures the degree of aversion to payoff inequality in the advantageous domain (i.e., how the participant dislikes that he/she earned more than Player B; also named as “guilt” or “altruistic” parameter). Based on the original model assumption, we restricted the range of $\beta$ from 0 to 1 and the range of $\alpha$ from $\beta$ to 5 (i.e., $0 \leq \beta \leq 1, \beta \leq \alpha \leq 5$).

To integrate the impact of Game 1 on the degree of inequality aversion, we varied both $\alpha$ and $\beta$ in the original model (model 1) across partner (i.e., human/computer) and split (i.e., greedy/equal/generous) in Game 1. Hence, we generated four variations (i.e., models 2-5) of model 1 as below:
Moreover, the probability of choosing the right-positioned option was determined by the softmax function:

\[
p(\text{choose right}) = \frac{e^{\tau u(\text{right})}}{e^{\tau u(\text{left})} + e^{\tau u(\text{right})}} \quad (6)
\]

where \( \tau \) is the inverse softmax temperature parameter (\( \tau > 0 \)) which denotes the sensitivity of individual’s choice to the difference in utility between the left and right options.

Model Fitting and Model Selection

We used the “hBayesDM” package (Ahn et al., 2017) to fit all aforementioned candidate models using the Hierarchical Bayesian Analysis (HBA) approach (Gelman et al., 2014). The
“hBayesDM” package is developed based on the Stan language (Stan Development Team, 2016) which utilizes a Markov Chain Monte Carlo (MCMC) sampling scheme to perform full Bayesian inference and obtain the actual posterior distribution. We practice HBA rather than maximum likelihood estimation (MLE) because HBA provides much more stable and accurate estimates than MLE (Ahn et al., 2011). Following the approach in “hBayesDM” package, we assumed the individual-level $\alpha$ and $\beta$ were drawn from a group-level normal distribution: $\alpha$ or $\beta \sim \text{Normal} (\mu, \sigma)$. In HBA, all group-level parameters and individual-level parameters are simultaneously estimated through the Bayes rule by incorporating behavioral data. We fit each candidate model with four independent MCMC chains using 1,000 iterations after 1,500 iterations for initial algorithm warmup per chain, which resulted in 4,000 valid posterior samples. Convergence of the MCMC chains was assessed both visually (from the trace plot) and through the Gelman-Rubin R-hat Statistics (Gelman and Rubin, 1992). R-hat values of all parameters are close to 1.0 (at most smaller than 1.01 in the current case), which indicates adequate convergence.

For model comparison, we computed the widely applicable information criterion (WAIC) score per candidate model (Vehtari et al., 2016). WAIC score provides the estimate of out-of-sample predictive accuracy in a fully Bayesian way, which is more reliable compared to the point-estimate information criterion (e.g., AIC). By convention, the lower WAIC score indicates better out-of-sample prediction accuracy of the candidate model. Plus, a difference score of 10 on the information criterion scale is considered decisive (Burnham and Anderson, 2004). We selected the model with the lowest WAIC as the winning model for subsequent analysis. Based on the winning model and its parameter estimation, we derived the mean of the trial-wise subjective utility for each option and defined the following two indices in terms of specific decisions (in Game 2):

$$\text{Absolute chosen value} = u(x_*, x_\circ | \text{chosen option}) \quad (7)$$
Relative chosen value = \( u(x, x_{\text{c}} | \text{chosen option}) - u(x, x_{\text{c}} | \text{unchosen option}) \) (8)

These trial-wise absolute chosen values and relative chosen values were used as parametric modulators during decision-making period (Game2) in GLM1 and GLM2 respectively for model-based fMRI analyses.

Additional Results on Decision Time

Due to the non-normal distribution of decision times (Anderson-Darling normality test: \( A = 152.08, p < 0.001 \)), we performed a log-transformation on the original data (Supplementary Figure S1) and used the transformed data for later analyses. Compared with the null model, the main-effect-only model provided a significant better fit to the data (LRT: \( \chi^2(4) = 178.26, p < 0.001 \)). More importantly, the main-and-2-way-interaction model (vs. the main-effect-only model) further improved the model fit (LRT: \( \chi^2(5) = 12.71, p = 0.026 \)), revealing the decision \( \times \) split interaction (at the equal treatment: Odds Ratio = 0.95, \( b = -0.06, p = 0.002 \)). However, the model fit was not improved by additionally including the decision \( \times \) partner \( \times \) split interaction in the main-and-all-interaction model (vs. the main-and-2-way-interaction model; LRT: \( \chi^2(2) = 0.34, p = 0.842 \); see Supplementary Table S4 for the full model output).

To further disentangle the interaction effect, we did the follow-up analyses by separating trials based on generous and selfish decisions. Given that no partner \( \times \) split was detected in the main-and-2-way-interaction model, we only included partner and split as fixed-effect predictors in both follow-up analyses (see Supplementary Table S5 for the full model output). We found that participants responded to choose the generous option significantly faster after being treated equally (vs. greedy: \( b = -0.07, p < 0.001 \); vs. generous: \( b = -0.08, p < 0.001 \)). However, when participants
chose the selfish option, the effect of equal treatment on speeding up decisions was reduced (vs. greedy: $b = -0.01, p = 0.098$; vs. generous: $b = -0.02, p = 0.012$).

**Additional Results on Posterior Mean of Individual $\alpha$ and $\beta$ Estimated Based on the Winning Model**

Due to the non-normal distribution of the posterior mean of both individual parameters (i.e., Shapiro-Wilk normality test: $\alpha$: $W = 0.865$, $p < 0.001$; $\beta$: $W = 0.597$, $p < 0.001$; see Supplementary Figure S2 for the overlay with individual data points), we adopted the bootstrap approach which belongs to a resampling methods and provides accurate estimation of the confidence interval when the assumptions of normal distribution are violated. Specifically, we took the bias-corrected and accelerated (BCa) bootstrap paired t-test (bootstrap replications = 9,999, as the default value), revealed by the `boot.paired.bca` function in the “wBoot” package, to reanalyze the results previously detected with the mixed-effect linear model. As shown in Supplementary Figure S2, none of the 95% bootstrap CI (i.e., $\alpha_{gr}$ vs. $\alpha_{gc}$: Bootstrap mean difference: 0.770, SE = 0.206, 95% CI: [0.380, 1.190]; $\alpha_{eq}$ vs. $\alpha_{ge}$: Bootstrap mean difference: 0.751, SE = 0.174, 95% CI: [0.426, 1.116]; $\beta_{gr}$ vs. $\beta_{eq}$: Bootstrap mean difference: -0.121, SE = 0.041, 95% CI: [-0.223, -0.055]; $\beta_{gr}$ vs. $\beta_{ge}$: Bootstrap mean difference: -0.070, SE = 0.030, 95% CI: [-0.150, -0.026]) covered the 0, confirming the robustness of the results we reported in the main text.
Figures

Figure S1. The mean decision time (ms) of selfish and generous choice participants made in Game 2 given different partner × split conditions in Game 1. Error bars refer to s.e.m.
Figure S2. Left Panel: bar plot of the group-level mean of the posterior distribution of the individual parameters (i.e., $\alpha$, $\beta$) based on the winning model (i.e., m3). Dots refer to mean of the posterior distribution of the estimated parameters for each individuals; error bars refer to S.E.M. Significance level: ***$p < 0.001$, *$p < 0.05$; Middle and Right Panel: histogram of the distribution of bootstrap mean of certain contrast; gr = greedy, eq = equal, ge = generous. Notably, none of the 95% bootstrap CI (indicated by blue lines) covered the 0, confirming the robustness of the results we reported in the main text.
Figure S3. The effect of partner on neural correlates of receiving the monetary split in Game 1 (GLM 3). A) Regions showing stronger activation to human (vs. computer) partner. LPFC = lateral prefrontal cortex, TPJ = temporo-parietal junction. B) $partner \times split$ (generous/equal) interaction effect represented in the right TPJ. Error bars refer to s.e.m.. Display threshold: for right TPJ: voxel-level $p$ (uncorrected) $<$ 0.001, masked by a priori mask of right TPJ; for the rest: voxel-level $p$ (uncorrected) $<$ 0.001, $k = 150$. 
### Tables

Table S1 Payoff (in €) stimuli used for the previous online study and fMRI study (i.e., greedy and generous splits in Game 1)

|    | Player A or Computer | Participant | Player A or Computer | Participant |
|----|----------------------|-------------|----------------------|-------------|
| 1  | Greedy               | 6.63        | Generous             | 0.78        |
| 2  | 6.79                 | 3.21        | 0.85                 | 9.15        |
| 3  | 6.85                 | 3.15        | 0.94                 | 9.06        |
| 4  | 6.97                 | 3.03        | 1                    | 9           |
| 5  | 7                    | 3           | 1.16                 | 8.84        |
| 6  | 7.14                 | 2.86        | 1.27                 | 8.73        |
| 7  | 7.18                 | 2.82        | 1.38                 | 8.62        |
| 8  | 7.35                 | 2.65        | 1.43                 | 8.57        |
| 9  | 7.61                 | 2.39        | 1.51                 | 8.49        |
| 10 | 7.76                 | 2.24        | 1.61                 | 8.39        |
| 11 | 7.86                 | 2.14        | 1.75                 | 8.25        |
| 12 | 7.94                 | 2.06        | 1.99                 | 8.01        |
| 13 | 8                    | 2           | 2                    | 8           |
| 14 | 8.08                 | 1.92        | 2.03                 | 7.97        |
| 15 | 8.21                 | 1.79        | 2.26                 | 7.74        |
| 16 | 8.49                 | 1.51        | 2.31                 | 7.69        |
| 17 | 8.54                 | 1.46        | 2.54                 | 7.46        |
| 18 | 8.56                 | 1.44        | 2.67                 | 7.33        |
| 19 | 8.69                 | 1.31        | 2.78                 | 7.22        |
| 20 | 8.87                 | 1.13        | 2.82                 | 7.18        |
| 21 | 9                    | 1           | 2.93                 | 7.07        |
| 22 | 9.13                 | 0.87        | 3                    | 7           |
| 23 | 9.24                 | 0.76        | 3.16                 | 6.84        |
| 24 | 9.35                 | 0.65        | 3.41                 | 6.59        |

Note: Payoff stimuli used for the equal split was always €5 for both Player As (or the computer) and participants. To increase the variation of the stimuli and maintain participants’ attention during the experiment, we added a uniformly distributed random fluctuation (between -0.5 and 0.5) to payoffs.
Table S2 Unequal payoff options (in €) used in Game 2

|                  | Participant | Player B |
|------------------|-------------|----------|
| **Disadvantageous inequality context** |             |          |
| 1                | 0.93        | 9.1      |
| 2                | 1.12        | 7.03     |
| 3                | 1.86        | 7.94     |
| 4                | 2.05        | 5.98     |
| 5                | 2.87        | 8.98     |
| 6                | 3.04        | 6.97     |
| 7                | 3.92        | 6.02     |
| 8                | 4.02        | 9.86     |
| 9                | 4.05        | 8.12     |
| 10               | 4.88        | 8.91     |
| 11               | 4.91        | 7.06     |
| **Advantageous inequality context** |             |          |
| 12               | 5.1         | 3.01     |
| 13               | 5.17        | 1.04     |
| 14               | 5.9         | 3.89     |
| 15               | 6.02        | 1.99     |
| 16               | 6.94        | 4.82     |
| 17               | 7.04        | 2.95     |
| 18               | 7.06        | 0.85     |
| 19               | 8           | 2.01     |
| 20               | 8.09        | 4        |
| 21               | 8.87        | 3.05     |
| 22               | 9.04        | 4.92     |
| 23               | 9.12        | 1.07     |
| 24               | 9.92        | 3.87     |

Note: To increase the variation of the stimuli and maintain participants’ attention during the experiment, we added a uniformly distributed random fluctuation (between -0.2 and 0.2) to payoffs.
Table S3 Estimate and standard error (SE) of fixed effects in mixed-effect logistic regressions predicting generous decisions in Game 2.

|                              | The null model | The main-effect-only model | The main-and-interaction model |
|------------------------------|----------------|----------------------------|-------------------------------|
|                              | b (SE)         | b (SE)                     | b (SE)                        |
| Intercept                    | -1.99 (0.28)***| -2.23 (0.29)***            | -2.20 (0.29)***               |
| Partner                      | -0.04 (0.07)   |                            | -0.12 (0.12)                  |
| Split (equal)                | 0.31 (0.08)*** |                            | 0.27 (0.11)                   |
| Split (generous)             | 0.46 (0.08)*** |                            | 0.39 (0.11)***                |
| Partner × Split (equal)      |                |                            | 0.09 (0.16)                   |
| Partner × Split (generous)   |                |                            | 0.13 (0.16)                   |
| AIC                          | 5863.4         | 5835.1                     | 5838.4                        |
| BIC                          | 5877.1         | 5869.3                     | 5886.3                        |
| Log Likelihood               | -2929.7        | -2912.6                    | -2912.2                       |
| Deviance                     | 5859.4         | 5825.1                     | 5824.4                        |
| Numbers of Observation       | 6890           | 6890                       | 6890                          |
| Numbers of Groups (Participant) | 48             | 48                         | 48                            |
| Variance:                    | 3.53           | 3.55                       | 3.56                          |
| Participant (Intercept)      |                |                            |                               |

Note: Reference levels were set as follows: Partner = computer, Split = greedy, Domain = disadvantageous inequality. Table also shows goodness-of-fit statistics: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. Significance: *p < 0.05, ***p < 0.001.
Table S4 Estimate and standard error (SE) of fixed effects in mixed-effect linear regressions predicting participants’ decision time in Game 2.

|                        | The null model | The main-effect-only model | The main-and-2-way-interaction model | The main-and-all-interaction model |
|------------------------|----------------|---------------------------|--------------------------------------|-----------------------------------|
| b (SE)                 | 7.21 (0.04)**  | 7.19 (0.03)**             | 7.18 (0.04)**                        | 7.18 (0.04)**                     |
| **Intercept**          |                |                           |                                      |                                   |
| Decision               | 0.10 (0.01)**  | 0.12 (0.02)**             | 0.12 (0.02)**                        |                                   |
| Partner                | 0.01 (0.01)*   | 0.01 (0.01)               | 0.01 (0.01)                          |                                   |
| Split (equal)          | -0.03 (0.01)** | -0.01 (0.01)              | -0.01 (0.01)                         |                                   |
| Split (generous)       | 0.01 (0.01)    | 0.00 (0.01)               | 0.00 (0.01)                          |                                   |
| Decision × Partner     | 0.01 (0.02)    | 0.00 (0.03)               |                                      |                                   |
| Decision × Split (equal)| -0.06 (0.02)**| -0.07 (0.03)**            |                                      |                                   |
| Decision × Split (generous) | 0.01 (0.02)  | -0.01 (0.03)              |                                      |                                   |
| Partner × Split (equal) | -0.01 (0.02)  | -0.01 (0.02)              |                                      |                                   |
| Partner × Split (generous) | 0.00 (0.02)  | 0.00 (0.02)               |                                      |                                   |
| Decision × Partner × Split (equal) | 0.02 (0.04) |                                |                                      |                                   |
| Decision × Partner × Split (generous) | 0.00 (0.04) |                                |                                      |                                   |

AIC: 1113.3 943.1 940.3 944.0
BIC: 1133.8 990.9 1022.4 1039.7
Log Likelihood: -553.7 -464.5 -458.2 -458.0
Deviance: 1107.3 929.1 916.3 916.0
Numbers of Observation: 6890 6890 6890 6890
Numbers of Groups (Participant): 48 48 48 48
Variance: Participant (Intercept): 0.06 0.05 0.05 0.05

Note: Original data (unit: ms) were log-transformed before running the analyses due to its non-normal distribution. Reference levels were set as follows: Decision = selfish, Partner = computer, Split = greedy. Table also shows goodness-of-fit statistics: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. Significance: *p < 0.05, **p < 0.01, ***p < 0.001.
Table S5 Estimate and standard error (SE) of fixed effects in mixed-effect linear regression (full model) predicting participants’ decision time of choosing generous and selfish option in Game 2.

|               | Generous Choice | Selfish Choice |
|---------------|-----------------|----------------|
|               | \( b \) (SE)    | \( b \) (SE)   |
| Intercept     | 7.35 (0.04)***  | 7.19 (0.03)*** |
| Partner       | 0.02 (0.01)     | 0.01 (0.01)    |
| Split (equal) | -0.07 (0.02)*** | -0.01 (0.01)$^5$ |
| Split (generous) | 0.00 (0.02) | 0.01 (0.01)    |
| AIC           | 471.2           | 448.2          |
| BIC           | 503.4           | 487.7          |
| Log Likelihood| -229.6          | -218.1         |
| Deviance      | 459.2           | 436.2          |
| Numbers of Observation | 1577 | 5313         |
| Numbers of Groups (Participant) | 44 | 48             |
| Variance: Participant (Intercept) | 0.06 | 0.05         |

Note: Original data (unit: ms) were log-transformed before running the analyses due to its non-normal distribution. Reference levels were set as follows: Decision = selfish, Partner = computer, Split = greedy. Table also shows goodness-of-fit statistics: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. Significance: $^5p < 0.1$, $^{***}p < 0.001$. 
Table S6 Neural correlates of absolute chosen value (i.e., subjective utility of chosen option; GLM1) and relative chosen value (i.e., subjective utility difference between chosen and non-chosen option; GLM2) during decision-making period in Game 2 (N = 48)

| Brain Region                        | Hemisphere | Cluster Size | MNI X  | MNI Y  | MNI Z  | BA    | T-value |
|-------------------------------------|------------|--------------|--------|--------|--------|-------|---------|
| **Absolute Chosen Value**           |            |              |        |        |        |       |         |
| *Human (Generous - Equal) > Computer (Generous - Equal)*          |            |              |        |        |        |       |         |
| Inferior Frontal Gyrus/             | L          | 180          | -52    | 38     | 10     | 46    | 4.24    |
| Medial Frontal Gyrus                |            |              |        |        |        |       |         |
| Medial Frontal Gyrus/               | B          | 218          | -2     | 44     | -8     | 10/32 | 3.72    |
| Anterior Cingulate Cortex           |            |              |        |        |        |       |         |
| **Relative Chosen Value**           |            |              |        |        |        |       |         |
| *Human > Computer*                  |            |              |        |        |        |       |         |
| Insula/Superior Temporal Gyrus      | L          | 217          | -48    | 4      | -10    | 13/22/38 | 4.17   |
| Gyrus/Inferior Frontal Gyrus        |            |              |        |        |        |       |         |
| Temporo-Parietal                    | R          | 279          | 52     | -50    | 14     | 21/22 | 3.79    |
| Junction/Superior Temporal Gyrus    |            |              |        |        |        |       |         |
| Gyrus/Middle Temporal Gyrus         |            |              |        |        |        |       |         |
| Supramarginal Gyrus/Inferior Parietal Lobule/Postcentral Gyrus | R          | 276          | 56     | -40    | 50     | 2/3/40 | 4.06    |

Note: Regions shown here met the Family-Wise Error (FWE) corrected cluster-level threshold of p < 0.05, with an uncorrected voxel-level threshold of p < 0.001 as the cluster-defining threshold. Regions were labelled according to the automated anatomical labelling (AAL) template via the xjView toolbox ([http://www.alivelearn.net/xjview8/](http://www.alivelearn.net/xjview8/)). Coordinates shown here were based on Montreal Neurological Institute (MNI) coordinate system. L= left, R = right, B = bilateral, BA = Brodmann Area.
Table S7 Conjunct activation of receiving both types of unequal monetary split (i.e., greedy vs. equal AND generous vs. equal) in Game 1 (N = 48; GLM3)

| Brain Region                                      | Hemisphere | Cluster Size | MNI x  | MNI y  | MNI z  | BA      | T-value |
|---------------------------------------------------|------------|--------------|--------|--------|--------|---------|---------|
| Middle Frontal Gyrus/Inferior Frontal Gyrus/Precentral Gyrus | L          | 2809         | -44    | 2      | 30     | 6/8/9   | 7.87    |
| Middle Frontal Gyrus/Inferior Frontal Gyrus/Precentral Gyrus | R          | 1676         | 42     | 4      | 30     | 6/8/9/46| 6.60    |
| Anterior Cingulate Cortex/Middle Cingulate Gyrus/Supplementary Motor Area/Superior Frontal Gyrus | B          | 1764         | 6      | 16     | 52     | 6/8/9/32| 7.37    |
| Inferior Parietal Lobule/Superior Parietal Lobule/Supramarginal Gyrus/Precuneus/Superior Occipital Gyrus/Middle Occipital Gyrus/Postcentral Gyrus/Precentral Gyrus/Middle Temporal Gyrus | L          | 3017         | -44    | -38    | 44     | 2/7/19/40| 8.08    |
| Inferior Occipital Gyrus/Middle Occipital Gyrus/Fusiform Gyrus/Middle Temporal Gyrus | L          | 2506         | -46    | -60    | -14    | 17/18/19/20/37| 7.30    |
| Inferior Occipital Gyrus/Superior Occipital Gyrus | R          | 7089         | 26     | -62    | 50     | 2/7/17/18/19/20/30/31/37/38/39/40| 7.21    |

Note: Regions shown here met the Family-Wise Error (FWE) corrected cluster-level threshold of p < 0.05, with an uncorrected voxel-level threshold of p < 0.001 as the cluster-defining threshold.
Regions were labelled according to the automated anatomical labelling (AAL) template via the xjView toolbox (http://www.alivelearn.net/xjview8/). Coordinates shown here were based on Montreal Neurological Institute (MNI) coordinate system. L = left, R = right, B = bilateral, BA = Brodmann Area.
## Table S8 Neural correlates of receiving monetary split in Game 1 (N = 48; GLM3)

| Brain Region                                      | Hemisphere | Cluster Size | MNI  | BA      | T-value |
|--------------------------------------------------|------------|--------------|------|---------|---------|
|                                                  |            | X   | y   | z       |         |
| Human > Computer                                 |            |      |     |         |         |
| Middle Frontal Gyrus/Inferior Frontal Gyrus      | L          | 2365 | -40 | 6       | 8/9/45/46 | 6.41    |
| Inferior Occipital Gyrus/                        | L          | 2302 | -40 | -8      | 17/18/19/37 | 5.82    |
| Middle Occipital Gyrus/Cuneus                    |            |      |     |         |         |
| Middle Frontal Gyrus/                             | R          | 1256 | 46  | 30      | 9/46     | 5.36    |
| Inferior Frontal Gyrus                            |            |      |     |         |         |
| Inferior Parietal Lobule/                         | L          | 1227 | -32 | -56     | 7/40     | 5.06    |
| Superior Parietal Lobule/                         |            |      |     |         |         |
| Inferior Parietal Lobule/Precuneus/Angular Gyrus/ | R          | 662  | 38  | -54     | 7/40     | 4.74    |
| Supramarginal Gyrus                               |            |      |     |         |         |
| Supplementary Motor Area/                         | B          | 759  | -6  | 8       | 6/8/32   | 4.96    |
| Superior Frontal Gyrus/                           |            |      |     |         |         |
| Inferior Occipital Gyrus/                         | R          | 769  | 42  | -84     | 18/19/37 | 4.82    |
| Middle Occipital Gyrus/                           |            |      |     |         |         |
| Inferior Temporal Gyrus/Cuneus                    | R          | 326  | 48  | -44     | 20/21/37 | 4.59    |
| Inferior Parietal Lobule/                         | R          | 662  | 38  | -54     | 44       | 7/40     | 4.74    |
| Superior Parietal Lobule/Precuneus/Angular Gyrus/ | R          | 326  | 48  | -44     | -16      | 20/21/37 | 4.59    |
| Middle Temporal Gyrus/                            | R          | 662  | 38  | -54     | 44       | 7/40     | 4.74    |
| Fusiform Gyrus                                    | B          | 293  | -6  | -50     | 28       | 7/31     | 3.71    |
| Precuneus/Posterior Cingulate Gyrus               | B          | 293  | -6  | -50     | 28       | 7/31     | 3.71    |
| Computer > Human                                  |            |      |     |         |         |
| Fusiform Gyrus/Lingual Gyrus/                     | R          | 829  | 30  | -50     | -8       | 18/19/36/37 | 7.07    |
| Parahippocampal Gyrus                             |            |      |     |         |         |
| Greedy > Equal                                    | L          | 3020 | -44 | -38     | 44       | 2/7/19/40 | 8.08    |
| Inferior Parietal Lobule/                         |            |      |     |         |         |
| Superior Parietal Lobule/                         |            |      |     |         |         |
| Precuneus/Cuneus/                                 |            |      |     |         |         |
| Region                                           | Hem | MNI X  | Y  | Z  | Cluster Size | Peak MNI X  | Y  | Z  | 8/9/46/32/30/17/18/19/20/37/32/30/37/40/20 | Z    |
|-------------------------------------------------|-----|--------|----|----|--------------|-------------|----|----|--------------------------------------------|------|
| Supramarginal Gyrus                              | L   | 2839   | -44| 2  | 30           | 6/8/9/46    | 7.87|
| Middle Frontal Gyrus/Inferior Frontal Gyrus/Precentral Gyrus | B   | 1881   | 6  | 16 | 52           | 6/8/9/32    | 7.37|
| Supplementary Motor Area/Superior Frontal Gyrus/Cingulate Gyrus | L   | 2506   | -46| -60| -14          | 17/18/19/20/37 | 7.30|
| Fusiform Gyrus/Inferior Temporal Gyrus/Precentral Gyrus | R   | 7097   | 26 | -62| 50           | 2/7/17/18/19/20/37/30/37/40 | 7.21|
| Inferior Parietal Lobule/Superior Parietal Lobule/Precuneus/Cuneus/Precentral Gyrus/Postcentral Gyrus/Ligual Gyrus/Angular Gyrus/Inferior Occipital Gyrus/Middle Occipital Gyrus/Fusiform Gyrus/Inferior Temporal Gyrus/Middle Temporal Gyrus | R   | 1680   | 42 | 4  | 30           | 6/8/9/46    | 6.60|
| Insula/Inferior Frontal Gyrus                   | L   | 225    | -28| 18 | 10           | 13/47       | 4.20|
| Cuneus/Superior Occipital Gyrus                 | L   | 390    | -12| -98| 20           | 18/19       | 5.78|
| Middle Occipital Gyrus                          | R   | 444    | 68 | -30| 30           | 40          | 4.30|
| Inferior Parietal Lobule/Inferior Occipital Gyrus | R   | 384    | 18 | -90| 4            | 17/18       | 5.43|
| Cuneus/Lingual Gyrus                            | R   | 4282   | 10 | 14 | 0            | 8/9/10/11/   | 5.18|

**Equal > Greedy**

**Generous > Greedy**
Running Title: Neural Basis of PIF Reciprocity

| Region                                      | Side | MNI X | MNI Y | MNI Z | Cluster Size | Z Max |
|---------------------------------------------|------|-------|-------|-------|--------------|-------|
| Middle Frontal Gyrus/                      |      |       |       |       |              |       |
| Superior Frontal Gyrus/                     |      |       |       |       |              |       |
| Inferior Frontal Gyrus/                     |      |       |       |       |              |       |
| Anterior Cingulate Gyrus/                   |      |       |       |       |              |       |
| Caudate/Putamen                             |      |       |       |       |              |       |
| Cingulate Gyrus/Precuneus/                  | B    | 794   | 2     | -34   | 44           | 5.09  |
| Paracentral Lobule                          |      |       |       |       |              |       |
| Lingual Gyrus/Cuneus/                       | L    | 531   | -14   | -90   | 0            | 4.71  |
| Fusiform Gyrus/                              |      |       |       |       |              |       |
| Middle Occipital Gyrus/                     |      |       |       |       |              |       |
| Middle Frontal Gyrus/                       | R    | 268   | 36    | 48    | 14           | 4.07  |
| Superior Frontal Gyrus/                     |      |       |       |       |              |       |
| Middle Frontal Gyrus/                       | L    | 227   | -22   | 50    | 12           | 4.06  |
| Superior Frontal Gyrus/                     |      |       |       |       |              |       |
| Inferior Parietal Lobule/                   | L    | 238   | -46   | -42   | 60           | 4.00  |
| Postcentral Gyrus                           |      |       |       |       |              |       |
| Cingulate Gyrus/Thalamus                    | B    | 263   | 4     | -12   | 34           | 3.96  |

**Generous > Equal**

| Region                                      | Side | MNI X | MNI Y | MNI Z | Cluster Size | Z Max |
|---------------------------------------------|------|-------|-------|-------|--------------|-------|
| Large Cluster (including)                   | B    | 53227 | -44   | -38   | 44           | 10.22 |
| Middle Frontal Gyrus/                       |      |       |       |       |              |       |
| Superior Frontal Gyrus/                     |      |       |       |       |              |       |
| Inferior Frontal Gyrus/                     |      |       |       |       |              |       |
| Medial Frontal Gyrus/                       |      |       |       |       |              |       |
| Supplementary Motor Area/                   |      |       |       |       |              |       |
| Anterior Cingulate Gyrus/Insula/            |      |       |       |       |              |       |
| Superior Parietal Lobule/                   |      |       |       |       |              |       |
| Inferior Parietal Lobule/                   |      |       |       |       |              |       |
| Postcentral Gyrus/Precentunus/              |      |       |       |       |              |       |
| Middle Temporal Gyrus/                      |      |       |       |       |              |       |
| Superior Temporal Gyrus/                    |      |       |       |       |              |       |
| Inferior Temporal Gyrus/                    |      |       |       |       |              |       |
| Middle Occipital Gyrus/                     |      |       |       |       |              |       |
| Inferior Occipital Gyrus/                   |      |       |       |       |              |       |
| Caudate/Putamen/Pallidum/Thalamus)          |      |       |       |       |              |       |
| Caudate                                     | R    | 304   | 10    | 14    | 0            | 5.15  |
| Brainstem                                   | L    | 233   | -2    | -24   | -26          | 3.96  |
Note: Regions shown here met the Family-Wise Error (FWE) corrected cluster-level threshold of p < 0.05, with an uncorrected voxel-level threshold of p < 0.001 as the cluster-defining threshold. Regions were labelled according to the automated anatomical labelling (AAL) template via the xjView toolbox (http://www.alivelearn.net/xjview8/). Coordinates shown here were based on Montreal Neurological Institute (MNI) coordinate system. L = left, R = right, B = bilateral, BA = Brodmann Area.