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Do Altruists Like Equity?

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Supplementary Materials: Data, Materials [see Index of Supplementary Materials]

Abstract

Altruism and inequity aversion are often conceptually interrelated, which implies that altruistic and selfish humans may respond differently to disadvantageous inequity conditions. However, a correlation between altruism and inequity responses has thus far not been directly tested experimentally. We have addressed this question using an experimental paradigm inspired by animal experiments in which adult humans work for real food rewards. We have studied whether subjects' responses to different reward distributions were altered by being exposed to equitable or non-equitable situations. In the control conditions, subjects expressed either a strong altruistic attitude, choosing to work for their partner's welfare in the majority of trials, or mostly rejected this course of action. These purely altruistic and selfish behaviors were also expressed after being exposed to disadvantageous inequity, but priming with equitable conditions significantly reduced their occurrence. This implies an important role of inequity pressure, which is presumably present in modern society, in shaping human-helping attitudes.

Keywords

animal-human transition, inequity aversion, selfishness, priming with equity/inequity

Theories of the evolutionary origin of human altruism often consider inequity aversion to be a co-evolving attitude. Some theories explain the origin of altruism in terms of reciprocity (Fehr & Fischbacher, 2008; Fehr & Schmidt, 1999; Hauser, McAuliffe, & Blake, 2009; Trivers, 1971). Reciprocity evolved exclusively in human society due to the adaptive demands of cooperation within large groups of unrelated individuals, in contrast to the animal kingdom, in which individuals could rely on their kin's help to survive. Human cooperation requires reciprocal altruism, in which each act of helping is dependent upon receiving help in the future. In parallel, individuals develop a willingness to punish defectors at their own personal cost, a behavior known as altruistic punishment; they also develop attitudes promoting fairness and become averse to inequity. Other theories assume that inequity aversion is an important mechanism for promoting successful cooperative relationships, for which altruistic acts are necessary, in both human and non-human animals (Brosnan, 2011). Moreover, the co-emergence of strong egalitarian drives and helping attitudes has been demonstrated in the evolutionary model of group-living individuals (human or not-human) competing for resources and reproductive success (Gavrilets, 2012). In this model, each individual benefits if a transfer of resources from weaker to stronger individuals is prevented which consequently explains the evolutionary origin of both inequity aversion and altruism without any need for reciprocity.

Are altruists more sensitive to inequity than non-altruistic individuals or, on the contrary, are they completely indifferent? Even if helping behavior and inequity aversion emerge together in evolution, they can be shaped differently during the course of one's life by social context and feedback from social interaction. A correlation between altruism and aversion to inequity has never been investigated experimentally. Interestingly, however, Capraro, Smyth, Mylona, and Niblo (2014) reported that in an economic game the majority of people, when asked to decide on an amount of money to offer, are ready to increase the benefit of someone else beyond one's own (which is fixed); only a small fraction of subjects act in an inequity-averse way. This suggests that the pleasure of giving may be stronger than aversion to inequity.

In our study, we asked whether conditions of equity or inequity influence subject's altruistic choices. We answer this question using an experimental paradigm inspired by animal experiments in which adult humans work for real food rewards. This approach, known as "animal-human translation," (de Wit & Dickinson, 2009) was previously used in experiments with both human adults (Hachiga, Silberberg, Parker, & Sakagami, 2009; Ostojić & Clayton, 2013) and children (Blake & McAuliffe, 2011; Cheke, Loissel, & Clayton, 2012).

First, we tested subjects' responses to different reward distributions between subjects and partners that were decided by the experimenter, whereas the partner remained passive, such as in the Dictator game (Task B). On the computer screen, different propositions of work for reward were presented so that the subjects could choose for both themselves and for their partners (Social groups) or for themselves and a "virtual person," when nobody except the subjects would benefit from it (non-Social group). The non-Social conditions were introduced in order to check whether actors' responses were socially mediated. The rate of rewards (0–1, 1–0, 1–1, 1–6) was presented randomly. The first number corresponded to the subject's reward, whereas the second number indicated the participant or "virtual person's" reward. Rate 0–1 was used to test for altruism, whereas other rates were included in order to increase the variety of propositions. Actors had to respond within 5 sec to each of 64 randomly distributed propositions by exerting a physical effort (pressing a bike pump) to accept a given rate.

Secondly, we asked whether priming subjects with inequity or equity conditions would have any effect on their altruistic choices. In the priming experiment (Task A), the subject was asked to perform a task requiring patience and caution, namely filling a tube with small beads using a ski glove; he/she could quit the task whenever he/she wished. The food reward was proportional to the volume of the tube filled, whereas the reward rate was either lower or equal to the rate received by the other subject, which was visible on the video during the course of the experiment. To prime subjects with equity (E) or inequity (IE), Task A was used before Task B, whereas in the control situation, Task A was used after Task B (see Figure 1). We found different effects for priming under conditions of equity and inequity on subjects' behavior.

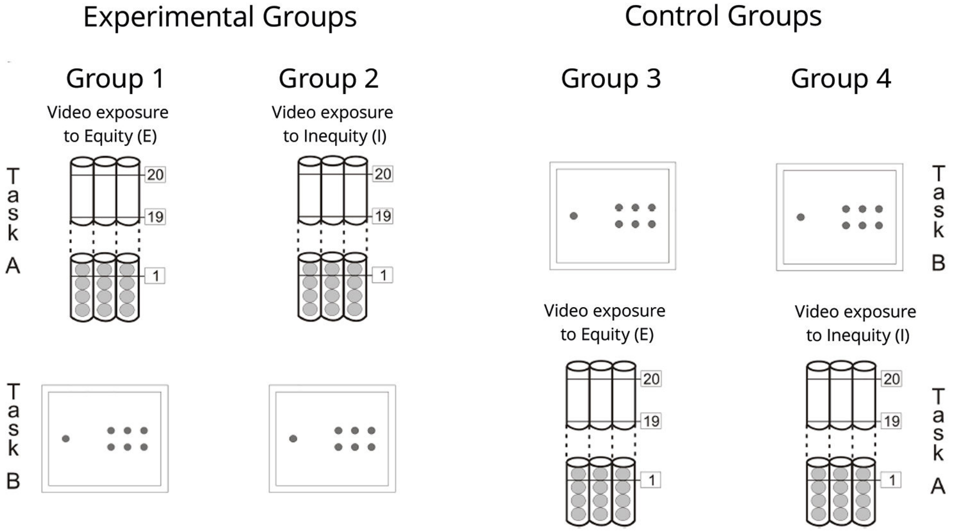

Figure 1. The scheme of the experimental paradigm.

Note. Left panel (Experimental Groups): After priming with equity or inequity conditions in Task A, the subjects' responses to different reward distributions were tested in Task B. Right panel (Control Groups): In the control groups, Task B was performed before Task A. Schemes: cylinders represent the tubes that were to be filled with beads (dark discs), and the numbers in small squares represent the amount of reward corresponding to a given level filled (Task A); large squares with dark circles represent computer screens with proposed reward distributions (1–6) for the subject (left) and the partner (right) (Task B).

Materials and Methods

Subjects

Forty-eight people (graduate students and postdocs) between the ages of 18 and 35 were recruited from the vicinity of Cambridge, England. The subjects were tested in the Department of Experimental Psychology in the University of Cambridge. For the purpose of the experiments, (see below) the subjects (24 female and 24 male) were randomly distributed to one of the four experimental groups. Moreover, four "actors" (two females and two males) participated in the experiments. Only same-sex pairs were formed in order to diminish the effect of the so-called "romantic issue," which might influence subjects' behavior (Griskevicius et al., 2007).

This research has been approved by the Cambridge Psychology Research Ethics Committee, University of Cambridge. Participants provided their written consent to participate in this study. The Ethics Committees approve this consent procedure.

Experimental Setup

Task A

Apparatus and procedure — The task consisted of picking out round dark blue beads (5 mm of diameter) from an assortment of beads with different colors and shapes from a box positioned on a table in one corner of the room (16 m^2). The subjects then dropped these beads into three transparent Plexiglas tubes (1 m height) glued together (like the pipes on an organ). The tubes were positioned on a table in a corner on the opposite side of the room from the bead box. Subjects were asked to take one bead at a time; to increase the difficulty of the task, the subject was asked to wear a ski glove. On the right side of the tubes, the computer screen was positioned against the wall 1.5 m off the ground, where the subject could see another subject performing the same task. All subjects saw the same pre-recorded movie displaying either female or male stooges, according to the sex of the subject. Two cameras were fixed above both the set of tubes and the bead box. The subject was told that his activity would be monitored and displayed online in the other subject's experimental room.

To create inequity or equity situations, subjects were informed that they would be rewarded with either 1 or 5 points for each segment of the Plexiglas tubes filled up and were asked to draw a ticket to determine the rate of the reward. However, only tickets corresponding to rate of 1 point were used in the drawing procedure. Thereafter, tags indicating the points available at different tube levels were attached to the tubes by the experimenter. The subject was informed that the other participant had drawn rate 1 (Equity condition) or rate 5 (Inequity condition). Tags corresponding to rates 1 or 5 were attached to the tubes and were visualized in a movie showing the participant's room during the course of the experiment. At the end of the experiment, the total points earned were exchanged for various food rewards (chocolate, cereal or biscuit bars).

Instruction and training — Subjects were brought to the experimental room by the experimenter, who indicated that, during the testing, another participant would be doing exactly the same task in another room and that they could see each other via a system of cameras and computers. After reading the instructions (see Supplementary Materials), subjects started with a training session that lasted 5 minutes in order to get accustomed to the task. During this period they received no rewards. Subjects were told that they could work on the task for no longer than 2 hours and could quit whenever they wanted. Moreover, it was stated that they could only use the hand wearing the glove, but that it was possible to switch hands. If they dropped a bead on the ground, they would have to pick it up. Finally, if they placed a bead into the wrong tube, the segment that contained the wrong bead would not be counted toward their reward.

Testing — The test phase began immediately after training. The experimenter sat in an adjacent room in order to minimize the possibility that his/her presence would influence the subjects' behavior, but the doors between the two rooms were open, allowing for contact at any time.

Task B

Apparatus and procedure — The procedure of this task has been comprehensively described in a study by Ostojić and Clayton (2013) and is summarized here. Task B was performed in the same room as Task A. Another, larger table was positioned to the right of the bead box table with a single computer screen on it. On the computer screen, different propositions of work for reward were presented so that the subjects could choose for both themselves and for their partners (social groups) or for themselves and a "virtual person," in which case nobody except the subjects would benefit from it (non-Social group). To accept a given reward rate, symbolized by small disks on the screen, subjects had to press the bar of a bike pump within 5 seconds of receiving a proposition. This simple device transformed the mechanical information into a computerized signal that signaled the acceptance of the proposition, and the number of rewards earned was shown on the screen for both the actor and the partner. If the pump was not pressed within 5 seconds, the proposition was rejected and the rewards were not credited. The time interval between successive trials was the same, independent of whether the proposition was accepted or not. The task was programmed in the Express Version of Microsoft Visual Basics 2008.

Instruction and training — Subjects read the written instructions. In the social condition, the partners, who were the same for all subjects tested (one female and one male, according to the sex of the subject), also received instructions. Subjects went through a training phase to assure that they understood and performed the task well. Because the task could trigger slight muscular fatigue, female subjects were allowed to perform 20 training trials, whereas male subjects were asked to execute 30. The rate of rewards (0–1, 1–0, 1–1, 1–6) appearing on the screen was presented randomly and was similar to those used during the testing phase. The first number, which appeared on the left side of the computer screen, corresponded to the subject's reward, whereas the second number appearing on the right of the computer screen indicated the participant or "virtual person's" reward.

Testing — The training period was followed by the test phase. In the social condition, both the subject and the partner were seated side-by-side in front of the computer screen, with the subject always seated on the left of the participant. They were asked not to talk to one another. The actual task consisted of 64 trials in which the four randomly distributed rates were presented 16 times each. The subjects were asked to answer the proposition without taking into account their previous choice. The final score was known only after 64 trials had been complete. Then, the participant was asked to leave the experimental room and the subject was told to start the same task again in the absence of the participant (non-social condition). During both phases of testing, the experimenter sat, as in Task A, in an adjacent room to minimize the possibility that his/her presence would influence the subjects' behavior. At the end of the task, the subjects and participants were allowed to collect their rewards (either Haribo Goldbears, Mars M&Ms, or hazelnuts).

Data Analysis

To determine how rate value, priming conditions, social conditions and sex interacted with the probability of acceptance, we fit the data with a logistic regression model with a random intercept, a special generalized linear mixed model (GLMM), which is described as follows (Agresti, Booth, Hobert, & Caffo, 2000; Hedeker, 2005):

Assume that μ_{ij} represents the conditional probability of a response that is the acceptance probability for *i*-person and *j*-treatment where $i = 1,\ldots, n$ and $j = 1,\ldots,m$. A random-intercept model, which is the simplest mixed model, augments the linear predictor with a single random effect for subject *i*, $\eta_{ij} = \log(\mu_{ij}/(1 - \mu_{ij})) = x_{ij}\beta + \nu_i$, $j = 1,n$ where $x_{ij}\beta = \beta_1 x_{(ij)1} + \beta_2 x_{(ij)2} + \ldots + \beta_p x_{(ij)p}$ where vector β represents the parameters of fixed effects considered, n is the number of fixed effects and ν_i is the random effect (intercept), which could be interpreted as a personal propensity to accept a proposition. These random effects represent the influence of subject *i* on his/her repeated responses that are not captured by the observed covariates, which are assumed to be distributed as $N(0, \sigma^2_{\nu})$. The parameter σ^2_{ν} indicates the variance in the population distribution, and therefore the degree of heterogeneity of the subjects. Notice that whether η_{ij} is negative, equal to zero or positive corresponds to the probability of acceptance being less than .5, equal to .5 or greater than .5, respectively.

We considered 10 GLMMs with different fixed effects and selected the best one according to the minimal Bayesian informational criterion (BIC). This criterion assigns to a model M a cost $BICj = -2 \log(f_M) + p_M \log(n)$, where f_M denotes a probability density function for M, n is a number of observations and p_M is the number of parameters in M.

To quantify the difference for the distribution of the 0–1 rate between groups E, IE and C, we fit the data with the beta-binomial distribution. The parameters of the beta-binomial model were estimated by the maximum likelihood method. To quantify the difference for the distribution of the 0–1 rate between groups E, IE and C, we fit the data with the beta-binomial distribution, which is a family of probability distributions in which the probability of success in each known number of Bernoulli trials (in our experiment, 16 propositions for a given person) is not constant (in our experiment, it is a person's dependent parameter equal to his/her number of acceptances). The probability of the occurrence of k successes in n trials depends on two parameters (α, β) and is given by the following expression:

$$f(k|\alpha,\beta) = \binom{n}{k}\frac{B(k+\alpha, n-k+\beta)}{B(\alpha,\beta)}$$

where

$$B(\alpha,\beta) = \int_0^1 t^{\alpha-1}(1-t)^{\beta-1}dt$$

Results

Subjects Quit Task A Earlier in IE Than in E Conditions

We first tested whether subjects expressed an inequity aversion by quitting Task A earlier under conditions of inequity (IE) than under conditions of equity (E). The performance time in either IE or E groups did not differ depending on whether the task was performed before or after Task B (see Figure 1). Indeed, the distribution of the performance time shows no difference between Groups 1 and 3 (E condition) (Mann-Whitney test, $U = 75$, $p = .43$) and Groups 2 and 4 (IE condition) (Mann-Whitney test, $U = 81$, $p = .29$). Therefore, the data were pooled in groups 1+3 and 2+4. Subjects quit the task earlier under the IE condition (after 17.35 min +/- 3.78) than under the E condition (after 29.35 min +/- 4.37) (Mann-Whitney test, $U = 405$, $p = .008$). This time difference indicates that subjects reacted to the situation by expressing an aversion to inequity.

No Effect of Priming With IE or E on the Probability of Acceptance in Task B

In Task B, each of the following reward distributions between the subject and the partner (1–1, 1–0, 0–1 and 1–6) was proposed 16 times in randomly distributed sequences of 64 trials in social conditions and 64 trials in non-social conditions (see Method). As illustrated in Figure 1, we tested subjects' choices after experiencing equity (E) and inequity (IE) conditions (Groups 1 and 2, respectively) to see whether they influence subjects' choices in Task A. In the control groups (C) (Groups 3 and 4), Task A was presented after Task B so that subjects were tested without any previous experience of equity or inequity.

To describe the probability of acceptance for different reward distributions, we fit the data with GLMMs with the subject as a random factor, in which the following fixed effects were considered: group (E, IE, C), rate (0−1, 1−1, 1−6, 1−0), sex, conditions (social, non-social) and interactions between these effects. We constructed 10 GLMMs with different configurations of fixed effects and interactions. Importantly, no significant effect for groups was found in these models, which indicates that the probability of acceptance for any rate (0−1, 1−1, 1−6, 1−0) was not influenced by conditions prior to the experiment (E, IE, C). This was further confirmed by a Mann-Whitney U test that showed no differences between groups E and IE (median values: 8.5 (E), 3 (IE), $p > .5$, $r = .13$ (rate 0−1); median values: 16 (E), 16 (IE), $p > .5$, $r = .12$ (rate 1−1); median values: 14.5(E), 15.5(IE), $p > .6$, $r = 0.11$ (rate 1−6); median values: 16 (E), 16 (IE), $p > .4$, $r = .16$ (rate 1−0)) in social conditions. A similar lack of difference between E and IE groups was found for non-social conditions (median values: .5 (E), .5 (IE), $p > .7$, $r = .06$ (rate 0−1); median values: 16 (E), 16 (IE), $p > .1$, $r = .31$ (rate 1−1); median values: 16 (E), 16 (IE), $p > .5$, $r = .13$ (rate 1−6); median values: 16 (E), 16 (IE), $p > .9$, $r = .01$ (rate 1−0)). Finally, no differences were found between groups E+IE and C in social (median values: 8 (E+IE), 5 (C), $p > .6$, $r = .06$ (rate 0−1); median values: 16 (E+IE), 16 (C), $p > .8$, $r = .02$ (rate 1−1); median values: 15 (E+IE), 10.5 (C), $p > .16$, $r = .2$ (rate 1−6); median values: 16 (E+IE), 16 (C), $p > .9$, $r = .08$ (rate 1−0)) or non-social conditions (median values: .5 (E+IE), 0 (C), $p > .7$, $r = .23$ (rate 0−1); 16 (E+IE), median values: 16 (C), $p > .7$, $r = .33$ (rate 1−1); median values: 16 (E+IE), 16 (C), $p > .3$, $r = .12$ (rate 1−6); median values: 16 (E+IE), 16 (C), $p > .6$, $r = .07$ (rate 1−0)).

Priming With E Alters Acceptance Distribution of 0−1 Rate in Social Conditions

Looking for another putative effect of priming, we asked whether the distribution of acceptances for any rate was influenced by priming with IE or E. We found that only the acceptance distribution for the 0−1 rate in social conditions was altered. Indeed, in the IE group, the distribution was bimodal, indicating that approximately 50% of subjects accepted the 0−1 proposition in a majority of trials, whereas the other 50% of subjects mostly rejected it (see Figure 2A). The presence of these two extreme behaviors was reduced in the E group, in which subjects mainly expressed ambivalent attitudes: some of the 16 altruistic propositions were accepted while the others were rejected (see Figure 2B).

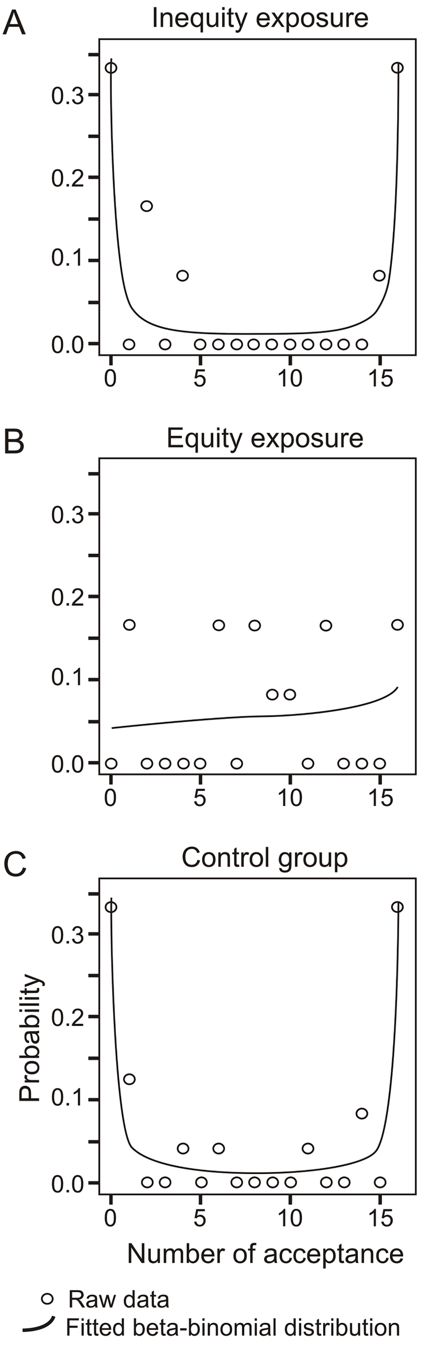

Figure 2. Distribution of acceptances of the 0–1 rate in the social condition in E, IE and C groups.

To quantify this phenomenon statistically, we fitted the data with a beta-binomial distribution (Table 1) and checked whether the models were equal (see Method). We found a relevant difference between the beta-binomial distributions of acceptances for the E and IE groups (likelihood ratio test: p = .003). Moreover, we found that subjects belonging to the control group, which did not experience either equity or inequity conditions before the test, expressed a bimodal distribution of acceptance of the 0-1 rate similar to that of the IE group (likelihood ratio test: p = .986).

Table 1

Distribution of Acceptances of the 0–1 Rate: Parameters of Beta-Binomial Model Estimated by Maximum Likelihood Method for E, IE and C Groups

Group	α	β
E	1.063	.835
IE	0.129	.132
C	0.127	.133

Acceptance of the 0–1 Rate Increases in Social Conditions

To estimate the probability of acceptance for different rates in social and non-social conditions among 10 GLMMs constructed, we chose the best model according to the Bayesian information criteria (BIC) (see Method) with condition (social, non-social), rate, and sex as fixed effects and a condition by rate interaction (Table 2).

Table 2

GLMM Analysis of the Factors Affecting the Number of Acceptances of Different Rates

Parameters	Estimate	*SD*	Z	*p*
β1 (rate 0–1)	-3.3835	.4600	-7.356	<1.89e-13
β2 (rate 1–6)	4.9431	.2023	24.438	< 2e-16
β3 (rate 1–1)	6.2213	.2305	26.995	< 2e-16
β4 (rate 1–0)	7.7642	.3121	24.877	< 2e-16
β5 (socCond)	2.6024	.1774	14.673	< 2e-16
β6 (sex)	1.7894	.6203	2.885	.004
β7 (rate 1–6:socCond)	-3.5882	.2321	-15.460	< 2e-16
β8 (rate 1–1:socCond)	-1.5207	.3113	-4.885	1.03e-06
β9 (rate 1–0:socCond)	-4.2083	.3402	-12.370	< 2e-16

Here, β1 (a random intercept of the model) indicates that a personal propensity to accept propositions had a significant (p < .001) effect; it was also the indicator for the estimated probability of acceptance of 0–1 in the non-social condition. The model fits the data in the non-social condition with an increase of acceptance probability in the following order: 0–1, 1–6, 1–1, 1–0 ($p < .001$) (Table 2, β1–β4; see Figure 3). Indeed, whereas the 0–1 rate was accepted with negligible frequency rates, in non-social conditions, 1–1 and 1–0 propositions were accepted in almost all trials. In the social condition, we found a significant increase in the acceptance probability for the rate 0–1 ($p < .001$) (Table 2, β5; see Figure 3) and the negative rate*socCond interaction for rates 1–6, 1–1 and 1–0 (Table 2, β7–β9, $p < .001$). Indeed, the positive effect of the social condition on the acceptance probability for the 0–1 rate was diminished for the 1–1 rate and reversed for the 1–0 and 1 –6 rates, which were accepted less frequently in the social condition than in the non-social (see Figure 3). In addition, a positive fixed effect of sex (Table 1, β6, $p < .01$) was found, showing that across all conditions and rates, males accept with a higher probability than females.

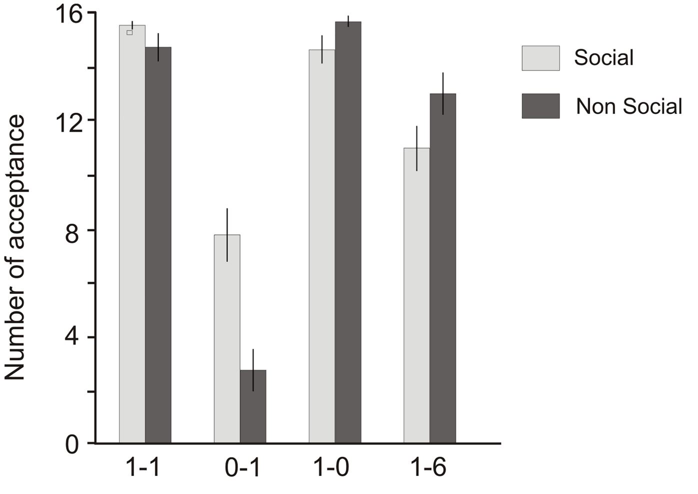

Figure 3. Mean (+/- SE) acceptance number of 1–1, 0–1, 1–0 and 1–6 rates in social and non-social conditions.

In summary, using the experimental design, as illustrated in Figure 1, and GLMM analysis, we were able to show that the acceptance of the 0–1 rate, which was negligible in the non-social situation, significantly increased when subjects acted in the social condition, indicating altruistic concerns.

Discussion

In our study we did not find any effect of being exposed to equity or inequity situations on the *probability* of 0–1 rate altruistic choices or any other propositions. However, the *distribution* of acceptances for the 0–1 rate was altered by a previously experienced equity situation. Indeed, in both the control conditions and when exposed to an inequity the distribution of acceptances for the 0–1 rate was clearly bimodal: some subjects totally accept, whereas others mostly reject this proposition. Surprisingly, in the group who experienced equity conditions, the presence of extreme behaviors was strongly reduced. Instead, subjects expressed an ambivalent attitude: some 0–1 propositions were accepted whereas others were rejected.

These findings indicate that, in general, people answer either *I accept* or *I reject* quite strongly when faced with an opportunity to work for others. Interestingly, these strong attitudes anticipate the presence of inequity situations: in our study they were expressed both under inequity situation and in the control conditions.

It is commonly accepted that helping and cooperative attitudes are shaped by cultural and social contexts (Bowles & Gintis, 2011; Rand, Greene, & Nowak 2012; Tomasello & Vaish 2013). Therefore, it is possible that because disadvantageous inequity conditions are so ubiquitous in our world, subjects decide to protect themselves (selfish concern) or to help others who are, in general, under the same inequity pressure (altruistic concern). However, when equity is introduced, both of these attitudes become less strongly expressed.

The original protocol used in this study (inspired by "animal-human translation"; de Wit & Dickinson, 2009) put the subject in the situation in which repetitive altruistic or egoistic choices must be made in a short period of time. This seems very remote from any real settings in which people make altruistic choices. However, the bimodal distribution of choices in inequity or control conditions suggests that subjects decided only once, at the beginning of the experiment, "*I will reject*" or "*I will accept 0-1 rate*" and thereafter continued on the same line. Only in the equity conditions did subjects seem to hesitate and to make different decisions for each of the 16 propositions. Since this study has been done on a very specific population (PhD students at Cambridge University), to generalize the findings presented in this paper, further research should be undertaken, using a wide range of social groups.

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Data Availability: For this study a dataset and materials are freely available (see the Supplementary Materials section).

Supplementary Materials

The following Supplementary Materials are available via the PsychArchives repository (for access see Index of Supplementary Materials below):

1. Dataset (occurences and timing)
2. Instructions for participants

Index of Supplementary Materials

Bem, T., Pokarowski, P., & Meyrand, P. (2019). *Supplementary materials to "Do altruists like equity?"* PsychOpen. https://doi.org/10.23668/psycharchives.2420

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