Decision Changes, Time Pressure, and Prosocial Intuition in the Public Goods Game

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Abstract

There has been much debate about the idea that humans are intuitively prosocial. Theories and accompanying experiments have debated the idea and provided evidence both in favor and against. One tool that has been used to test for intuitive prosociality is time pressure. Forcing decisions to be made quickly causes subjects to rely on intuition rather than deliberation. This paper contributes to the argument by using a small methodological change: offering subjects the opportunity to change decisions in order to gather data on fast, intuitive decisions as well as more deliberative decisions from the same subject. This methodology provides a new test for prosocial intuition. Using the public goods game, subjects make initial decisions with/without time pressure depending on treatment. By comparing subjects' fast decisions with the accompanying slow decisions as well as comparing decisions under time pressure with those that are not pressured, evidence in favor of prosocial intuition is found. This paper also examines several potential drivers of decision changes including parameters and emotions.

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[2]Comments and suggestions are welcome. All mistakes in this paper are my own. This paper is a work in progress and updated versions will be posted when available. The author can be reached at maddler@email.arizona.edu

1 Introduction

If no outside information was gained which would update prior beliefs about the expected utility of the purchase, then why change the decision? One explanation for changing a decision in this case is ex post reflection. Something about the act of making a decision, in this case clicking the "Place Order" button on a website, caused an internal change within the person and lead to a change of heart. Traditional economic thinking would classify this as a failure to anticipate one's feelings and/or thoughts prior to the decision. In this situation and many like it, this type of the mistake can lead to utility losses if there is no option to change a decision. This paper explores decision changes by having experimental subjects play a public goods game where there are opportunities to change contributions to the public good. .

As a methodological innovation, offering decision changes opens up a new avenue to be used to test hypotheses of human economic behavior. In this paper in particular, offering subjects the option to change decisions in a public goods game is crucial to providing a new test of the hypothesis that individuals are intuitively prosocial, but become more selfish when they deliberate. Prior tests of this hypothesis, which I outline in Section 2, have relied heavily on between-subject designs. By offering an option to change a decision, I have the same subject make a quick and deliberative decision in the same decision environment. I can then compare the decisions to see whether the quick, initial decision is more cooperative than the more deliberate decision which is made when the opportunity to change the initial decision is presented. The remainder of the paper proceeds as follows: Section 3 outlines the design of the experiment and details specific design decisions, Section 4 presents an analysis of the data, and Section5 concludes.

2 Literature Review

This paper is closely related to a strand of literature that has been debating the merits of the idea that humans are intuitively prosocial. The argument is that when people are forced to make a quick decision, the decision will be prosocial in comparison to a decision where a person takes more time to think about the decision. This idea was tested by Rand et al. (2012) [13] and follow-up work papers include Rand et al. (2014)[14]. In Rand et al. (2012)[13], results from multiple experiments are presented. One particular experiment from that study that informs my paper is a public goods game where subjects in one treatment must make contributions to a public good within 10 seconds while subjects in the control treatment must wait at least 10 seconds before making their decision. The paper finds evidence that subjects contribute more to the public good when time pressured than when they are forced to wait before making their decision. This result has created a lot of discussion and debate to which my paper contributes. I discuss design similarities my paper shares with Rand et al. (2012) in the experimental design section.

The linear public goods game, or voluntary contribution mechanism (VCM), was popularized by Isaac and Walker (1988) [8] who determined that the MPCR was a strong predictor of cooperation in a public goods setting. This game has since become a standard tool for economists to study individual decision making in an environment where there are social implications to decisions. Important work using this experimental procedure includes Palfrey and Prisbrey (1997) [12] who show that behavior in this game can be influenced by changes in various parameters.

This paper contributes to a few overlapping strands of economic research. The first is a blooming strand of literature regarding decision time. There have been papers which draw inference from decision/response time of subjects as well as a few papers cautioning against such inference. Rubinstein (2007) [15] conducted a series of online experiments where decision time was tracked. In this case, the decision time was endogenous and the author found that simple decisions tended to be made more quickly, while more complicated/difficult decisions were often paired with increased decision times. In subsequent work, Rubinstein (2013) [16] analyzes instances of mistakes in relation to decision time and posits that it might be beneficial to classify individuals as fast or slow decision makers for modelling purposes. Kocher and Sutter (2006) [9] find that when participants in a p-beauty contest are pressured to make quick decisions, decision quality is lower and there is a slower convergence to equilibrium. Chabris et al. (2009) [3] test the hypothesis that decision time is a function of the expected payoff between two options in a binary choice problem. They find that this gap in expected value explains about half of the variance of subjects decision times. Haji et al. (2019) [7] conduct a Vickrey auction where bidders are time pressured and find that the added pressure leads to more bidders abstaining from bidding and bidding lower than the optimal strategy than when there is no time pressure. In each of these settings, decision time was used either varied across treatments, or measured to gain information about the decision-making process of subjects.

Related to research on decision times are studies regarding mistakes. The common-sense argument is that quicker decisions are more likely to be mistakes than slower decisions. To explore

this dynamic, Caplin and Dean (2015) [2] develop a model which involves making a decision after costly information acquisition. One implication of this model is that mistakes are not a result of irrational behavior, rather a decision maker optimizing given constraints.

Perhaps the least developed strand of literature my paper belongs to is research regarding decision changes. The only papers I am aware of that allow for decision editing before outcomes are realized are [1], Krawczyk and Sylwestrzak (2018) [10], and Gawryluk and Krawczyk (2019) [6]. In these experiments, the authors use a novel experimental procedure to have subjects make a quick decision as well as a more deliberative one. One decision round has a set time limit. Subjects are allowed to deliberate between two choices for the duration of that time and are allowed to change between options at will during this time period. At the end of the round, one second the time period is randomly selected, and whatever choice was on record during that time is implemented. The authors argue that this method encourages subjects to make quick initial decisions and allow for deliberation and potential decision changes throughout the round. This allows the authors to collect data on subjects initial, intuitive decision as well as their more deliberative decision. For this reason, the authors refer to this procedure the "choice process protocol" in Agranov et al. (2015) and double response method in Krawczyk and Sylwestrzak (2018) and Gawryluk and Krawczyk (2019). I will discuss differences between my design and these methods in the Experimental Procedure Section.

When people change decisions, these changes usually result from new information or evidence that is acquired which changes the optimal decision for an agent. Picture a couple buying a new sports car only to find out they are expecting a child. Now, the parents-to-be prefer an SUV or minivan. Why might a person change their decision when theyve received no new information externally? Perhaps the evidence gained is internal in origin. If this is the case, then emotion likely plays a role in decisions. One can imagine a situation where a person makes a decision, instantly regrets it due to the emotional response he/she has, and desires to change the decision. This idea is supported by an idea from psychology: affect as information. This theory, described by Clore et al. (2001) [4] describes a process by which people use emotions to inform decisions. Essentially, emotions and moods are treated as pieces of information and used as a feedback system to inform current and future decisions. Loewenstein and ODonoghue (2004) [11] develop a model of decision-making where a person has both deliberative and affective systems in an attempt to explain behavior in economic contexts. My paper explores the role of affect as information by gathering measurements of emotion using FaceReader to see if emotion is a driving force behind decision changes in the experiment.

FaceReader and similar technologies allow researchers to gather near-continuous analysis of emotional states of human subjects by recording video of subjects faces. This video is analyzed by a program which uses face measurements to determine the emotional composition of faces.

(INSERT FACEREADER LIT REVIEW HERE)

3 Experimental Design

3.1 Procedures

First, I discuss the general setup of the experiment, then I will go into detail about specific design decisions. This experiment consists of two stages. In the first stage, I replicate (as closely as possible) an experiment from Rand et al. (2012) [13] with a small, yet important alteration. Subjects are divided into groups of four and play a public goods game. Each subject is endowed with $4 and use a slider to indicate how much money they contribute to the public good (in increments of 4 cents). Whatever amount is contributed is multiplied by two before being divided equally among all members of the group. This translates to a marginal per capita return of 0.5. Subjects simultaneously decide how much to contribute.

The treatment in this experiment is whether or not subjects' initial decisions are time-pressured. In the Time Pressure treatment (TP), subjects must make their initial decision within 10 seconds using the slider on their screen. If a decision is not made in those 10 seconds, the position of the slider at the end of the 10 seconds is submitted as the contribution. In the control group, or the No Time Pressure treatment (no TP), initial decisions are not time-pressured. Subjects have up to 3 minutes to submit a decision. This is the only difference between the two treatments in this experiment.

Once the initial decision is made by all subjects, they see a 10 second waiting screen. Then, all subjects are offered an opportunity to change their decision. Subjects were not aware of this opportunity before they made their initial decision, they simply knew that they would be asked a question about their decision. Subjects final decisions were recorded and used to determine payment. The opportunity to change the decision in the game was not offered in the original experiment, and this opportunity to change a decision is a central feature of this experiment. Offering a decision change allows the experimenter to see the same subject make an initial decision

as well as a more deliberative one. Differences between initial decisions and the final decision will be a variable to be analyzed. I am not the first to allow subjects to alter decisions. Other authors have taken a different approach, however. In the other papers including experiments with decision alteration opportunities: Agranov and Caplin(2015), Krawczyk and Sylwestrzak (2018), and Gawryluk and Krawczyk (2019), all involve continuously altering a decision over a period of time. One moment of time is then randomly selected to determine payment. In my experiment, subjects explicitly make an initial decision, and then may or may not get the opportunity to change it at a later stage. There is no randomness in which decision counts. There is randomness in the opportunity to change, however. Using my methodology still maintains the incentivized quick decision while eliminating uncertainty about which decision will count. My methodology does however sacrifice analytical power as I do not see how decisions evolve over time, only the results of the decision-making process.

Once the first stage is complete, a secondary set of instructions was provided to subjects. In this set of instructions, subjects are told that the experiment will continue for 13 more rounds. In each round, the parameters of the public goods game change, and groups are scrambled (stranger matching). The subjects then play 13 more public goods games. In each game, there is a 10 second time limit in the decision-making stage (in the TP treatment only). The opportunity to change decisions in the final 13 rounds of the experiment is no longer offered with certainty. There is also a 50% chance that a given subject will have the opportunity to change their initial decision in any given round. This is done to incentivize subjects to take initial decisions seriously, as there is a chance they cannot be altered. Subjects do not see outcomes of the games they play. Subjects receive payment according to the outcome of the first stage of the experiment and according to the outcome of one randomly selected round from the second stage of the experiment.

At the end of each session, regardless of treatment, a brief questionnaire was distributed which gathered data on ethnicity, age, and gender. The experiment was coded and implemented using Ztree (Fischbacher 2007) [5].

3.2 Specific Design Choices

In this section I discuss the design in terms of the treatments and various design decisions that were made in the planning of the experiment. The overall structure of the public goods games played by subjects was kept as close to Rand et al. (2012) as possible for the sake of comparing results. Subjects used the same method to submit decisions and received very similar instructions before the game was played. Rand also uses a time pressure in his treatment, but does so slightly differently than in this experiment. In Rands experiments, subjects are either forced to decide within 10 seconds, or forced to wait 10 seconds before deciding. In this experiment, subjects are either forced to decide within 10 seconds or can make the decision whenever they are ready (depending on the treatment). This design decision was made so that subjects can self-select into making quick decisions to see whether this self-selection influences instances of decision changes.

This treatment structure results in a combination of possible comparisons. Between subject analysis can occur using the data from the TP and No TP treatments, as well as an analysis of how one subject alters decisions if given the opportunity.

The experiment consists of two distinct yet similar stages. In stage 1, subjects participate in a public goods game under very similar conditions to that of Rand et al. (2012). In the second stage, subjects are asked to play a series of public goods games under varying parameters. Subjects are not aware of the details of stage 2 while they are in Stage 1. Subjects simply know that there is more of the experiment to follow. Having the two stages is helpful for analysis. The first stage provides a new way of testing the hypothesis of prosocial intuition that was presented by Rand et al. (2012), while the second stage allows us to test for behavioral regularities that might appear in the data. Are subjects more/less reactive to parameter changes under time pressure? Do instances of decision changes decrease with experience? Do emotions correlate with decision changes?

Table 1 displays the parameters for each round of the experiment. The order of these rounds (beyond Round 1) was randomly generated but all sessions and subjects experienced the 14 rounds in this order. Endowments vary between \$2, \$4, and \$8, and the MPCR varies between .375, .5, and .625 to generate 9 of the rounds. This grid was chosen so that the game remains the same from a qualitative standpoint, while still allowing for subjects to experience new situations with more/less money initially and a varying value of contributing. Rounds 4 and 13 have an MPCR $\leq .25$ which means that contributing to the public good in these rounds either does not increase social welfare (Round 4) or actually reduces social welfare (Round 13). These rounds are included to check for inattention among cooperators as time pressure might lead subjects to fall into a pattern of behavior and not notice parameter changes. Rounds 7 and 11 are included to check for inattention among selfish subjects. In these rounds, a perfectly selfish player will either be indifferent between freeriding and cooperating (in the case of round 7) or strictly prefer cooperating (Round 11). Again, if time pressure leads to inattention, these rounds will check for parameter responsiveness. Note,

there are certain social preferences that can lead to contributions in rounds where the MPCR is very low and freeriding in rounds where the MPCR is very high. For example, an envious player might not contribute when the MPCR is very high in order to reduce the payoffs of coplayers.

Throughout the course of the experiment, subjects' faces are recorded using webcams on each computer. This video is analyzed using a software called FaceReader. I discuss the nature of this data in Section 3.4. In addition to gathering information on subjects' emotional states during the experiment, a questionnaire was distributed to subjects at the end of the experiment collecting demographic data and asking several questions about subjects' attitudes during the experiment. The following three questions were asked and the possible answers were yes, no, and I don't know.

1. Did you become more confident in your decisions as the experiment progressed?
2. Were you happy that you were offered the opportunity to change a decision?
3. Did being offered the opportunity to change a decision change the way you thought about future rounds of the experiment?

3.3 Hypotheses

Hypothesis 1 (H1): *Average initial contributions to the public good will be greater than final contributions.*

This hypothesis is a direct prediction of the prosocial intuition hypothesis from Rand et al. (2012). If individuals are intuitively prosocial, then their initial contribution to the public good will be weakly greater than their final contribution, should they get the opportunity to change their decision. This is because offering a decision change prompts subjects to deliberate further before submitting the final decision. More deliberation should be correlated with weakly more selfish behavior, regardless of whether or not initial decisions are time-pressured.

Hypothesis 2 (H2): *Decision changes will be more likely and larger in magnitude in the TP treatment than in the No TP treatment.*

This is another prediction of the prosocial intuition hypothesis in Rand et al. (2012). In the Time Pressure (TP) treatment, subjects only have 10 seconds to make their initial decision, which does not afford much time for deliberation or thought. Theoretically, the prosocial intuition should then lead to high initial contributions. When subjects in this treatment are offered opportunities to change, I expect that the additional deliberation will lead to more selfish behavior. However, in the No Time Pressure (No TP) treatment, subjects can deliberate as long as they like on their initial decision, so I expect the additional deliberation that comes with a decision change offer will have little impact on the final decision. Theoretically, subjects who are allowed to deliberate as long as they like should be less likely to change a decision, and if they do change, their final decision should be close to their initial decision.

Hypothesis 3 (H3): *One or more measures of emotional state will be correlated with the magnitude of decision changes.*

This hypothesis is based on the theory that humans use affect as information that is presented in Clore et al.(2001). If a subject decides to change a decision in this experiment, the subject has received no additional external information which would update his/her beliefs about expected utility of different decisions . Affect-as-information theory predicts that emotional states and/or changes in emotional state will be correlated with decision changes and magnitude of decision changes.

3.4 Data

Data used in the following analysis was gathered from experimental subjects recruited through the Economic Science Lab recruiting client and experimental sessions were all run on computers in the Economic Science Lab at the University of Arizona. Seven experimental sessions were conducted between February and March, 2019. There were 4 sessions of the TP treatment and 3 sessions of the No TP treatment. Average session size as about 12 subjects, and 80 total individuals participated in the experiment. All subjects who started a session completed the experiment. Subjects' faces were recorded using webcams and the video was analyzed using FaceReader software in order to produce data about emotional states. This is done by analyzing video using algorithms to produce a percentage breakdown of emotions expressed in the face. Seven emotions were measured: fear, anger, disgust, happiness, sadness, surprise, and neutral. For each stage of a round, the data contains a percentage breakdown of those seven emotions. Unfortunately, there is a nontrivial of missing FaceReader data due to both the nature of filming subjects who are moving and looking

around as well as technical errors. Analysis conducted using the FaceReader data will indicate the number of observations used. Table 3 presents summary statistics of the data gathered. Out of 1,120 total round-subject observations, there were 590 opportunities to change offered, and of those 590 offers, 391 resulted in a decision change (66.2%). The average magnitude of a decision change was −41% of the endowment in that round. This number is calculated by including observations where there was a change offered, but no change was made. The average initial contribution across the entire dataset was $2.01, while the average final contribution was just $1.05.

Table 2 presents the same information as Table 3 but separated by treatment. From looking at Table 2, it appears that there are small differences between the treatments in terms of average initial and final contributions. There does not appear to be much of a difference between treatments in terms of the tendency to change. The proportion of changed decisions is similar in each treatment.

4 Analysis

4.1 Hypotheses

Result 1: In all rounds across both treatments, average initial contributions to the public good are greater than average final contributions, with this difference being statistically significant in many rounds for the TP treatment and for several rounds of the No TP treatment.

Support: Figure 1 and Figure 2 plot average contributions as a percentage of the endowment for each round of the experiment. Figure 1 presents data from the TP treatment and Figure 2 presents data for the No TP treatment. In both graphs, the red line represents average initial contributions in each round while the blue line represents final contributions. In both figures, average initial contributions are higher than average final contributions in every round of the experiment. As one can see, this phenomena seems to be independent of experience in the game environment, at least experience accumulated over the course of the experiment, and persists across a range of game parameters.

Are the differences between initial and final contributions in each round statistically significant? Wilcoxon rank-sum tests show statistically significant differences between initial and final contributions for all rounds in the TP treatment, except Round 4 and Round 13. Each of these two rounds has an MPCR so low that contributions are not social-welfare-improving. In Round 3, contributing to the public good does not increase social welfare and in Round 13 contributing actually reduces social welfare. The fact that initial contributions are so close to final ones in these rounds indicates that perhaps the urge to change decisions only occurs when there is a net social welfare benefit to contributing in the first place. Or, subjects noted the somewhat peculiar parameters and reacted appropriately by not contributing initially and thus not contributing much with their final decision.

Turning attention to Figure 2, we see average initial and final contributions for the No TP treatment. We see a similar general pattern in the data but the initial contributions seem to track more closely to the final decisions than in the TP treatment. The difference between initial and final decisions is statistically significant at the 5%-level for all rounds except Rounds 3, 4, 5, 13, and 14. With the exception of Round 14, the rounds without a statistically significant difference between initial and final contributions are all in rounds with relatively low MPCR (MPCR ≤ 0.5). In rounds with exceptionally high MPCR, like Rounds 7 and 11, the difference is highly significant both statistically and in magnitude. Looking back at Figure 1 and the TP data yields a similar qualitative conclusion. This phenomenon is supported by regression coefficients yet to be discussed, so there is a behavioral mechanism that must be addressed. Why would subjects go from relatively high levels of contribution in a situation where the MPCR is above 1, like in Round 11, to relatively low final contributions. This is despite the fact that it is uniquely optimal for a perfectly selfish subject to contribute fully to the public good. One potential explanation is that some subjects might want to deliberately reduce the payoff of other players in the game, even if it means sacrificing some of their own material payoff. This explanation is unlikely in this experiment because there is stranger matching of groups between rounds and no outcomes of individual rounds are observed until the end of the experiment. So, there should be no motive to punish others unless a subject holds rather extreme beliefs about the cooperative tendencies of her co-players or a subject has strong preferences for reducing others' payoffs. Given the likelihood of this extreme subject type and the strong statistical significance and magnitude of the difference between initial and final contributions in this round, this result is likely due to a different behavioral mechanism. Addressing this puzzling result further from a behavioral mechanism perspective is outside the scope of the current paper and an open question for further research. These results do provide evidence in support of Hypothesis 1.

Result 2: Time pressure appears to have a significant effect on both the frequency and magnitude of decision changes.

Support: Probit regressions where the dependent variable is whether or not a decision is changed show a significant treatment effect once controlling for subject fixed effects. The estimated treatment effect is that subjects in the TP treatment are almost 30% more likely to change a decision than their counterparts who made an initial decision that was not pressured. (Probit regression table forthcoming)

In terms of the magnitude of decision changes, there is once again a strong treatment effect. Table 8 presents results from OLS regressions where the dependent variable is the difference between final and initial contributions, scaled by the endowment. In Column (2), we see a large treatment effect on the magnitude of decision changes. When initial decisions are pressured, we expect the decision change to be 56% of the endowment lower than if initial decisions are not pressured. This effect is not only highly statistically significant, but also very large in magnitude. This evidence supports Hypothesis 2.

Result 3: There is no correlation between emotional states and decision variables in this experiment.

Support: OLS regressions on several different dependent variables including initial contribution, final contribution, and decision change scaled by endowment, all return statistically insignificant coefficients on the regressors for each of the seven emotions measured. Not only are the coefficients statistically insignificant, but they are small in magnitude as well. This is evidence that decision changes in this experiment are not being driven by emotion. This evidence leads me to reject Hypothesis 3.

4.2 Exploratory Analysis

This section presents results from data analysis that did not have an accompanying hypothesis at the inception of the experiment. This section is actively under construction.

Result 4: Decision changes result in drastically reduced contribution to the public good, on average.

Support: Figure 3 presents a histogram of decision changes scaled by the endowment in each round. For example, a value of -1 for this variable indicates that a subject went from full contribution to no contribution in a round. Similarly, if the variable has a value of 0.5, this means a subject increased their initial contribution by 50% of their total endowment before submitting their final decision. As one can see, there is a large mass near -1 and a large mass near 0. The histogram plots the data from the 590 round-subject observations where an opportunity to change the initial decision was offered. Out of 590 opportunities, 199 decisions did not change. Out of 590 observations, 184 resulted in a subject initially cooperating fully and contributing their entire endowment to the public good only to change their decision and contribute nothing, fully freeriding. There were 315 total observations where subjects went from contributing any nonzero amount initially, but then contribute nothing with their final decision. The extremity of these decision changes is quite surprising and equally puzzling.

Result 5: In rounds where $MPCR \geq 1$, decision changes result in greatly reduced contributions.

Support: Looking back at Figures 1 and 2, particularly rounds 7 and 11, we see some of the largest differences between initial and final contributions, regardless of treatment. In these rounds, a perfectly selfish individual would either be indifferent between all levels of contribution (in the case where $MPCR = 1$) or strictly prefer to contribute their entire endowment to the public good (when $MPCR > 1$). It is puzzling to see such a reduction in contribution when it is the most valuable to the croup to contribute.

This observation is backed up by OLS results. In Table 8, the coefficient on MPCR is highly statistically significant in all three specifications, large in magnitude, and negative. In Column (2), the coefficient on MPCR indicates that a one unit increase in MPCR leads to a reduction in final contributions equal to 64.2% of the endowment . This result runs contrary to economic logic. One would expect that as the MPCR increases, subjects contribute more. In other words, when it is more valuable to the group to contribute, we expect higher contributions. However, these regression results say this does not hold when there is an opportunity to change decisions. In fact, these results indicate the opposite is true when decision changes are offered. The magnitude and significance of this coefficient is relatively robust to different regression specifications and is quite surprising.

Result 6: Male subjects lower contributions less than female subjects when making

decision changes.

Support: By looking at summary statistics, we can see a small difference between genders already. Tables 5 and 6 present summary statistics for the TP treatment and No TP treatment respectively, with data separated between men and women. In the TP treatment, the average initial contribution by men is higher than women, but the opposite is true in the No TP treatment. The average final contribution among men is higher than women in both treatments, but this average ignores the changing parameters of each round, like endowment and MPCR. In the TP treatment, women changed decisions 64.1% of the time, while men changed 68.8% of the time. In the No TP treatment, women changed decisions 71.2% of the time while men changed 63.8% of the time. It appears to be the case that women react differently to the treatment than men. When considering the size of changes, it appears that women changed more drastically in the no TP treatment, which is the opposite of what I expect to find.

To better understand the gender difference in this experiment, I examine the gender difference in initial contributions. Column (2) in Table 7 includes a regressor for subjects' gender. The base case is female, so the coefficient on Gender:Male indicates that male subjects in the experiment give $2.90 less than their female counterparts when making an initial decision.[3] When this result is paired with regressions where the dependent variable is the decision change scaled by endowment in Table 8, a more nuanced interpretation is necessary. Since the male subjects were more selfish initially, there is less room for them to decrease contributions when given the opportunity to change decisions. Looking at Column (2) in Table 8, we see a coefficient on Gender:Male of 0.768. The positive sign indicates that being male would predict an increase in contributions for men, on average. However, because males are more selfish than females initially, the males simply cannot reduce contributions as much as female subjects in this experiment. Thus, this positive coefficient on gender could be interpreted as "men reduce contributions less than women."

Result 7: Initial contributions are higher under time pressure than under no time pressure.

Support: Table 7 presents OLS regression results where the explanatory variable is a subject's initial contribution to the public good in a round. Column (1) and Column (2) regress initial contribution on the same set of explanatory variables, but Column (2) includes subject fixed effects. Column (3) adds decision time, and Column (4) adds regressors from subjects' emotional state during the decision stage. Due to data loss, Column (4) contains fewer observations. Column (2) is my preferred specification. This specification includes subject fixed effects to control for heterogeneity in subjects' underlying tendencies in the game. I find statistically significant coefficients on all explanatory variables in Column (2) including a highly significant treatment effect. The coefficient on the variable "Pressured (Initial)" of 2.309 can be interpreted as the average treatment effect on initial contributions. Subjects who were pressured to make their initial decision within 10 seconds will, on average, contribute $2.31 more to the public good than their counterparts who are not time pressured. This result supports the prosocial intuition hypothesis. When subjects are forced to make quick decisions, they contribute more, at least initially. Coefficients on Endowment, MPCR, and Period all have expected signs and reasonable magnitude. I expect subjects to contribute more initially when the MPCR is higher, which they do, and I also expect subjects to contribute more when endowments are higher. This also appears to be the case. The small, negative coefficient on Period indicates that initial contributions decline slightly over the course of the 14 rounds in the experiment. This is a regularity found in many experiments involving repeated public goods games.

5 Discussion

In the analysis of data from this experiment, several hypotheses were tested. Hypothesis 1 predicted that when subjects make an initial contribution and then are allowed to change that decision, initial contributions would be higher on average than final ones. This was true for both treatments, and moreso for the TP treatment. This supports the hypothesis that people are intuitively prosocial and increased deliberation leads to increased selfishness. Hypothesis 2 predicted that decision changes would be more frequent and larger in magnitude in the TP treatment as opposed to No TP. This hypothesis is not supported. I find no evidence of a statistically significant difference in the magnitude or frequency of decision changes between treatments. Hypothesis 3 posited that decision changes would be driven by emotion. If subjects do not gain any additional information

[3] One subject out of 80 identified their gender as non-binary. Data from this subject was included in the analysis under a separate gender category from male/female. I suppress the coefficient on Gender:non-binary from regression tables to prevent erroneous conclusions form being drawn from data on one experimental subject.

about the game or decisions of others, it must be some sort of internal reflection guiding decision changes. If emotion were a driver, this would support the idea that people use affect as information. I reject the hypothesis that emotion is a driver of decision changes in this experiment. I do not find statistically significant effects of emotions on all of my regression analysis.

In addition to the conclusions drawn from data analysis, several behavioral oddities arose. The first oddity is that subjects, when given the opportunity to change decisions, reduced contributions more in rounds with a high MPCR, the very rounds where it is the most socially efficient to contribute. This paper can not speak to why this occurs, but I suspect this has to do with beliefs about the actions of other players in the game. Data on beliefs in this experiment was not collected, so the question is open for future research. Another phenomena that arose in the data was the pervasiveness of decision changes. One would expect that, as subjects gained experience in the decision environment, they would gradually make less decision changes, and the decision changes would decrease in magnitude as periods progressed. Evidence indicates that is not the case. Why do decision changes persist? One potential explanation could be an experimenter demand effect. Subjects are possibly exercising the opportunity because they think the experimenter wants them to change. My prior work using this decision change methodology indicates that this is not the case. In a trust game where trustees can change decisions about how much money to return, less than 30% of opportunities to change decisions were exercised. Changes that did occur were relatively small (Addler 2014 working paper). A similar trend of minimal changing arose in an individual choice experiment where subjects allocated money across a portfolio of stocks (Addler 2016 working paper). So, there is something about the public goods environment that is driving these decision changes. Once again, this question is left open for future research.

Yet another open question created by the present research regards the difference between genders in reacting to treatments. The tendency for female subjects to make more extreme decision changes as opposed to male subjects could perhaps be explained by societal pressures. This is speculation, but society tends to be more accepting of assertive and selfish men than women. So, perhaps women are feigning cooperation in initial decisions due to societal pressure, but upon revisiting the decision take a selfish approach. The classic example of this is that man who asks for a promotion is often viewed as ambitious while a woman in the same position is not viewed as positively. In any case, answering the question as to *why* there is a gender difference in this experiment is beyond the scope of this paper. Documentation of the difference will have suffice for the current experiment.

This paper has used a small methodological innovation, offering subjects the opportunity to change decisions, to test for prosocial intuition in a new way. I find evidence that pressuring subjects to make fast decisions leads to increased contributions in the public goods game. I find that, regardless of whether or not the initial decision was time-pressured, offering subjects an opportunity to change how much they contribute results in an alarming number of instances of full freeriding. Furthermore, this behavior persists across a wide range of parameters, including situations where it appears to be suboptimal for a wide range of social preferences. Future research needs to be conducted to better understand the decision change process and determine drivers of decision changes. Existing economic research on decision changes is sparse, leaving much room for later research into why people change decisions in economic contexts.

References

[1] Marina Agranov, Andrew Caplin, and Chloe Tergiman. "Naive play and the process of choice in guessing games". In: *Journal of the Economic Science Association* 1 (2015), pp. 146–157.

[2] Andrew Caplin and Mark Dean. "Revealed Preference, Rational Inattention, and Costly Information Acquisition". In: *American Economic Review* 105.7 (2015), pp. 2183–2203.

[3] Christopher F. Chabris et al. "The Allocation of Time in Decision-Making". In: *Journal of the European Economic Association* 7 (2010), pp. 628–637.

[4] G. L. Clore, K. Gasper, and E. Garvin. "Affect as Information". In: *Handbook of Affect and Social Cognition*. Mahwah, NJ: Lawrence Erlbaum Associates, 2001, pp. 121–144.

[5] Urs Fischbacher. "z-Tree: Zurich toolbox for ready-made economic experiments". In: *Experimental Economics* 10.2 (June 2007), pp. 171–178. ISSN: 1573-6938.

[6] Katarzyna Gawryluk and Michal Krawczyk. "Additional deliberation reduces pessimism: evidence form the double-response method". In: *Journal of the Economic Science Association* 5 (2019), pp. 51–64.

[7] Anouar El Haji et al. "Time pressure and risk taking in auctions: A field experiment". In: *Journal of Behavioral and Experimental Economics* 78 (Feb. 2019), pp. 68–79.

[8] Mark R. Isaac and James M. Walker. “Group Size Effects in Public Goods Provision: The Voluntary Contributions Mechanism”. In: *The Quarterly Journal of Economics* 103.1 (Feb. 1988), pp. 179–199.

[9] Martin G. Kocher and Matthias Sutter. “Time is money - Time pressure, incentives, and the quality of decision-making”. In: *Journal of Economic Behavior & Organization* 61 (2006), pp. 375–392.

[10] Michal Krawczyk and Marta Sylwestrzak. “Exploring the role of deliberation time in non-selfish behavior: The double response method”. In: *Journal of Behavioral and Experimental Economics* 72 (2018), pp. 121–134.

[11] George Loewenstein and Ted O’Donoghue. “Animal Spirits: Affective and Deliberative Processes in Sconomic Behavior”. In: (2004).

[12] Thomas Palfrey and Jeffrey E. Prisbrey. “Anomalous Behavior in Public Goods Experiments: How Much and Why?” In: *American Economic Review* 87.5 (1997), pp. 829–846.

[13] David G. Rand, Joshua D. Greene, and Martin A. Nowak. “Spontaneous giving and calculated greed”. In: *Nature* 489 (2012), pp. 427–430.

[14] David G. Rand et al. “Social heuristics shape intuitive cooperation”. In: *Nature Communications* 5 (2014).

[15] Ariel Rubinstein. “Instinctive and Cognitive Reasoning: A Study of Response Times”. In: *The Economic Journal* 117 (2007), pp. 1243–1259.

[16] Ariel Rubinstein. “Response time and decision making: An experimental study”. In: *Judgement and Decision Making* 8.5 (Sept. 2013), pp. 540–551.

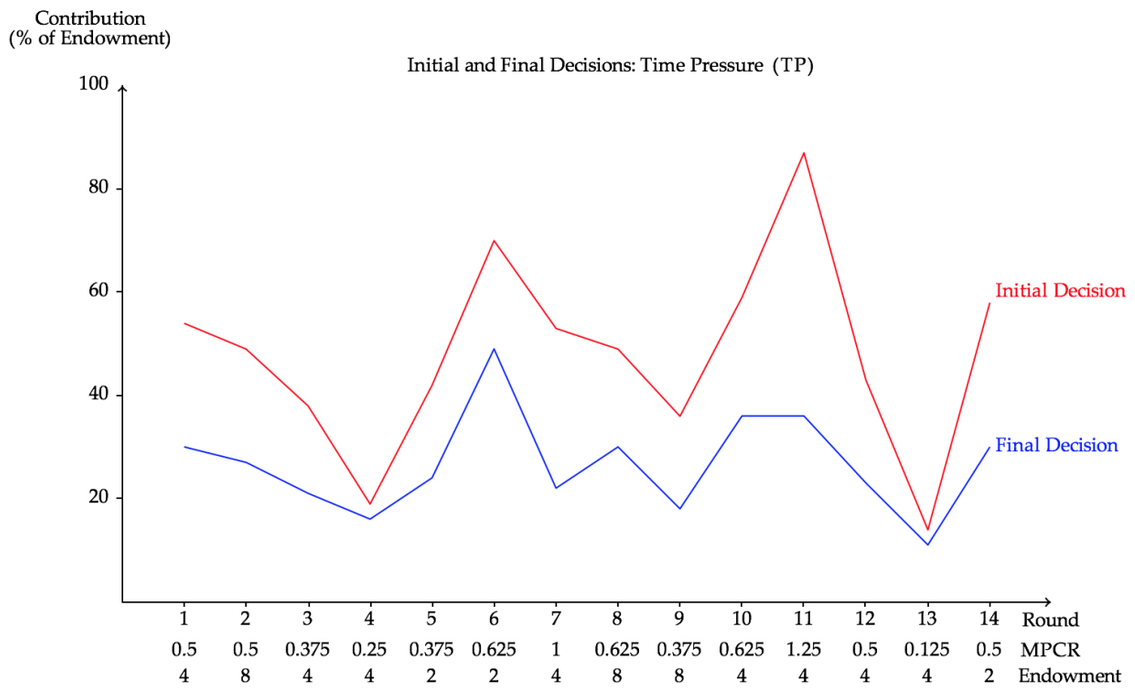

Figure 1: A graph indicating average initial contributions as well as average final contributions for each round of the experiment in the Time Pressure (TP) treatment. The MPCR and endowment for each round are found under the horizontal axis.

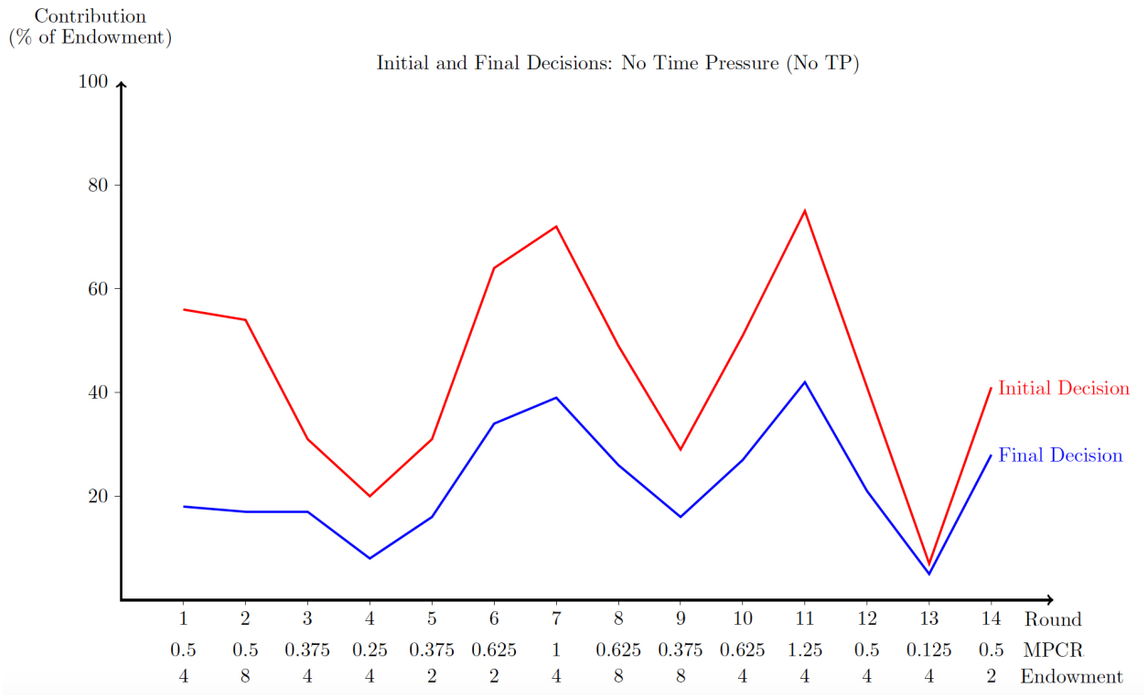

Figure 2: A graph indicating average initial contributions as well as average final contributions for each round of the experiment in the No Time Pressure (No TP) treatment. The MPCR and endowment for each round are found under the horizontal axis.

Parameters

Round	MPCR	Endowment($)
1	0.5	4
2	0.5	8
3	0.375	4
4	0.25	4
5	0.375	2
6	0.625	2
7	1.0	4
8	0.625	8
9	0.375	8
10	0.625	4
11	1.25	4
12	0.5	4
13	0.125	4
14	0.5	2

Table 1: Parameters for the 14 Rounds of the experiment are presented in the table above. Rounds highlighted in blue have MPCR ≥ 1 while those in red have MPCR ≤ 0.25

Summary Statistics

	Time Pressure (TP)	No Time Pressure (No TP)
Mean Initial Contribution	2.06	1.96
Mean Final Contribution	1.14	0.96
# of Opportunities to Change	324	266
# Changed Decisions	216	175
Mean Change (Scaled)	-40.3%	-41.9%
# of Obs. (Subject-Round)	616	504

Table 2: Summary statistics separated by treatment

Data Summary

Number of Subjects	80
Number of Subject-Round Obs.	1,120
# of Opportunities to Change	590
# Changed Decisions	391
Mean Change (Scaled)	−41%
Mean Initial Contribution	2.01
Mean Final Contribution	1.05

Table 3: Summary statistics for the entire dataset

	Questionnaire Regressions			
	(1)	(2)	(3)	(4)
	I	F	F - I	(F - I)/E
Pressured (Initial)	-0.116	0.254**	0.370	0.0648
	(0.305)	(0.0854)	(0.294)	(0.0637)
MPCR	2.646***	-0.0883	-2.735***	-0.676***
	(0.218)	(0.119)	(0.226)	(0.0533)
Period	-0.0335	-0.00554	0.0279	0.00468
	(0.0180)	(0.0115)	(0.0175)	(0.00419)
Decision Change Time (sec)	0.0159	0.0472***	0.0314**	0.00772***
	(0.00806)	(0.00736)	(0.00991)	(0.00211)
Gender: Male	-0.333	-0.0413	0.292	0.0661
	(0.310)	(0.0979)	(0.303)	(0.0669)
More confident over time: IDK	-1.118	-0.448*	0.670	0.163
	(0.692)	(0.199)	(0.656)	(0.136)
More confident over time: Yes	-1.146**	-0.229	0.917*	0.194*
	(0.364)	(0.170)	(0.363)	(0.0771)
Happy could change?: IDK	0.0712	-0.0588	-0.130	0.000972
	(0.437)	(0.120)	(0.409)	(0.0895)
Happy could change?: Yes	0.558	0.219	-0.339	-0.0699
	(0.356)	(0.120)	(0.336)	(0.0701)
Thinking change?: IDK	-1.334**	0.203	1.537***	0.329***
	(0.437)	(0.212)	(0.393)	(0.0821)
Thinking change?: Yes	-0.502	0.165	0.666	0.137
	(0.424)	(0.228)	(0.400)	(0.0904)
Observations	590	590	590	590
Adjusted R^2	0.353	0.234	0.285	0.225

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: OLS results from regressions using categorical regressors obtained through subject questionnaires. Each column presents results from regressions on different dependent variables.

Time Pressure (TP) Treatment

	Female	Male
Mean Initial Contribution	1.94	2.15
Mean Final Contribution	1.09	1.18
# of Opportunities to Change	148	176
# Changed Decisions	95	121
Mean Change (Scaled)	−37.3%	−42.9%
# of Obs. (Subject-Round)	280	336

Table 5: Summary statistics for the Time Pressure (TP) Treatment separated by gender

No Time Pressure (No TP) Treatment

	Female	Male
Mean Initial Contribution	2.12	1.89
Mean Final Contribution	0.95	1.01
# of Opportunities to Change	139	119
# Changed Decisions	99	76
Mean Change (Scaled)	−48.5%	−37%
# of Obs. (Subject-Round)	266	224

Table 6: Summary statistics for the No Time Pressure (No TP) Treatment separated by gender

	Dependent Variable: Initial Contribution			
	(1)	(2)	(3)	(4)
Pressured (Initial)	0.111	2.309***	2.349***	0.520
	(0.272)	(2.52e-12)	(0.0367)	(0.304)
Endowment	0.419***	0.419***	0.415***	0.439***
	(0.0440)	(0.0456)	(0.0457)	(0.0569)
MPCR	2.747***	2.678***	2.668***	2.820***
	(0.163)	(0.180)	(0.183)	(0.220)
Period	-0.0418***	-0.0411***	-0.0381***	-0.0304*
	(0.0101)	(0.0105)	(0.0108)	(0.0142)
Gender: Male	0.00756	-2.900***	-2.954***	-0.349
	(0.275)	(1.86e-12)	(0.0492)	(0.285)
Decision time (sec)			0.0120	0.0161
			(0.0109)	(0.0136)
Subject FE	No	Yes	Yes	No
Emotion Regressors	No	No	No	Yes
Observations	1120	1120	1120	699
Adjusted R^2	0.271	0.534	0.534	0.320

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Columns (1)-(4) present results from OLS regressions where the dependent variable is a subject's initial contribution to the public good.

	Dependent Variable: (Final - Initial Contribution)/Endowment		
	(1)	(2)	(3)
Pressured (Initial)	-0.566***	-0.569***	-0.0183
	(0.00839)	(0.00833)	(0.0722)
MPCR	-0.636***	-0.642***	-0.686***
	(0.0595)	(0.0579)	(0.0707)
Period	-0.00270	0.00319	0.00257
	(0.00402)	(0.00437)	(0.00560)
Gender: Male	0.786***	0.768***	0.0972
	(0.00330)	(0.00681)	(0.0693)
Decision Change Time (sec)		0.00605**	0.00754*
		(0.00207)	(0.00304)
Subject FE	Yes	Yes	No
Emotion Regressors	No	No	Yes
Observations	590	590	355
Adjusted R^2	0.433	0.444	0.199

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: OLS results from regressions where the dependent variable is the difference between final and initial contributions scaled by the endowment

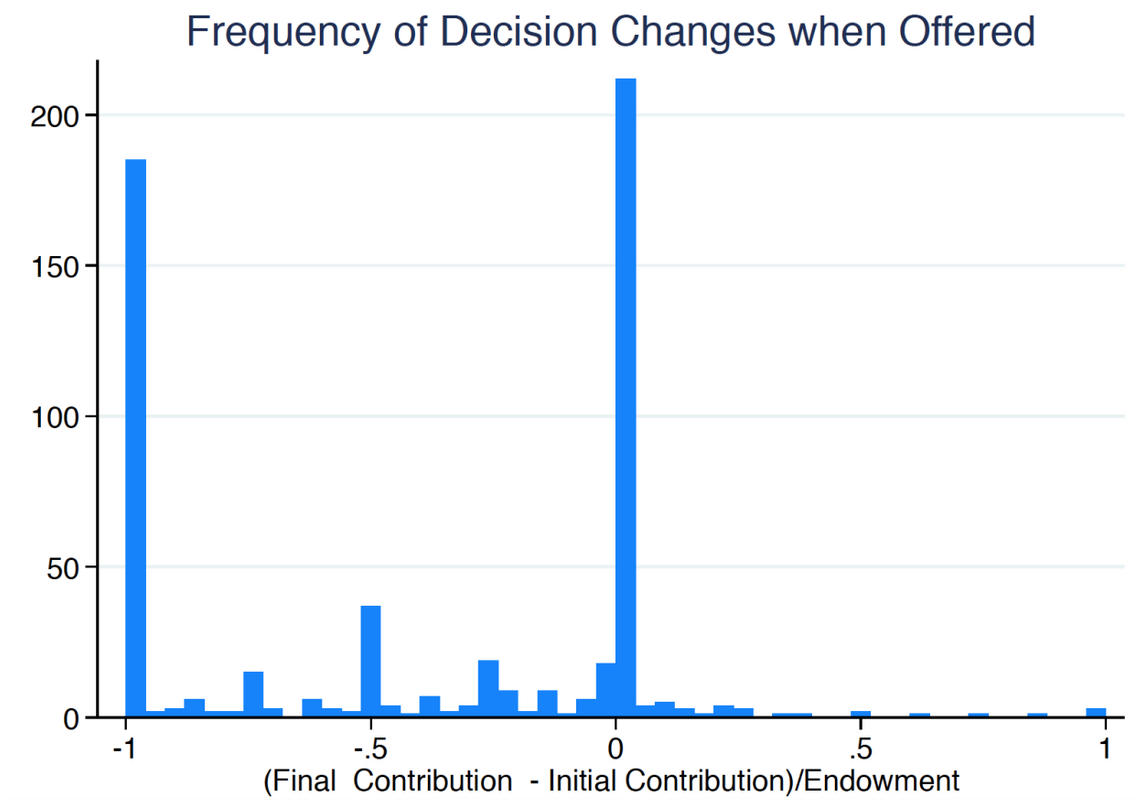

Figure 3: Histogram showing the frequency of decision changes